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12th ANNIVERSARY RADIO NEWS

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Home Recording

Short-wave "Supers"

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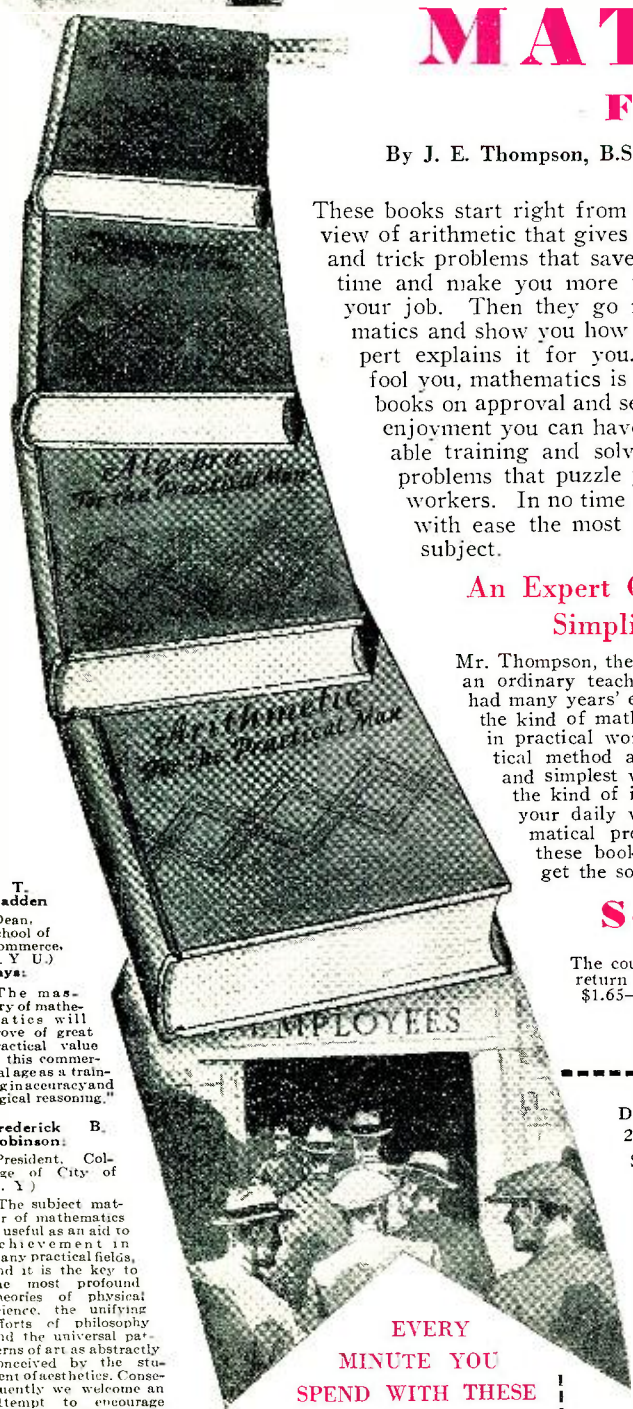
By J. E. Thompson, B.S. in E.E., A.M. Dept. of Mathematics, Pratt Institute, Brooklyn



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Associate Editor

12th ANNIVERSARY
RADIO NEWS

S. GORDON TAYLOR
Technical Editor

WILLIAM C. DORF
Associate Editor

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DEPARTMENTS

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The Editor—to *You*

ON this the twelfth anniversary of RADIO NEWS, the editor extends a hearty welcome to all our friends and associates here at the Chicago trade show and also to those of you who have to stay at home. For the latter group this issue of RADIO NEWS is to be the "eyes" and "ears" to acquaint you with the new developments to be offered to the radio public direct from the laboratories of America's leading radio manufacturers. The text matter of this issue contains a survey of future trends in radio, as expressed by noted authorities, that will give you a conservative picture of what the following radio season has in store. It will give you the opinions of the world's television pioneers on the new science of seeing-by-radio. It will tell of the increasing practicability of this new art. The survey will also contain the predictions of experts on future receiving-set design, the future of short waves, and developments to come in all branches of radio. All in all, the survey will present a most complete and authoritative prognostication that will give you the most up-to-date viewpoint on research and development. You will be looking ahead with the pioneers of radio!

* * *

YOU WILL also find included in the contents of the magazine descriptions of the wonderful new apparatus to be on demonstration in the booths at the show; new tubes, new television receivers, new broadcast sets, home recording apparatus, midget receivers, loud speakers, transmitting equipment, set analyzers, etc. Condensed here is the inside information on all types of new apparatus that will really save you the time, be you dealer, serviceman or amateur experimenter, ordinarily spent in walking miles from booth to booth, at the actual exhibit.

* * *

AND looking the other way, into the past, you will find an article, "Twelve Years of Radio Progress," that outlines the past history and background of radio since the great war. RADIO NEWS has been an outstanding factor in telling this great story of development in the art, science and industry of radio during the building-up process. A large group of our readers maintain a complete file of the magazine to be used as radio references. Do you make use of this worthwhile service?

* * *

OUR Technical Editor has been making a month's research of short-wave reception and the things he has accomplished in receiving broadcasts on the short waves, from literally every corner of the earth, would just make a short-wave fan shiver with anticipation. He has actually made phonograph records of a number of these broadcasts and has played them in the office to the delight and mystification of even the secretaries in our various departments. Imagine dancing to a jazz orchestra "just as jazzy as our American ones," from a home-made record broadcast originally from the Grosvenor House, London. By the way, these records were made with the same apparatus described in the article on page 26 of this magazine. You can do the same thing with the apparatus described.

* * *

A STEADY stream of congratulations is coming in from our readers on our anniversary and they are from long-time readers, too. I am quoting a few of them.

* * *

"Every radio man, be he serviceman, experimenter, engineer, technician or what have you, that has once seen a copy of RADIO NEWS, *cannot do without his copy when the new month rolls around. I know I cannot."* (Signed) A radio serviceman.

* * *

"I have an almost unbroken file of RADIO NEWS *running back to the days of the 'Electrical Experimenter.' This is my first letter to your organization, but I cannot help commenting on the improvement that* RADIO NEWS *has shown in the last few months and know that it will continue to improve under your direction."* R. M. ELLIS.

* * *

"Have been a subscriber to RADIO NEWS *for a long time and a reader about ten times as long. Your magazine is getting to be one of the most comprehensive sources of radio science at the beck and call of anyone so inclined.*

"'Mathematics in Radio,' the articles of which have been appearing in recent editions, are a revelation even to some of the best electrical engineers I know, for the ease of calculation possible thereby." S. J. MURCEK, President Bliss Radio Club, Bliss Electrical School, Tacoma Park, Washington, D. C.

* * *

"Congratulations on RADIO NEWS' *twelfth anniversary. You may be interested to know that our firm is actually receiving orders from all over the civilized world through the medium of* RADIO NEWS. *We are putting your magazine on top of our advertising appropriation lists and I do not hesitate to say that money spent with* RADIO NEWS *is more than well spent."* S. J. SPECTOR, President, Insuline Corporation of America.

* * *

DID you ever stop to think that the chemist plays no small part in radio development and progress? In fact, he is as much responsible for the perfection of radio technique of today as is the radio engineer himself, although his work is little known. Turn to page 28 and read the interesting article by Austin Lescarboura on "The Chemist's Rôle in Radio."

ARE you fully acquainted with the wonderful new tubes that are to be used by the leading set manufacturers in 1931-32 receivers? They include the multi-mu tube and the pentode tube. This issue contains two articles that will be enlightening and descriptive of these new inventions. Perhaps you are planning on using them yourself.

* * *

AS THIS issue goes to press featuring an article, "The Electrical Future of Music," the editor receives a news dispatch from a Schenectady theatre where Betty Lee Taylor, organist, sits in front of a large theatre organ. She was sitting with her back to the audience playing the "Parade of the Wooden Soldiers" and the full, deep tones of the organ were heard.

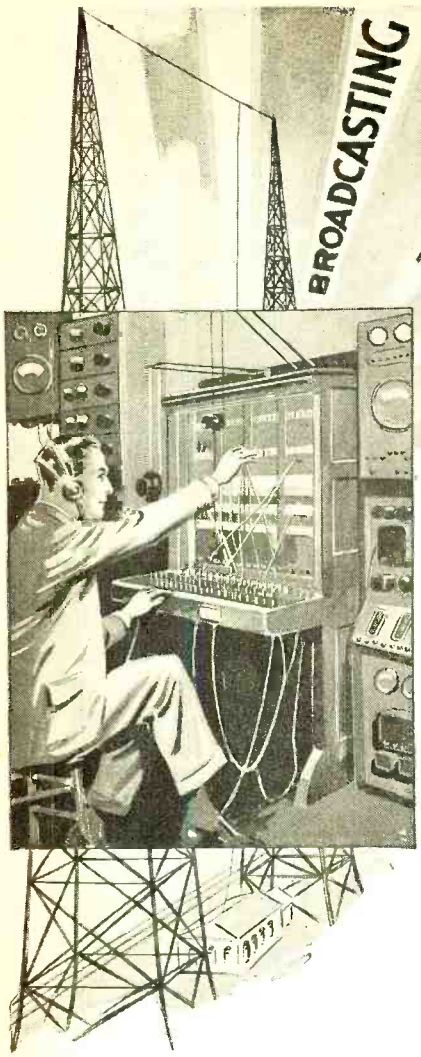
She stood up, turned around, and faced the audience, but the music continued. From the balcony the beam of a spot-light shot down and showed Miss Taylor holding a toy piano in the crook of her left arm while she played on the tiny keyboard with her right hand. The stage curtains parted, revealing a small open box with eight thyratron tubes gleaming with the pale blue light characteristic of mercury. From this box a cable led to the toy piano held by the organist and another cable led to the theatre's loud speaker system. The toy piano had been made part of the vacuum-tube organ and the music was the product of the electrical synthesis.

* * *

FIRST Boston and now New York have regular television broadcast services. On April 26th the Jenkins Television station was officially opened and a large number of leading artists and performers stood before the searching radio eye. They were "put on the spot," but do not be alarmed; it was only the "flying spot" that took their picture and reproduced it in the homes of those fortunate enough to own a television receiver. The sound program was broadcast through the New York Station WGBS. Next month we are to describe the apparatus and tell how to build it so that you too may look in as well as listen in.

* * *

WHAT with the description of a fine new short-wave superheterodyne, by McMurdo Silver, a practical vacuum-tube voltmeter, a public address on wheels, and many other features, the editor believes our readers will find much of interest and helpfulness within these covers.



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Don't spend your life slaving away in some dull, hopeless job! Don't be satisfied to work for a mere $20 or $30 a week. Let me show you how to make **real money** in **Radio—the fastest-growing, biggest money-making game on earth!**

JOBS LEADING TO SALARIES OF $60, $70 A WEEK AND UP!

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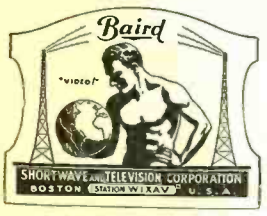
Most Important of All—

A Receiver that has been Especially Designed for TELEVISION! Don't be misled! You can't get satisfactory TELEVISION unless your Receiver is built for TELEVISION. Just imagine—your Audio Amplifier must cover a frequency band of 10 to 40,000 cycles to get a good picture and the regular radio set only covers 100 to 5,000 cycles! If you compared Television to an orchestration on this basis, about 90% of the music would be inaudible!



If you want QUALITY—EFFICIENCY—SIMPLE TUNING—CONSISTENT LOUD SPEAKER RECEPTION—CONSISTENT RECEPTION OF LONG DISTANCE—BROADCAST RECEPTION—SHORT-WAVE RECEPTION OF VOICE AND MUSIC FROM ALL OVER THE WORLD—*AND TELEVISION*—

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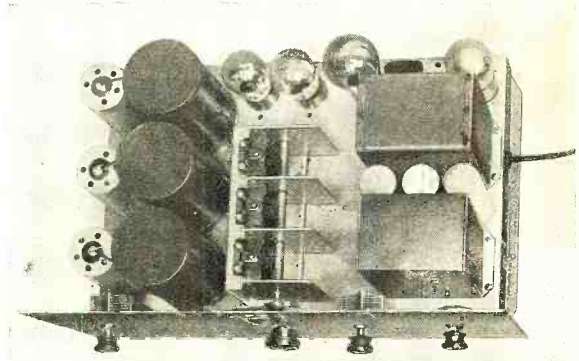
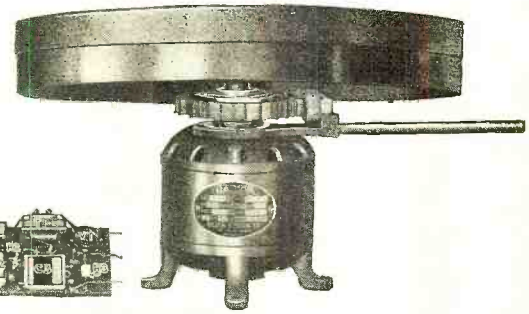
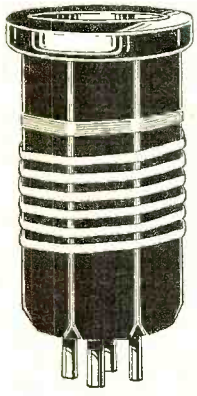


With the No. 36 complete Receiver, in conjunction with the No. 35 Short-Wave set, you will be able to tune in Television stations and get the new and wonderful thrill of SEEING PICTURES. It is the only Television set offered which has horizontal scanning equipment—covered by patents pending. It is the only satisfactory distortionless method of Television reception. Automatic synchronization of pictures . . . no fussing . . . no struggling to keep your pictures in frame! Tune in your station and there you are!





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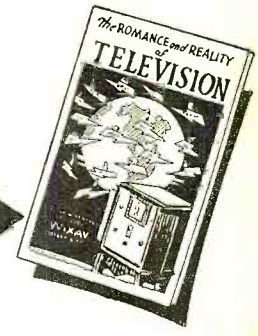

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☐ Enclosed, find 25c for booklet, "Romance and Reality of Television," including diagrams for 1, 2 and 3-tube shortwave tuners, also list of shortwave stations of the world.

Please send me the following at special experimenter's prices listed below:

☐ No. 25 Complete Short Wave Kit, wave length range 15 to 520 meters, including 15 OCTOCOILS, blue print and construction manual (Less tubes and cabinet) $56.25

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☐ No. 36 Television Receiver, completely assembled in cabinet. Ready to operate in conjunction with a No. 25 or No. 35 Short Wave Receiver 75.00

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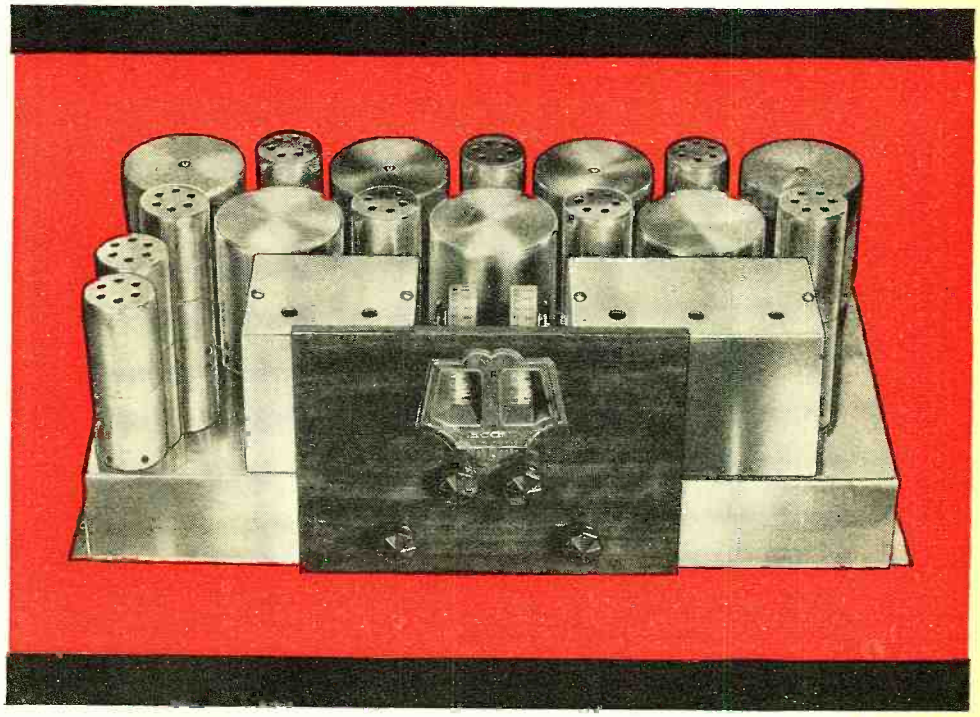

Dance to music received direct from the Mayfair, in London! Step to a Tango received direct from the Argentine! Thrill to the beauty of real Grand Opera received direct from Rome! ... Such reception is the easy, daily accomplishment of the new Scott All-Wave, 15 to 550 meter Superheterodyne.

The advent of this receiver marks the opening of a new era in short wave reception. For, gone is the need for head-phones—gone is the discomfort of crowding close to the speaker—gone is the excessive background noise that has heretofore been considered a necessary evil to short wave reception. The new Scott All-Wave brings in London, Rome and many other foreign stations between 15 and 200 meters—just as clearly—just as cleanly—and with just as much volume as a 50,000 watt local in the 200 to 550 meter band! And every short wave station—once logged—is subsequently found at the same, exact dial setting.

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Such amazing performance as the regular, daily, clean-cut reception of stations located all over the world, has not been the work of one, particular laboratory model. Nor has it been due to an especially advantageous location, or other favorable condition. Any Scott All-Wave Receiver taken from the stock room and properly installed will duplicate or better the records made at our own laboratory. Proof of this statement is contained in the letters reproduced on the opposite page.

Advanced circuit design—the far greater efficiency of the new and radically different intermediate frequency transformers—and precision, hand-building in the laboratory, account for this receiver's extreme sensitivity, its accurate 10 kilocycle selectivity, and the subjection of background noise.

Scott advanced engineering again scores a triumph, in the perfect performance of the push-pull audio system employed. Greater musical range and perfect quality, from a whisper to concert volume, are delivered by the new Scott All-Wave Superheterodyne.

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THE SCOTT

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JUST AS LOUD - JUST AS CLEAR

Europe Every Day

I am the proud possessor of a SCOTT ALL-WAVE SUPER 1931 model. This set has been doing wonderfully well. I have been daily, picking up a station in Naples, Italy, and G5SW at Chelmsford, England. Both of these stations at times come in with more volume than WEAF. Since the announcement of the Italian station is in Italian I can't follow it, but I hear the LADY announcer state "Italia A Naples" always. This station always signs off about 4:15 P. M., E. S. T. with little musical ditties of a martial air which are very brief after which she bids goodbye. This Italian station comes in within a point of the English station G5SW at Chelmsford. I have listened to station PJC at Hilversum, Holland, also. I had been hearing G5SW for about two weeks and did not dream that it was England. It always came in so loud that I thought it could only be the short wave of some station in the U. S. and consequently I did not listen to it long enough to get the call letters. However, one day just as I tuned in this station the announcer was saying: "You are listening to station G5SW of the British Broadcasting Co., Chelmsford, England! I was astounded at such volume and clarity. Now I tune in England and Italy every day just as easily as Chicago or New York. I know where to find them on the dial and they are always there. Dr. W. I. Carpenter, Va.

Eight from Japan

I have logged 168 stations from all over the U. S. Have eight from Mexico. Picked up 12 foreign stations one morning. Eight logged in Japan, but could not get the calls of the other four. Wm. Lundgren, Washington.

2,000 Miles in Daytime

The receiver performs marvelously. The tone is so full and rich that I never tire of listening to it. I have been getting daylight reception regularly at 1500 to 2000 miles. I cannot praise the set too highly.

C. C. Gaylord, Idaho.

Seven from California

When I got home with the new SCOTT ALL-WAVE RECEIVER yesterday, immediately hooked it up using temporarily a very short in-door aerial. Travelled all over the country, heard seven California stations also one in Seattle, and one in Portland, Oregon, one in Mexico and finished up with a 100 watter at Vancouver. The marvelous thing about your receiver is the tone quality. Both the deepest and the highest notes are brought in with absolute fidelity. This new set surpasses any of my fondest hopes. In your description of it in your advertising literature you do not do it half justice. Dr. Sydney Kuh, Illinois.

E. H. SCOTT, the designer of World's Record Radio Receivers

Scott Radio, I believe, has made history. My first superheterodyne—an eight tube instrument, established the world's record for long distance reception. This record of 112 programs from 19 different stations within the 200 to 550 meter band and 6000 or more miles away, still stands unchallenged.

The new Scott All-Wave Superheterodyne Receiver, according to everyone who has sat at its dials; is the most outstanding achievement ever presented to the radio world. I, and those who help me build it, have such complete faith in the soundness of its engineering and in its quality that we guarantee each receiver for five full years. The Scott All-Wave Superheterodyne should give a whole lifetime of perfect satisfaction.

E. H. Scott

Chelmsford and Rome

I have had excellent results with my SCOTT receiver. On the short waves have brought in G5SW at Chelmsford, England. One notch up from G5SW I have had some beautiful music with a woman announcing in Italian which I believe to be 12 RO Rome, Italy.

W. O. Lovelace, Canada.

Holland and Honduras

The set works very good. I have received the following short wave stations: FCV, Holland; HRB, Honduras; GBC, GBX, England; GFWV, England; 13RO, Italy, and G5SW, England, the last two named were very good.

Lionel W. Kinsey, Nebraska.

112 in Two Nights

The first night I listened in I received 15 Californian stations and that is **some record here.** In two nights (eight listening hours) I have received 112 stations.

Stephen J. Drapchaty, Ohio.

Bogota, Colombia

The sensitivity is better than other sets for the reason that the signals on 500 meters are just as good as the 200 meter signals. The selectivity is absolute 10 kilocycles and the tone is wonderful. The first night I had the set, I played Bogota, Colombia, and the short wave station in Honduras. J. W. Harlan, Texas.

DX Like Local

This evening played WEAF with tremendous volume and tone such as no other radio has ever attained. And of course, all Pacific Coast stations were like locals.

Nelson, N. Dakota.

No Background Noise

Never saw such selectivity, and the tone quality I never could describe and give it due credit. The receiver is so free from background and other noises. I am a SCOTT man from now on. I never heard a radio until I listened to a SCOTT. A. L. Julienne, R. I.

Italy Again

I have received Italy with powerful volume and excellent quality, while Big Ben booms from London so loud you seem to think you are there. Truly the SCOTT is the Rolls Royce of radio. Jack Morgan, New York.

Tunes In The Whole World

If I couldn't replace it, money couldn't buy my SCOTT. Rome, Italy, and G5SW at Chelmsford, England, come in just as loud and almost as clear as W8XK and W2XAD. I had a houseful of friends up this afternoon and for three unbroken hours we had G5SW with enough volume to be heard a city block away. We danced for thirty minutes to popular American numbers played direct from the London Wintergarden, and we heard the Big Ben chimes at midnight (6 P. M. here) and they sounded like they were in the room. I get HRB, Central America and numerous stations in Mexico, Canada, Cuba, and South America. Get code from all over Europe, Africa, South America, etc. Just picked up a new one—lots of punch to his signals—RKC somewhere in Russia. S.O. Kennedy, Ala.

ALL-WAVE SUPERHETERODYNE

MAIL NOW

SCOTT TRANSFORMER CO. RN7
4450 Ravenswood Ave., Chicago

Send me full details of the new Scott All-Wave Superheterodyne Receiver. I am Dealer ☐ Set Builder ☐ Service Man ☐ Radio Fan ☐

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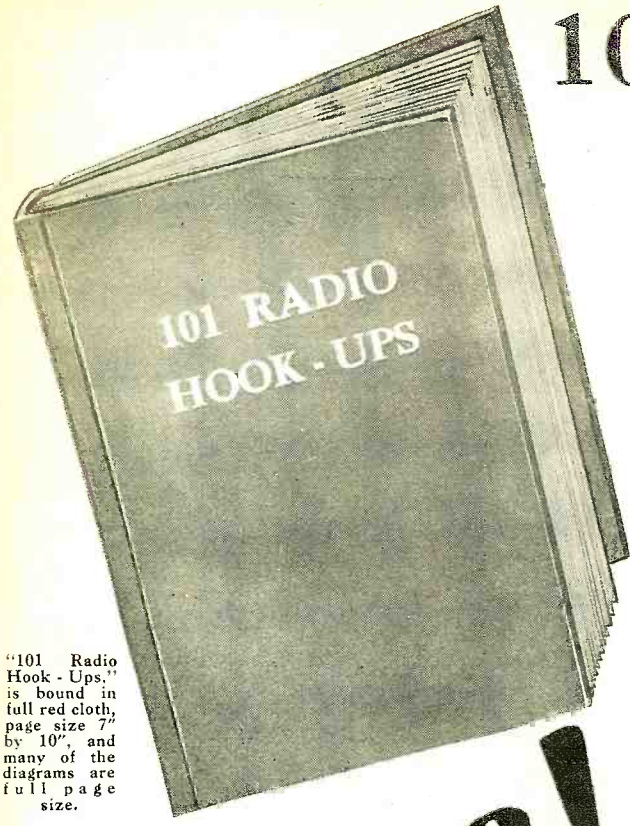

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For you will admit with us that the greatest pleasure in radio lies in construction. The first note of a program coming over the air through a receiver that you have built—the first signal you get proving that the transmitting set you have constructed has "put it over,"—these are the real thrills of radio achievement!

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But this exceptional book is not only useful to the man who gets a kick out of construction and building. It is also of supreme assistance to the dealer and the salesman. Its diagrams and charts are so accurate and so easily understood, *they furnish a comprehensive background for discussion on practically any subject in the radio field!* From a casual inspection of this book, you can back up your sales talk with definite facts!

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Many set builders have been anxious to experiment with the superheterodyne circuit, but the expense of the equipment has prevented them. Circuit No. 13, in the "101 Radio Hook-Ups," shows a clever diagram that has for its principle the superheterodyne method, and the parts are surprisingly inexpensive!

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"During the past twelve years RADIO NEWS *has been of increasing service in the radio industry as a medium for portraying the history of research, development and future trends. Current issues contain the latest news of the radio industry.*

"RADIO NEWS *has made itself indispensable to engineers, technicians and laboratory workers."*

H. W. HOUCK
Chief Engineer
Dubilier Condenser Corporation

Future Trends *in* Radio

To foresee imaginatively but sanely what will be the future of radio is a duty RADIO NEWS *will not shirk. The editor introduces a subject that is of vital importance to all radio men*

By Laurence M. Cockaday

IN an art and industry progressing as rapidly as radio, change and improvement, new development and branching out into new fields make prognostication of future trends a difficult, if not impossible, task for a single individual. In accomplishing this survey for RADIO NEWS readers and the trade in general, I have asked a number of the leading authorities in their respective fields to co-operate with us in outlining what they believe will be the trends of activity during the coming season. These experts are famous not only for their standing in their special lines of endeavor, but also for their vision and past experience.

The reader will find in the concise statements on this page and the following six pages a wealth of information regarding the future of broadcasting and the development of receiving set design as well as what is to be accomplished in television, in the talking movies, in direct reception of foreign broadcasting and the international exchange of programs. The symposium also includes the trends in amplifier design for many uses, including talking pictures, electrical measurement work, and throughout the total electronic art. Some of these predictions have to do with future merchandising conditions, with the sale of battery sets for homes that are not wired with electricity.

Other questions considered are the following: What is to be the future of the midget receivers? What can the new multi-mu and pentode tubes accomplish in these fields? What are to be the future loud speaker improvements? How is the microphone to be developed? What will be the effect of synchronization on ether crowding? Will recorded programs be continued for both oral and television transmission? Will home recording become popular? What will be the future status of the serviceman? Has radio any value in police work? What about the future of short waves?

I do not believe anyone interested in radio can afford to miss reading these enlightening statements.

In summing up the trends as expressed, I find that almost everyone agrees that radio has a bright future and that due to improved merchandising conditions in the trade, the value of radio to the public is to receive a tremendous boost. Broadcasting authorities promise us many new kinds of featured programs with increasing interest and diversification. Radio receivers are to be more moderately priced, with improved operation and tone quality. There will be two lines of development, one the popular-priced midget receiver and the other the expensive, high-quality receiving set including reception on the broadcast and short-wave bands, home recording and electrical phonograph.

The short waves are to be opened up for long-distance reception all over the earth and for the transmission and reception of television or radio moving pictures. Short waves will be of increasing importance in aviation radio communication. Automobile radio receiving sets are to come in for their share of improvement and a wide use is predicted.

Synchronization of chain programs is looked forward to in clearing the crowded ether and eliminating cross modulation and heterodyning. International broadcasting is to become a reality. Future developments and applications of radio principles to the electronic arts will widen the radio field and accomplish marvelous results in associated industries. The multi-mu and pentode tubes are to simplify and improve radio circuit development. Amateurs will do much to bring about the day when television will be as popular as oral broadcasting is now in recording news events, the drama, and educational features, and enabling all listeners-in to see by radio as well as hear.

Servicemen are studying radio mechanics intensively and at the same time it is being realized that technical training is not the only requisite in this work. Sound business training for service work must now include a better understanding of the psychology of salesmanship. And thus is being born a new type of service-salesman who not only can keep the neighborhood receiving sets in perfect running order, but who will advise his clients how to get the most out of their radio. He will be their technical advisor, telling them what to buy in tubes, sets, speakers and television apparatus. Here is a new type of serviceman for the radio industry, a "super" service-salesman.

Read what these leaders in the industry have to foretell about radio's glorious future. You will find their words are packed with information and encouragement. Remember, they themselves are working at their own individual tasks to make their predictions come true.

Better Business Methods to Boom Radio

CIRCUS days of the radio industry are over. Sound business and sound merchandising are the new keynotes. There is a much higher class of merchandise being offered this season and many improved standards in merchandising methods exist. With new and better sets, tubes, speakers and allied lines of home talkie and television apparatus, we can look forward to good merchandising conditions. Ballyhoo in radio sales methods has been recognized as unprofitable.

Bond Geddes,
Executive Vice-President,
Radio Manufacturers Association.

. . . An Authoritative Forecast

A symposium on the future trends in various fields, combining the views and predictions of men who are making radio history, which gives great promise for advancement in the art and industry

Television's Progress to Be Great

By C. Francis Jenkins

Jenkins Laboratories

THE popular phrase, "the first hundred years are the hardest," holds true with television, though the number may be greatly reduced. We early pioneers labored under difficulties raised by the lack of proven principles, laws, formulæ and equipment. Our first strides, though not long compared with those still to be made, formed the solid groundwork on which others have built and will build in the future.

For this reason we may anticipate greater progress in television during the next five years than in the past ten, although such comparisons are difficult to make. Mathematically the difference between 0 and 1 is greater than between 1 and any other number. So, our past achievement in televising any image is greater than any improvement of that image.

But within five years I look forward to television becoming inseparably linked with radio broadcasting, and technical progress advanced to that point of fidelity where images will be accepted without thought of the fact that they are images, just as we now speak of seeing John Gilbert or Greta Garbo without thought that we see only their images on the movie screen.

Better Sets at Lower Prices

By Powel Crosley, Jr.

President, Crosley Radio Corporation

INDICATIONS point toward a continuation of the price market during the coming year. Therefore manufacturers will attempt to meet the public demand for better receivers at lower prices. It seems rather certain that this demand will be centered on small receivers with simple, compact cabinets, although more elaborate cabinets will be offered for those who desire them.

Many smaller receivers will incorporate features hitherto found only in the larger models, such as superheterodyne circuits, variable-mu and pentode tubes and other refinements. Superheterodyne circuits will be used almost exclusively in console models.

There will also be a certain demand for specialties such as clock model receivers. Automobile receivers will increase in popularity. In other words, the trend would seem to be merely a continuation of the past year's trend, with emphasis on superheterodyne and the pentode tube.

Broadcasting to Stride Ahead

By William S. Paley

President, Columbia Broadcasting System

RADIO'S uncharted future constitutes a challenge to human ingenuity and artistry. It is the assumption of everyone connected with broadcasting that great strides forward will be taken both culturally and scientifically; this assumption, as is proper, is based upon the record of the past.

We are told by radio engineers that synchronization, to say nothing of television while it remains in the experimental stage, will bring sweeping technical changes. Regardless of engineering developments, we may expect radio programs themselves to undergo constant improvement. I look for ever-growing popular interest in drama and music of the better grade. In anticipation of such interest we are constantly on the alert.

Trends in Receiver Design

By Ray H. Manson

Chief Engineer, Stromberg-Carlson Telephone Mfg. Co.

UP to the present time, the broadcast structure has not been treated as a systems problem, as exemplified by the fact that the broadcasters have made rapid strides for better audio quality, whereas the makers of receiving sets have lagged behind in this most important operating characteristic. It is obvious that the future success of the industry depends on the consistent improvement of the broadcast system as a whole, otherwise the excellent programs which are broadcast with outstandingly fine audio quality will fall upon deaf ears in the way of inadequate radio receivers.

After a season's experience in building down to extremely low price levels with inadequate performance, the present trend of radio sets manufacturers is towards better operating characteristics in the new models. There remain two distinct trends: first, the type of receiver which employs every advancement in the art for obtaining maximum performance to more nearly matching the fine performance provided by the modern broadcasting systems, and second, the type of receiver which has been designed to meet the popular demand for low cost or compactness, with consequent sacrifices in operating performance. Performance, rather than types of circuits or kinds of tubes, is now recognized as the deciding factor in receiving set acceptance on the part of the public.

C. Francis Jenkins

Ray H. Manson

Powel Crosley, Jr.

William S. Paley

H. B. Richmond

McMurdo Silver

F. A. D. Andrea

Big Future for Short Waves

By McMurdo Silver

President, Silver-Marshall, Inc.

WHAT are the trends of short waves and regular broadcasting? This is a question that may be viewed from the standpoint of the listener or of the broadcaster. The listener's viewpoint should be most interesting to RADIO NEWS readers.

In both fields the old urge and interest of distance reception is much to the fore. Due to the increasing number of short-wave stations the experimental, and today even the entertainment, feasibilities have so expanded, that a rapidly increasing use of short-wave receivers should occur. For the DX hound of the family, the short-wave set is an excellent and inexpensive solution to the old problem of fishing for distance on the regular broadcast set just when the family is all nicely settled down for an evening of chain program entertainment.

On the regular broadcast band, the increasing use of higher transmitting powers will increase the program availability for listeners, while this is even further increased by the growing popularity of good superheterodynes, increasing as they do through their excellent selectivity, the number of programs that may be had by the listener—in a word, more distance, but not just more distance for itself, but rather more entertainment in the form of localized programs from various stations of the continent when the big chain programs pall, as they will occasionally do.

Progress in Recorded Programs

By A. J. Kendrick

President, Sound Studios, Inc.

ALTHOUGH broadcast programs reproduced from the familiar phonograph discs have been a feature of the listener's fare from the moment broadcasting service began, the latest developments in the method of recording and reproducing electrical transcriptions has completely altered the status of the disc as a source of broadcasting features. The latest technical developments in the art have made possible the inscribing of a tone range extending from 30 to 9000 cycles in the disc. This is far greater than can be distributed from studios to outlet stations by any other means. At the same time, facilities have become available to broadcasting stations for reproducing slow-speed transcriptions without the speed changes heretofore characteristic of phonograph reproductions.

The combined use of these two major developments which have come to the forefront only during the last year have won instant recognition by program sponsor and broadcasting station alike. Over 150 broadcasting stations are already equipped to handle electrical transcriptions without loss of quality and already the largest distribution ever given any radio program of any kind, both by reason of coverage and number of stations employing it, is credited to modern electrical transcriptions. This distribution exceeds that obtainable if all the existing wire networks of the country were combined in a single hook-up.

Electronic Art Progressing

By H. B. Richmond

Treasurer, General Radio Company

INSTRUMENT development is going forward at an accelerated rate and gives every promise of continuing to lead in the rapid advance of the electronic art.

Attenuators working at one microvolt, cathode ray oscillographs for interstage frequency alignment, and decibel output meters were but laboratory experiments when a.c. sets came into existence. Today these and many similar instruments have been developed to such a point of perfection that they have contributed in a fair measure to the practicability of building sensitive, quality radio receivers at prices which appeared fabulously low less than half a decade ago.

Public Will "Buy" Television

By D. E. Replogle

Vice-President, Jenkins Television Corporation

TELEVISION has been developed in the laboratories many years. It will continue to be developed there for many years to come. But parallel to that will be the field development by the many thousands who will not only enjoy the programs but offer technical aid possible in no other way.

Television stations are already offering regular programs. The market for televisors will continue steadily, reaching this autumn a level comparable with the demand for radio receivers. The 1931-32 season will witness the selling of television receivers and radiovisors not only to the technically minded "ham," but likewise to those whose sole aim is the enjoyment of the programs. Television receivers will find a prominent place in radio stores, renewing public interest and selling not only themselves but other products associated with radio and television as well.

Multi-mu and Pentode Tubes

By F. A. D. Andrea

President, Fada Radio Company

THE outstanding development in radio receiver design in the immediate future will include pentode tubes, the adoption of multi-mu super-control screen-grid tubes and improved circuit designs will incorporate the best features of tuned radio frequency and superheterodyne.

Essentially, however, these developments are refinements of existing technique comparable perhaps to free wheeling or synchro-mesh in the automobile. They will provide a somewhat greater operational efficiency but will not necessarily directly effect the most important factor, "tone quality." Fada engineering laboratories are instructed to place tone at the head of their list and to strive with all their energies for even more faithfulness in reproduction, which we believe has always been a cornerstone in our success. Compact table receivers will undoubtedly remain standard items, with a definite demand for better quality performance and tone.

Console models will unquestionably continue as the predominant type of radio receiver, but these console models will be more refined in appearance and lower in price.

Battery Sets for Unwired Homes

By W. B. Schulte

Secretary, Burgess Battery Company

NO one can accurately predict the composite desire of the battery receiver prospects. Experience shows that many production and sales programs have missed this market sadly.

In my opinion, the battery set that will please the greatest number of unwired homes should fulfill all of the following specifications:

1—Small, simple and not necessarily of "period" design, and connected to the batteries with a four-wire cable.

2—Moderate selectivity, sensitivity and volume which will be acceptable in homes with low purchasing power but high and long aerials.

3—Low operating cost, which is possible by the use of a self-

W. B. Schulte

D. E. Replogle

A. J. Kendrick

biasing circuit to double the usual "B" battery life.

4—Movable and convenient "A" supply like door-bell dry cells or a Ford storage battery.

5—Low first cost obtainable from a small number of tubes, no "C" batteries and dry cells.

Each of these features has been separately obtained and it is not impossible to mould them into one receiver that should satisfy most of the unwired homes.

Battery Sets Increasing

By E. E. Horine

Sales Engineer, National Carbon Company, Inc.

THE new and greatly improved type of battery receiver, made possible by the constant voltage air depolarized primary "A" battery and the line of low-drain 2-volt tubes to go with it is arousing the trade to a realization of the great possibilities for profit in the neglected rural market.

Already a number of manufacturers are in production on the air-cell receiver and the remarkable success they are having with its sale indicates that the battery receiver is due to stage a sharp come-back this year and assume its rightful position in the radio picture.

Recorded Programs for Television

By John V. L. Hogan

Consulting Engineer

THE trend in combined sound and visual broadcasting seems likely to be toward a more extensive use of sound-on-film. The transmission of sound on the broadcast waves along with directly scanned pictures on the television waves involves very few technical problems, and is already quite satisfactory. However, the difficulty of supplying and syndicating program material for direct scanning constitutes a good reason for extending the use of recorded sight-and-sound.

For television, film and disc combinations are generally less satisfactory than sound-on-film, particularly when the pictures are scanned by the continuous-motion process. This latter avoids the complications necessary when intermittent film motion is used for the pictures, and makes reproduction of sound and sight from the same film a particularly desirable method. Future television programs will doubtless contain a large percentage of such co-ordinated sound entertainment and instruction.

Foreign Programs and Television

By Edwin K. Cohan

Technical Director, Columbia Broadcasting System

THE next few years will see tremendous strides in rebroadcasting programs of foreign origin. Much has already been accomplished in this direction and the Columbia Broadcasting System is offering transatlantic programs to its listeners throughout the United States on a regular schedule. Synchronization and television will also bring about many new developments in station transmitter design and in network engineering. There will also be an increase in the use of short waves in relaying programs.

Keen analysis of engineering requirements and efficient staffs enable network programs to go on the air uninterruptedly. The Columbia chain is on the air eighteen hours a day through the joint efforts of sixty technical men in New York and 800 engineers in other parts of the country. This number does not include telephone engineers in charge of the spider-web wire-line hook-up of the various chain stations.

Edgar H. Felix

E. E. Horine

Edwin K. Cohan

J. V. L. Hogan

Hollis S. Baird

E. F. W. Alexanderson

Amateurs to Help Television

By E. F. W. Alexanderson

General Electric Company

TELEVISION has given us hopes and promises to fulfill several of our natural desires. This explains the great interest shown. One of these desires is to be entertained; another is our curiosity, the desire to see with our own eyes whatever happens. A third interest is the thrills we get from experimentation and research as amateurs, as well as professionals. I have here indicated three possible branches of television and there may be more, but I believe that the method of attack in each of these branches will be different.

Those who seek entertainment at home will buy highly perfected instruments. Television news will be flashed on the screens in theatres and the amateurs will have their ever-varying home-made devices. It is their interest that will keep the flame alive until our greater hopes are fulfilled.

News Events by Television

By Hollis S. Baird

Chief Engineer, Shortwave and Television Corporation

WITH most television stations now sending a 60-line picture, the future should hold much more varied and entertaining television programs. This is of course very necessary to hold the public interest in their television receivers. The possibilities of mechanical television are by no means exhausted and we should see gradual improvements along these lines. More television channels are badly needed for the additional stations that are necessary to provide proper coverage. With recent improvements in photo-cells we may expect attempts to televise a boxing match or part of a baseball game with direct pick-up.

Synchronization to Clear Ether

By Edgar H. Felix

Broadcast Consultant

WHEN the Federal Radio Commission began its labors in March, 1927, it inherited the most hopeless tangle which was ever inflicted upon a government commission. After a rather extended study of its problems, the Commission evolved a plan of allocation which attempted to squeeze into the available ninety channels the excessive array of stations seeking the broadcasting privilege.

Major technical developments are gradually lifting the horizon and bringing us renewed hope that the overcrowded broadcast band will eventually be sufficiently enlarged so that the present occupants at least may enjoy elbow room. Within the last year there has been a notable increase in the stability with which stations remain on their assigned frequencies, with the result that there is less heterodyne interference. At the same time progress is being made in the development of frequency control apparatus which promises, within a few short years, to eliminate all heterodyne interference on regional channels due to the carrier interaction of two or more stations operating on the same channel. An elaborate experiment in synchronization involving interconnection by means of wire lines may show the way to a means of reducing excessive duplication of chain programs on the listener's dial, although the first reports on the results attained are favorable only in the immediate vicinity of the stations involved.

Concurrently with development in transmitting methods, radio receivers continue to show improved selectivity, particularly since the superheterodyne design has become generally available.

Jack Poppele

E. P. Mulrooney

Edward H. Loftin

Television Pick-ups Coming

By J. R. Poppele

Chief Engineer, Station WOR

RADIO, like a growing child, if observed through every day of its history, does not seem to change much. The changes and improvement are gradually but constantly applied. Looking back through the years, the vast strides of the industry can be readily seen.

In February, 1922, we installed the original transmitter of station WOR in the Bamberger Department Store in Newark. It was a 200-watt set and considered a perfect transmitter. It was erected in a room ten feet square that also housed the studio facilities of the station. In July of the same year, we moved into a room twice the size of the former and a new 5-kilowatt transmitter was erected on the roof. This transmitter is still used as an auxiliary "stand-by" set for emergency application. In September, 1927, WOR moved its transmitter to the present site at Kearny, N. J. Seven studios supply programs for WOR audiences. Four studios are in New York, two in Newark and one at Kearny.

Our next big step will most likely be to television. I can see many complications arising in transmitting sight from remote control points. At present it takes a crew of six men to tote "nemo" apparatus. It will probably take trucks to convey television pick-up apparatus to ball-parks and such other points where future television programs will certainly originate.

Radio Indispensable in Police Work

By Edward P. Mulrooney

Commissioner of Police, City of New York

OUR application of radio in the past proves that it is indispensable and a permanent unit of police operations.

On occasions, we utilize radio in new and unusual ways. Just recently, I spoke to Captain Randall of the Leviathan. His ship was at sea and I heard him distinctly over my desk telephone.

Several of the police automobiles are equipped with receivers that are capable of receiving programs on the ordinary broadcast band. A private, short-wave system for such communication, which we hope to obtain, will prove more valuable in this work.

Radio is today such an important division of the Police Department's Bureau of Telegraph, that I am asking for additional appropriations to expand the police radio system. If the expenditures are authorized, we will augment our present harbor communications systems, install a short-wave station for contacting radio-equipped police cars and equip the police airplanes with radio apparatus. The personnel of the radio division may also be enlarged if the appropriations are made.

Besides our present radio station, the Police Department has use of the facilities of station WNYC, the municipal transmitter operated by the Department of Plant and Structures.

Amplifiers for Many Uses

By Edward H. Loftin

Radio Engineer

DEVELOPMENT of various wanted and useful types of apparatus now seriously in progress forecasts oncoming large need for amplifiers of various forms in addition to the continuous demand for amplifiers in broadcast receivers. The coin-operated phonographs and radio sets, public address for schools and other fields, home talking movies and coin-operated and home recording are some outstanding examples. With the already established low-price radio market, and the fact that the new devices must be inexpensive to be popularized, I see the end of expensive audio transformers now that present tubes and resistances are working so well together in the matter of coupling, and there seems to be no better way to couple than directly.

Talking Film Improvements

By Carl Dreher

Director, RKO Sound Studios

THE motion picture is rapidly being freed of all the restraints previously imposed on it by sound. Recent pictures, such as "Cimarron," show all the mobility of the earlier silent pictures. Hollywood directors are now shooting with moving cameras to an extent rendered possible only by a corresponding development in sound recording, including directional microphones, acoustic concentrating devices, electromagnetic ribbon microphones in place of condenser transmitters, improved methods of mounting and moving microphones on stages, etc. This process will continue, with resulting artistic advantages to picture production. At the same time, improved methods of re-recording will lower production costs.

Another important development is "noiseless recording," by which the familiar nuisance of ground noise is eliminated, allowing cleaner and more effective reproduction of dialogue and music. By the end of 1931 all up-to-date motion picture recording will entail the use of noise-suppressing channels, and disc reproduction will continue to decline, partly because of the impossibility of a corresponding reduction of surface noise on discs.

Predicts Speaker Improvements

By A. I. Abrahams

President, Racon Electric Company

ADVANCED research has indicated that it is far less important for faithful reproduction of speech and music, to design a loud speaker which will reproduce fundamentals down to the lowest frequencies which the ear perceives, than it is to design a loud speaker capable of reproducing the high frequencies, inasmuch as the loudness of a combination tone depends upon that of its various components, rather than upon its own volume.

The low frequencies which we hear in music are combination tones, produced to a great extent by the high notes, since the low frequencies emitted from the average musical instruments are comparatively weak as fundamentals.

Development work on loud speakers should be concentrated along lines which will produce, not a speaker having a straight line frequency characteristic response, but rather one which will faithfully reproduce all the components of the combination sound and which will do this with sufficient volume to react upon the ear so that the sound is instantly recognized as an inherently natural one.

Battery-Set Sales to Increase

By W. H. Hollister

President, Lincoln Radio Corp.

THERE has always been a universal field for battery operated receivers which has been cramped by the necessity of charging storage batteries.

The development of low drain tubes and the Eveready Air-Cell, creates a possibility of operation for a year without inconvenience.

A. I. Abrahams

W. H. Hollister

Carl Dreher

In congested a.c. districts, 50 per cent. of noise is eliminated by independence from a.c. line noises especially in large apartments with individually operated refrigerators.

Residents of d.c., 25 cycle, or outlying country districts will welcome the new equipment with open arms. There will be a rapid increase in demand for the modern d.c. receiver.

Demand for Better Service

By J. E. Smith

President, National Radio Institute

"REFINEMENT" is the big word in radio today. Manufacturers are selling their products on the basis of refinement, not only with respect to appearance, tone control, etc., but with respect to actual mechanical and electrical construction. Manufacturing tolerances are not "what they used to be." This, of course, means that a new type of serviceman is coming into being—a serviceman who understands the use of precision instruments for proper testing, aligning, and balancing.

The allied fields of radio are, in many cases, taking good men away from radio. Altogether, there is a great dearth of properly trained, well-equipped servicemen to keep the newer sets in the pink of condition, in spite of the good work that various schools and institutes throughout the country are doing.

Television for Amateur Experimenters

By Harold P. Donle

Radio Engineer, Transmission Research Laboratory

TELEVISION is today a source of much interest for independent or amateur experimenter, but is not yet developed to the point of providing a home entertainment from apparatus available on the market. The job of transmitting pictures having entertainment value is not difficult, but the public has not yet been offered an adequate home receiver.

A reproducer that will satisfy the broadcast listener must have enough brilliancy to be used in a normally lighted room, a sixty degree angle of view and reasonable size of picture, without magnification. Nothing that meets these fundamental requirements has yet been announced, so far as I know. The future trend must be in those directions.

Direct Foreign Reception

By Robert Hertzberg

Pilot Radio and Tube Corporation

WITH the development of high-grade short-wave receivers approaching regular broadcast receivers in convenience, and surpassing them in sales appeal because of their promise of direct foreign reception, the short-wave market appears due for a profitable expansion. It is no longer limited to the comparatively small group of experimenters who "roll their own," but is widening rapidly to include a much larger section of the general public—men who won't touch a soldering iron but who will get up at 4:00 a. m. to hear Sydney or Bandoeng or Khabarovsk so that they can boast about their DX when they get to the office. No mistake about it; the short-waves are re-creating the early thrills of radio, and where there are thrills to be gotten there are also cash customers.

Harold P. Donle

Arthur Mohaupt

Robert Hertzberg

James Millen

S. I. Cole

J. E. Smith

Service Men Must Know Radio

By Arthur S. Mohaupt

President, Radio Training Association

THE radio serviceman is becoming the most important link in the radio trade. He will be the only means of contact the dealer retains with his customers and therefore will be the dealer's best sales and advertising medium.

A real serviceman must be more than a mere repair man—he must be an artisan, a diplomat and a salesman. He must first of all know radio in all its phases and be able to do neat and accurate repair work.

As a diplomat he must just as readily be able to repair the mental attitude of the customer, for the trouble that develops in the radio set may have severely bruised his friendly attitude toward the dealer. And as a salesman he must convert every service call into a sales call, either in selling the customer some accessories or additional equipment, or procuring for the dealer the names of real prospects for new sales.

International Broadcasting a Reality

By James Millen

General Manager, National Company, Inc.

NOW with the advent of more and more high-power short-wave broadcasting, all over the world, the much heralded era of "International Broadcasting" is fast becoming a reality—for the entire world is now available to every listener possessing a modern short-wave receiver.

The placing upon the market of an a.c. receiver with the appearance, ease of operation, and general overall performance of the better broadcast receivers, has rapidly brought into being an enthusiastic short-wave audience, especially in the Southern states where short-wave reception in the Summer months is generally much freer from static and other disturbances.

Midget Sets to Be Popular

By S. I. Cole

Secretary-Treasurer, Aerovox Wireless Corporation

I BELIEVE that the midget set will again this year be the dominating factor of the industry. Radio listeners, in addition to replacing their older and obsolete receivers, will purchase second, third and even fourth sets of the midget variety, to be placed in various other parts of their homes.

Parts business with jobbers is showing a huge increase. Jobbers report that parts sales are being boosted by the replacement of components in receivers.

Practically all manufacturers of receivers are using the electrolytic condenser because of the low cost per microfarad enabling them to use sufficient capacity to properly filter their circuits.

Our business volume for the first quarter of 1931 is 60 per cent. ahead of the volume for the same period a year ago. This very definitely indicates an upward trend for radio and the entire industry is reflecting general improvement.

We are experiencing a large demand for our electrolytic condensers. And we are now increasing our factory facilities so that we can easily turn out approximately 25,000 condensers each day.

Henry G. Richter

D. N. Dulweber

C. W. Horn

Amplifier and Speaker Improvements

By Henry G. Richter

Chief Engineer, Electrad, Inc.

ALL elements of audio-amplifying systems have been subject to careful and extensive research. It can be said that audio circuits, tubes, speakers, microphones, etc., are in a highly perfected state today, but progressive laboratories still continue developments of these essentials to audio systems. We know therefore that the future will bring more efficient amplifiers with even better response curves than we have today. There seems to be a possibility that speaker efficiency will be so increased that amplifiers of less gain and power output be used for optimum results.

Service-Salesmen Increase Sales

By D. N. Dulweber

Supreme Instruments Corp.

REMEMBER the old "meter box" of a few years ago? Just about in keeping with the usefulness of the man who used it. But testing equipment has graduated and received its diploma. With its advance the serviceman has kept pace—two good-will envoys capable of increasing the sales and profits of any radio business if given the opportunity.

The serviceman is fast becoming a service-salesman, with the finest portable testing equipment obtainable—a necessary and indispensable assistant. The dealer not using the sales possibilities of this combination is running in low gear and will soon be hopelessly out of the race for business.

Promises International Programs

By C. W. Horn

General Engineer, National Broadcasting Company

IN view of recent improvements in tubes, antennas and anti-fading methods, I expect the next year to give us reliable short-wave service for the interchange of radio programs with most great nations of the world.

We have already exchanged programs with most European nations, Australia, Japan, Hawaii, the Philippines, Brazil, Argentina and Honduras. We expect to constantly add other countries to this list.

The National Broadcasting Company engineering staff is gathering a mass of data on short-wave reception. We are studying the magnetism of the earth, sun-spots, season changes, lightness and darkness and such other subjects offering essential data on short-wave reception.

Conditions have improved to the extent where we may now plan international programs in advance. In the past we had to receive the program first and assure ourselves that the impulses were strong enough to be successfully rebroadcast. Now we can reliably schedule them far in advance.

Pentode Tubes for General Use

By Ernest Kauer

President, Ceco Manufacturing Co., Inc.

IT is now a certainty that this spring will see introduced for general use radio sets utilizing a pentode tube. Ever since the autumn of 1929, when experiments of engineers in our Providence laboratory were brought to a successful fruition and demonstrated in New York to radio engineers and technical editors, we have been confident that the time would come when this development would find a definite use in general set manufacture.

The pentode is an ideal application in the present economic situation. It permits better reception at less cost. Needless to say, it is a point of pride with us to have been permitted to help pioneer this great development.

Better Servicemen Needed

By E. L. Richards

Superintendent, Coyne Electrical School

THE radio and talking picture fields are constantly demanding a higher type of serviceman, and the television field will even further emphasize the need of thoroughly trained practical men, with a good knowledge of both electrical and radio principles, and skill in the use of modern methods of servicing and repair.

Modern a.c. receivers with their thorough shielding and compact arrangement of parts and wiring, short-wave receivers and the more critical nature of the very high-frequency energy they handle, and talking picture and public address systems with their exacting requirements of tone quality and absolute continuity of operation, are all causing radio manufacturers, dealers and other employers to insist that their servicemen have complete training.

New Tubes to Aid Radio

By Allen B. DuMont

Vice President, DeForest Radio Company

THE year 1930 has been one of refinement in tube design, during which time fundamental problems such as tube noise, mechanical strength, and a.c. hum have been eliminated to an extent that they are no longer troublesome factors. With these things taken care of, the tube manufacturer has had added time to think about and to develop improved tubes for various uses. The variable mu tube and the pentode output tube are examples of this. These tubes will be a very important factor in 1931 products.

In the industrial and power tube field the mercury vapor rectifier is fast displacing the thermionic rectifier and the motor generator. Broadcasting stations are going to higher and higher power, which means that the tube manufacturer without at least 50 kilowatt tubes in his line is considerably handicapped.

Television and the talkies have opened up a much wider field for the photo-electric cell and various neon devices used for either television reproduction or various methods of recording. Probably, the largest potential business in the tube industry lies in the developments ahead in television which will more than double the present set and tube market, as well as add tremendously to the demand for photo-cells and quick acting light sources.

Directional Microphones Aid Programs

By O. B. Hanson

Manager of Plant and Operations, National Broadcasting Company

ONE of the most important developments in broadcast engineering during the past year was the directional microphone, technically known as the parabolic-reflector microphone. This instrument was first introduced by the National (*Continued on page 74*)

O. B. Hanson

A. B. DuMont

E. L. Richards

More Power to the Midgets

The New Power Pentode Tube

The new pentode tube comes as a distinct contribution to radio, in these days of strong public demand for more compact receivers, because of its combination of large power handling ability with increased gain

By D. F. Schmit*

WITH the recent trend toward the use of power detection followed directly by a single power output amplifier stage a real need has developed for a power output tube which will provide adequate undistorted output with higher gain than has been heretofore obtainable with the power tubes in common use. Midget receivers particularly have called for some tube development which would incorporate these features. The type –47 power pentode tube has therefore been placed on the market to meet these requirements. That it will fill the need is apparent from the following description.

The power amplifier pentode is a five-element tube having a filament, plate and three grids. The coated filament operates at 2.5 volts and 1.5 amperes and is formed in the shape of an M supported at the top by means of two hooks and at the bottom by a central support in addition to the two end supports which also act as leads from the stem. The control grid is placed around the filament, the screen-grid is placed around the control grid, the suppressor or cathode grid is placed around the screen grid, and this, in turn, is surrounded by the plate. Two mica spacers are employed, one at the top and one at the bottom, to hold these elements in their proper position. Figure 1 shows the position of these elements and the position of the base contact pins.

The suppressor grid, which is connected to the central bottom filament support inside the tube, prevents the flow of secondary electrons from the plate to the screen grid when the plate voltage becomes lower than the positive screen voltage. Secondary emission is present at the plate of three-electrode power amplifier tubes, but the plate voltage is at all times positive with respect to any other element and therefore secondary emission from the plate does not limit the operation of the tubes. The suppressor grid placed between the screen and plate in the pentode permits the operation of the screen at a high positive voltage, thereby increasing the mutual conductance and extending the operating range of the plate current characteristic. Figure 2 shows a typical plate current-plate voltage relation which is obtainable from the C-347 pentode. These curves were plotted from data taken at a filament voltage of 2.5 volts d.c. and a screen voltage of 250 volts. The 7000-ohm load line shows that the plate voltage swings to approximately 65 volts as the control grid voltage swings to 0 with respect to negative filament. When the control grid voltage swings to 30.5 volts (twice the d.c. bias) the plate voltage is approximately 435 volts.

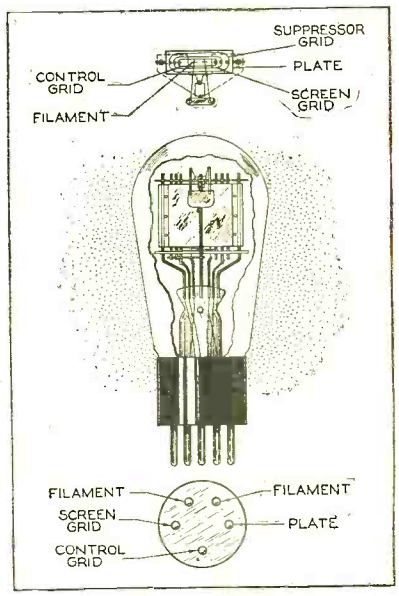


Photo and cut-away view (Figure 1, at left) of the new pentode tube. The suppressor grid is connected to the midpoint of the filament, within the tube, and therefore no external connection is required for this added element

Referring to the familiar plate voltage-plate current characteristic of a four-element screen-grid tube such as the C-324, the secondary emission from the plate causes a rapid decrease or dip in the plate current at a plate voltage approximately equal and below the screen voltage. Figure 2 shows the absence of this dip, in the pentode tube, for all values of plate voltage due to the retarding effect of the suppressor grid on the secondary electrons emitted from the plate.

The tabulation below gives the rating and characteristics of the C-347 power amplifier pentode:

Filament voltage, a.c.	2.5 volts
Filament current	1.5 amperes
Plate voltage, recommended	250 volts
Screen voltage, recommended and maximum	250 volts
Grid voltage (to center tap)	— 16.5 volts
Plate current	32 milliamperes
Screen current	7.5 milliamperes
Plate resistance	38,000 ohms
Mutual conductance	2500 micromhos
Load resistance, approximate	7000 ohms
Power output	2.5 watts

(*Continued on page* 81)

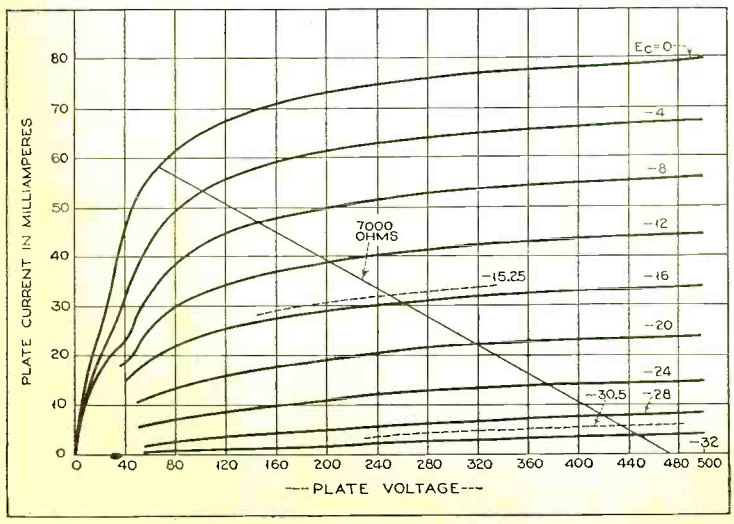


Figure 2. This shows the plate current, plate voltage characteristic of a typical pentode

*Chief Engineer, E. T. Cunningham, Inc.

Tapping *the* Short-Waves

Last month the author called attention to what short-wave broadcasting has to offer the radio enthusiast. This month he introduces the subject of code reception as a captivating pastime for the broadcast fan

PART TWO

By Zeh Bouck

IN the June issue of RADIO NEWS we described the characteristics of short radio waves—the high frequencies, to employ the more convenient designation of frequency rather than wavelength. Briefly recapitulated, these peculiarities include the skip-distance effect, describing a signal easily heard at a relatively great distance from the transmitter, but inaudible several thousand miles nearer the source; the uncanny carrying power of the high frequencies whereby low powers practically encircle the world; and the selection of certain bands for day and night transmission, making possible consistent long-distance communication without the familiar low-frequency dependence upon night.

These effects were considered in relation to radio telephone signals. However, there exists no inherent difference between code or voice radio (or between wireless and radio, if you prefer a popular but unjustifiable discrimination), and the same effects are to be observed on code signals. As a matter of fact, the only difference between code and voice signals is a matter of modulation, the manner in which the fundamental signal, or carrier wave, is broken up. In the code transmitter, it is interrupted in dots and dashes, which are nothing more than long and short "spurts" of radio power. In radio telephony, the carrier changes less regularly—in conformation with the vibrations of voice or music.

Above is shown a type of new home recording device which may be employed for making records of code transmissions which can then later be deciphered at leisure

Had we considered radio in a chronological order, we should have written our article on tapping code signals first—for code transmitters were developed to a high degree of perfection long before radio telephony was practical over long distances. We considered the possibilities of short-wave music and speech transmission in our original article because it is the system with which most of us are more familiar, and because it is the arrangement by which radio entertainment is brought to the majority of radio listeners. However, code reception is by no means void of entertainment value, and to the type of radio enthusiast interested in DX and short-wave telephone reception, it exceeds broadcasting in its pleasurable possibilities. Code reception provides an altogether new field of entertainment, psychologically akin to puzzles, which has intrigued the human mind from the days of its inception. To take advantage of this fascinating phase of radio, it is not necessary to be a code expert, or even to bestow upon its study any more concentration than one concedes to the solution of the cross-word puzzle problem involving a three-lettered bird ending in "u," or a four-letter musical instrument with "o" as the first letter.

The "International Morse Code" is the official name for the code employed in radio communication throughout the world. This radio code, as most of us appreciate, is a representation of the alphabet, numerals, punctuation marks and certain abbreviations, in what we call "dots and dashes." On paper they are actually dots and dashes—to the ear they are respectively a short sound and a longer sound. The relative length of the sound should always be the same—the dash being three times as long as the dot, the space between dots and dashes of the same letter, one dot long, between letters, three dots long, and between two words, five dots long. The actual timing, however, will vary with the speed of transmission. For instance, the expression "too bad" might be represented on paper as - --- --- ---- . .- -... (though no operator writes down the dots and dashes in this fashion), and would be transmitted as: dash three-dot-space dash one-dot-space dash one-dot-space dash three-dot-space dash one-dot-space dash one-dot-space dash five-dot-space dash one-dot-space dot one-dot-space dot one-dot-space dot three-dot-space dot one-dot-space dash three-dot-space dash one-dot-space dot one-dot-space dot.

The International Morse Code is shown in Fig. 1. It is not necessary to memorize or study this in order to identify distant code transmitters, though a familiarity with the code will follow as the game is played.

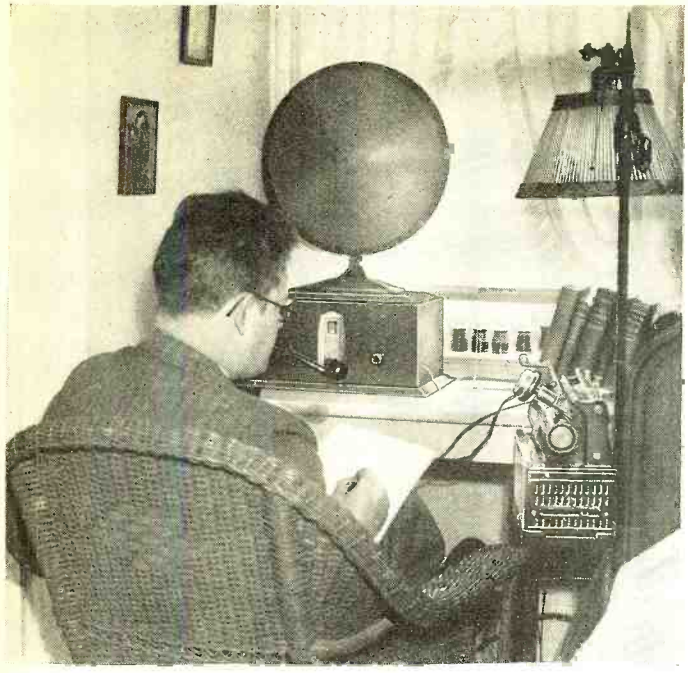
Tuning for Code

Code signals are tuned with a slightly different technique than that employed in telephone reception. We assume that the reader possesses either a short wave receiver or an adaptor similar to those described in the June article. The same receiver is used for short wave code reception. When listening to a broadcast program after it has been

INTERNATIONAL MORSE CODE

A	• —	Period	• — • — • —
B	— • • •	Semicolon	— • — • — •
C	— • — •	Comma	— — • • — —
D	— • •	Colon	— — — • • •
E	•	Interrogation	• • — — • •
F	• • — •	Exclamation point	— • — • — —
G	— — •	Apostrophe	• — — — — •
H	• • • •	Hyphen	— • • • • —
I	• •	Bar indicating fraction	— • • — •
J	• — — —	Parenthesis	— • — — • —
K	— • —	Inverted commas	• — • • — •
L	• — • •	Underline	• • — — • —
M	— —	Double dash	— • • • —
N	— •	Distress Call	• • • — — — • • •
O	— — —	Attention call	— • — • —
P	• — — •	General inquiry call	— • — • — — • —
Q	— — • —	From (de)	— • • •
R	• — •	Invitation to transmit (go ahead)	— • —
S	• • •	Warning—high power	— — • • — —
T	—	Question (please repeat after .....)—interrupting long messages	• • — — • •
U	• • —	Wait	• — • • •
V	• • • —	Break (Bk.) (double dash)	— • • • —
W	• — —	Understand	• • • — •
X	— • • —	Error	• • • • • • • •
Y	— • — —	Received (O.K.)	• • — •
Z	— — • •	Position report (to precede position messages)	— • — • —
Ä (German)	• — • —	End of each message (cross)	• — • — •
Á or Å (Spanish Scandinavian)	• — — • —	Transmission finished (end of work) (conclusion of correspondence)	• • • — • —
CH (German-Spanish)	— — — —		
É (French)	• • — • •		
Ñ (Spanish)	— — • — —		
Ö (German)	— — — •		
Ü (German)	• • — —		
1	• — — — —		
2	• • — — —		
3	• • • — —		
4	• • • • —		
5	• • • • •		
6	— • • • •		
7	— — • • •		
8	— — — • •		
9	— — — — •		
0	— — — — —		

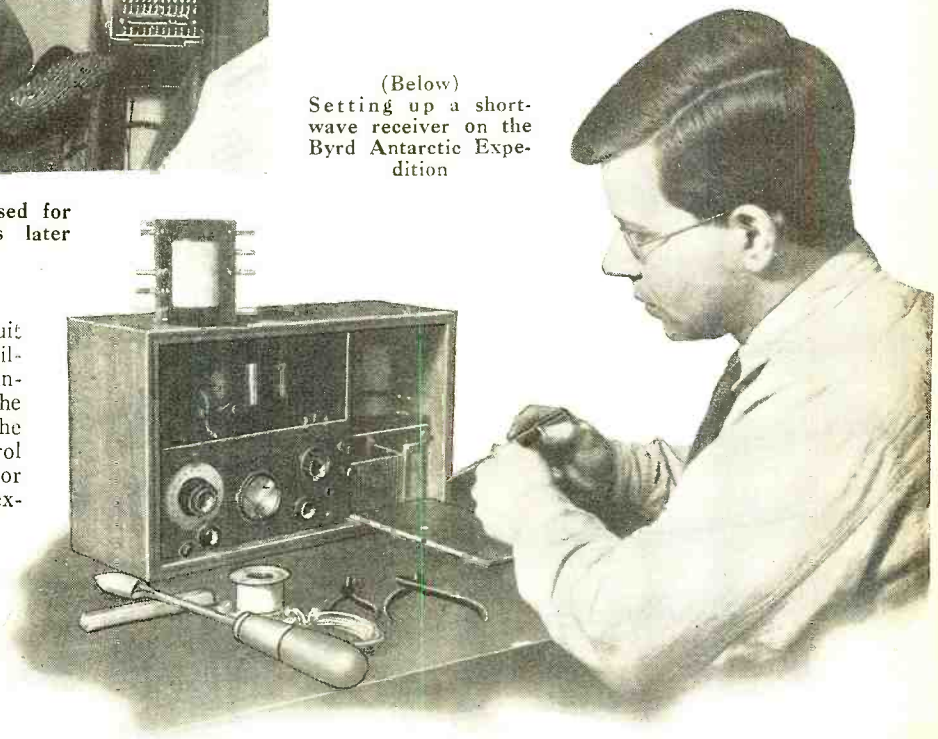
At the right is the complete International Morse code. It is possible to decipher many code signals without being an expert operator



Shown above, a dictaphone is being used for copying a fast code signal which is later transcribed at a slower speed

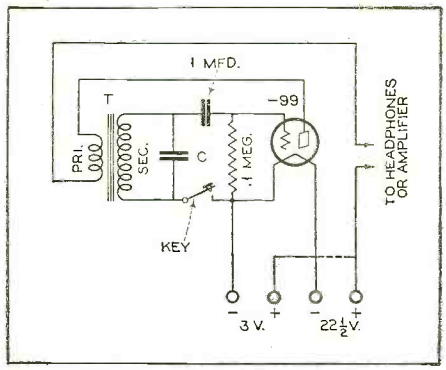
THE field of code reception is generally considered alien territory for the broadcast fan—a part of radio that holds for him nothing in the way of interest or entertainment. Mr. Bouck demonstrates the fallacy of this idea, and points out that here is meat for the DX fan blasé with the familiar possibilities of the broadcast bands. Code reception may be played as a fascinating game, without actually learning the code, or it may be taken more seriously as an introduction to the king of hobbies—amateur radio telegraphy.

—THE EDITORS.



(Below) Setting up a short-wave receiver on the Byrd Antarctic Expedition

tuned, care is observed to keep the circuit from oscillating. If the circuit is oscillating an annoying squeal will almost invariably be heard. (The exception is the case of "zero beat," referred to in the previous article.) As the tuning control is adjusted, the pitch of the whistle, or note, changes, becoming lower as the exact tuning point of the station is approached from either side. In code reception it is most often this whistle to which we listen, varying its pitch by tuning until it is most readable—a condition determined by the quality of the sound, freedom from interference and intensity. Such stations are described as continuous wave stations. Many code stations are modulated, the dots and dashes coming through as a musical note impressed on the carrier. These stations, more or less incorrectly described as icw (interrupted continuous wave), may be tuned exactly as you would a phone station. However, when weak, even icw signals are most readily copied with the circuit oscillating. Several types of code signals will be readily recognized, from the low, rasping sixty-cycle modulations, through the musical scale from two hundred to a thousand cycles, to the pure continuous wave, cw signal. (For the sake of accuracy the author recommends the designation of modulated continuous waves, abbreviated mcw, for code signals this condition correctly describes. Interrupted continuous waves, or icw, will refer to signals secured by chopping or other systems whereby the carrier is more definitely interrupted.)



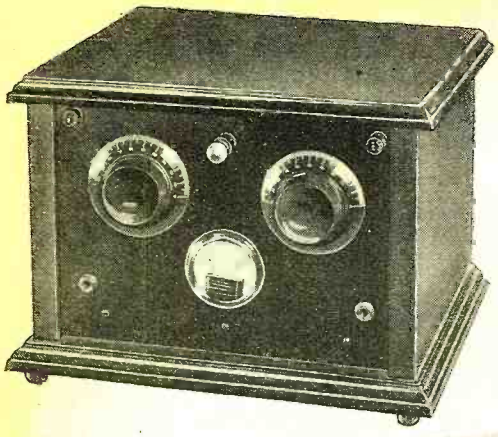
A simple and inexpensive arrangement for code practice, giving a clear, clean note similar to that of a c.w. signal

Having grasped the technique of tuning for code signals, let us investigate the high frequency spectra and discover just what is available for our delectation. Various frequency bands in this range have been definitely set aside for code communication of the various commercial services and amateurs. These short wave code bands are roughly divided by international agreement into the following allocations.

Kilocycles	Meters	Services
3,500– 4,000	87 –75	Amateur
4,000– 6,675	75 –45	Airplane
6,675– 7,000	45 –42.8	Commercial
7,000– 7,300	42.8–41	Amateur
7,300–14,000	41 –21.4	Commercial
14,000–14,400	21.4–20.8	Amateur
14,400–23,000	20.8–13.1	Commercial

(A complete list of allocations is contained in "Treaty Series, No. 767—Radiotelegraph Convention and General Regulations Between the United States and Other Powers," obtainable from the United States Government Printing Office for fifteen cents, and in "The Manual of Short Wave Radio," sold for fifty cents by the National Company, Malden, Mass.)

Of course, for the experienced radio operator, the entire code category unfolds a consistently fascinating source of interest. However, for direct transcription, the beginner will confine himself to commercial stations that are testing and amateurs calling "CQ." Fully half the commercial stations on the air at any one time are testing—transmitting a simple and characteristic signal, frequently interrupted with their call letters. The most common of these testers is what our good friend R. S. Kruse dubs—



Above is a simple short-wave transmitter made for the beginner

(Below)
A commercial form of code practice instrument operated by perforated tape and providing a pure c.w. note in the headphones. The speed may be regulated as desired

The "Dotters"

Tune your short wave receiver or adaptor, with the circuit oscillating, over the band best suited to the time of day (23,000 kc. to 10,000 kc. during the day and from 10,000 kc. to 3,500 kc. at night) and you will invariably run across a number of stations sending out a series of dots. These are sent out automatically by a tape transmitter. Every two or three seconds the series of dots will be broken by an irregular sequence—the call letters of the station. After you have heard them several times, you will be able to separate the groups and finally write down either the dots and dashes themselves, or the letters they represent. At first it will be easier to write down the actual code characters, such as ···· - ·· (two dots dash dot, dash, dot dash.) Referring to the code chart, you will interpret these characters as "FTA." By means of the call assignment list, given further along in this article, you may identify this transmitter as a French station. When a complete call list is available, the station can be definitely located.

Another common test signal is the letter "V," ···-, which is repeated over and over again, the sequence being broken with the call letters of the station. Occasionally the combination ····· is employed for testing, and quite often the simple sequence "ABC," ·- -··· -·-· is run off the tape for hours at a time. Test signals are used during off-traffic periods so that the receiving station may keep continually tuned to the transmitter and ready for the reception of the next message.

These various test signals are usually separated from the call by the letters "DE" (-·· .), which is Latin for "from."

The letters "RQ" will also often be identified on the commercial code channels, which signifies that the station so calling is requesting a correction on a previous message.

Amateur Stations

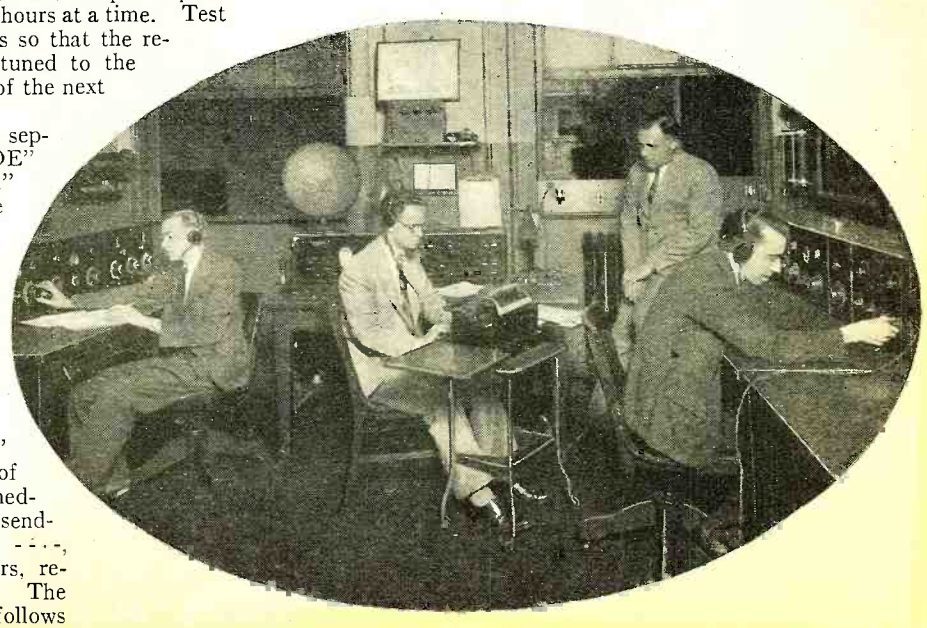
Amateur stations are logical fish in this new DX game due to the frequency of easily recognizable "CQ" transmissions. With the exception of stations working on a particular schedule, all amateurs open transmission by sending repetitions of the letters "CQ," -·-· --·-, which is a general call to all amateurs, requesting a reply from any listener. The call letters of the amateur station follows the usual separation, "DE." Amateur stations are often equally generous in repeating call letters, and the stations are therefore readily identified by the beginner at code. When calling another station, the procedure is to send the call letters of the desired station a number of times, then "DE" and the sign of the calling station. The location of Amateur stations can be ascertained according to country by the table of initial letters given in this article.

American amateurs are further divided into nine zones, covering the following approximate territories: 1—New England, 2—New York and Northern New Jersey, 3—middle Atlantic states, 4—south Atlantic states, 5—south central states, 6—California and far western states, 7—Washington and north western states, 8—western New York, Ohio and Michigan, 9—north central states. For instance, W1MK is located in Hartford, Connecticut, while W5VY is in Galveston, Texas.

Gaining Code Proficiency

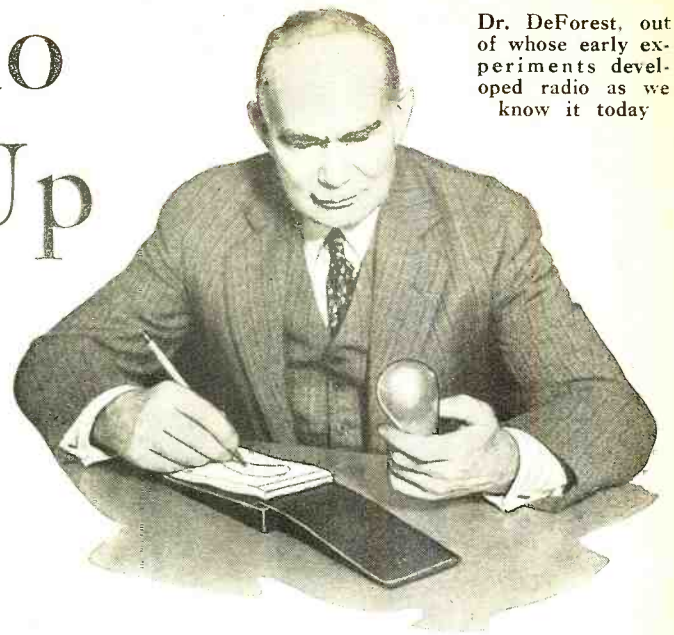
As the game of logging code stations is continued, the player will necessarily develop an increased degree of skill in deciphering the fascinating combinations of dots and dashes. At first the code itself will automatically become memorized, and the chart will be referred to only occasionally. Then the listener will begin to recognize the more familiar groups, and occasionally will be able to write down entire words. He will graduate from the method of writing down the dots and dashes. Instead he will translate them mentally into the corresponding letters. At this point he will become interested in trying the key, which is perhaps the quickest system of building up speed to the ten word per minute rate. A simple code set is diagrammed on the second page of this article.

"T" is a standard audio frequency amplifying transformer, the make, ratio and general excellence of which are not at all important. The circuit is self-explanatory. When the key is depressed, a whistle, similar to that of a cw signal, is audible in the head 'phones. It may be necessary to reverse the connections to the primary before the whistle is heard. The tone can be varied by changing the value of condenser C between .0005 and .01 mfd. In many instances this condenser will not be required. Similarly the grid- (*Continued on page* 66)



The operating room of the New York *Times* short-wave station WHD, New York City. This station maintains schedules with expeditions the world over

How *the* Radio Tube Grew Up



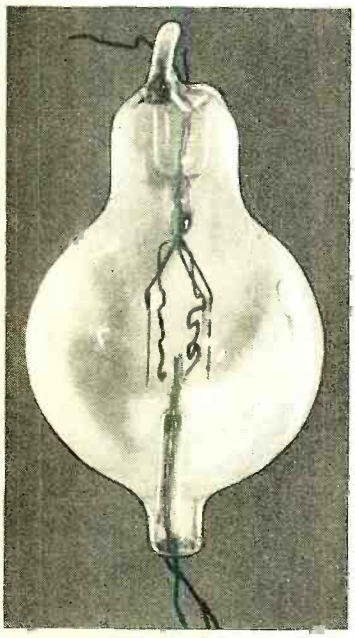
Dr. DeForest, out of whose early experiments developed radio as we know it today

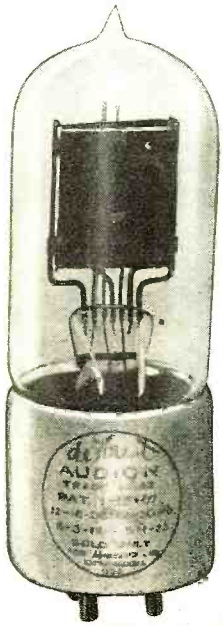
An intimate story of the vacuum tube from the first crude model to the highly perfected tube of today—as told by the pioneer inventor who had the courage of his convictions

By Lee DeForest, Ph.D.

WITHOUT the audion, or three-element vacuum tube, there would be no radio industry. At least, the radio industry would not be catering to the public at large, supplying millions of radio sets and tens of millions of radio tubes each year, and maintaining over six hundred broadcasting stations pouring forth a steady stream of entertainment and enlightenment—and considerable advertising. Rather, there would be a relatively small communication business for the handling of marine and transoceanic traffic. In the final analysis, it is the vacuum tube that has brought about simplified and practical radio. Hence, in the production of radio tubes—the veritable footlights of the world's stage—is reflected the rapid progress of the radio art, science and industry.

The giant radio tube industry of today came about through an accident. Many of my readers may recall the story. However, for the newer members of the radio fraternity, I may be permitted to repeat the brief details.





Three stages in the history of vacuum tube development. Above, one of the original audions of 1912 or thereabouts—hand made and of fragile construction, gassy, non-uniform and short-lived. The audion of 1924 (center) bears little resemblance to the early model. It was used extensively in battery-operated broadcast receivers of that period

(Right) The four-element a.c. audion of today—the type of vacuum tube which makes possible the near perfection of modern receivers

Back in 1904, while engaged as associate editor of *The Western Electrician,* I spent my spare time in wireless experiments. Among my possessions was a large jump-spark coil. One evening, I noticed that each time the spark jumped the gap, the near-by Welsbach mantle flickered. It occurred to me that the Hertzian or wireless waves must have some influence on the particles of heated gas in the Welsbach mantle. Perhaps, after all, this might be the basis for a new wireless detector, which was sadly needed in those days of crude coherers. And so I looked into the proposition.

The first gaseous detector took the form of a standard Bunsen burner, with a trough-like electrode containing common table salt and a piece of platinum wire about it, placed in the blue flame of the burner. A battery and headphone were shunted across the flame, through the electrodes. The salt was used to improve the action. The antenna and ground were connected to the two electrodes. Fair results were obtained from this detector.

However, marine wireless was our main consideration in those days. And since there was no illuminating gas available on shipboard, I decided to use a glass bulb filled with gas, and a heated filament as the source of heat, operated entirely by batteries. One discovery led to another. The fact that much of the signal energy passed through the battery and headphone instead of through the gaseous medium led to the idea of a separate and distinct path for the wireless signal, and in turn the third element made its appearance, first as a metal band around the outside of the glass bulb, then as a second plate quite close to the first or real plate, and finally in the shape of a zigzag length of wire which, for want of a better name, I called the grid. So by 1906 I had developed the audion or three-element tube, in all respects similar to the standard radio tube of today.

The next step was to manufacture the audion. At first I tried to interest the large lamp companies, since the audion was very much in their line, being a modified electric lamp. But to no avail. The lamp companies had no time to bother with this fantastic experiment. Somewhat of a contrast, to be sure, with present-day conditions when so many lamp companies have rushed into the vacuum tube business.

Finally, (*Continued on page* 74)

Twelve Years of 1919

From a small ateurs transmitting graph records to a ers, to the present when radio is manent utility, a dozen years have packed with discoveries,

By Capt. Robert

It was in amateur stations such as this that broadcasting of music started in 1919. The photo shows the vacuum tube transmitter equipment used by William Andrew Mackay at that time. The receiver shown below the transmitter is one of the first three-circuit tuners

MIRRORING the developments of radio for the past twelve years, RADIO NEWS has recorded the progress of radio virtually from the "stone age" of reception, when the crystal receiver intrigued the imagination up to the presentation of moving pictures via the ether.

Further than merely acting as an historian of radio progress, RADIO NEWS pioneered in the various departments of broadcast progress and has had the enviable distinction of crystallizing in workable form such developments as television, synchronization of two or more stations on the same wavelength, and the introduction of the first radio musical instrument. Direct outgrowths of these experiments are the huge radio organ and the Theremin, to say nothing of the impetus lent to a host of developments of the so-called infant industry, by the progressive spirit of radio's pioneer magazine.

In the short space of 12 years, radio has grown from an industry doing less than $2,000,000 gross business a year to a national institution, one of the country's leading industries, with a cash turnover of more than $500,000,000 for 1930.

RADIO NEWS was in existence before the first broadcasting station went on the air, for the first issue made its appearance in June, 1919, and KDKA, the world's first station, was not put into operation until November 2, 1920.

But radio in various forms, particularly that of wireless telegraphy, traces back as early as 1865, when James Clerk Maxwell, Scotch physicist, propounded the theory that light consists of electro-magnetic waves in the ether and that other waves, similar but invisible, exist. Twenty-two years later Heinrich Hertz, German electrical investigator, proved the existence of the radio waves through his famed experiments.

The next big impetus that wireless communications received was from Guglielmo Marconi, who in 1894 commenced his experiments with Branley's coherer, a crude device for the detection of minute high-frequency currents. He also was the first to use the antenna-ground system of transmission at about this same time.

Four years were devoted to these experiments, which were proven successful in 1898, when a message was sent through the air for a distance of about 14 miles. The distance was increased to over 200 miles in 1901 when a message was successfully sent from Cornwall to the Isle of Wight. It was on December 14 of this year that the historic three dots were transmitted over the Atlantic Ocean by him. This sensational demonstration was made in conjunction with John Hunter Tennant, until recently managing editor of the *Evening World*; Joseph Pulitzer, the elder, and Marconi. It was the outgrowth of a bet, and these men, always far-sighted, proved to a sceptical world that long-distance wireless communication was an actuality.

On this occasion Raydon Jones drew a cartoon which was published on December 16 thirty years ago, visualizing the potentialities of the new form of communication. He showed it used in a newspaper office, receiving bulletins on sports and world events; sending calls for help to ships at sea; stock reports to Morgan on his yacht and for other means of communication. About the only things he did not foresee was the broadcasting of music and television.

All this time the apparatus had been of the crudest sort —entirely unlike the highly developed equipment which we now know. Even the crystal detector, that good old standby of early broadcasting days, did not make its appearance until 1906. Credit for this device must be given to Pickard and Dunwoody, for inductive coupling to Sir Oliver Lodge, and for an improved form of electric arc, capable of generating frequencies up to 30 kilocycles, to Poulsen of Denmark. About this time, Fleming, another British scientist, devised a two-element vacuum tube, and in 1906 Dr. Lee De Forest interposed a third element, the grid, between the plate and filament, giving us the three-element vacuum tube to which radio broadcasting, as we know it, owes its existence.

Radio telephony existed commercially as long ago as 1915, when the vacuum tube was used in the transatlantic communications both as oscillators

"RADIO is still such a youthful industry, viewed from the standpoint of its enlarged service through broadcasting, that the observance of a twelfth anniversary is an event of significance. It shows a career contemporaneous with the great growth of radio, and, perhaps, a vision of the tremendous industrial expansion which, twelve years ago, lay just ahead. I am glad to extend felicitation to the RADIO NEWS *on the completion of its twelfth year.*

"Undoubtedly there is much that may still be told about radio. We look toward the coming years with a conviction that new services of public value will spring from the further development of this industry. I congratulate the RADIO NEWS *and its staff on the past service rendered by this magazine. I believe that an equally splendid opportunity lies ahead."*

DAVID SARNOFF.

Radio Progress

1931

beginning, with am- music from phono- few thousand listen- state of the industry recognized as a per- elapsed and these years have been inventions and developments

Scofield Wood

and modulators, and when they were replacing the high-frequency oscillator for use in radio telegraphy. The oscillator had been produced by Armstrong, Goldschmidt and Fessenden about 1910.

In these early days of radio communication, however, the maximum power obtainable from a tube was 25 watts, while today 20 and even 50 kilowatts are not unusual as standard equipment for broadcasting stations. Along the lines of reception, four-element or screen-grid tubes and five-element tubes or pentodes have also been developed.

The war gave radio its next big impetus, that form of communication being ideally suited to keeping planes in touch with the ground. It was almost immediately after the war that radio got its start, though as early as 1906 Fessenden had transmitted a Christmas Eve program. Whether or not anyone received it is a moot question.

However, shortly after the outbreak of the war, the British government requested Westinghouse to carry on some radio research for them. Transmission and reception was a branch, and in order to undertake it, it was necessary that experimental stations be built and operated. The Government issued permission and 2WM and 2WE came into existence.

The same organization, which controlled the International Radio Telegraph Company, was even then operating the several ship-to-shore stations owned by it, and the large investment tied up in this enterprise caused them to seek some means of realizing a profit from it. Dr. Conrad, one of the scientists of the company, had been consistently experimenting with voice transmission, occasionally sent out programs of phonograph music, talks and so forth over his station, 8XK.

David Sarnoff
President, Radio Corp. of America

Then a newspaper carried the advertisement of a Pittsburgh store offering for sale radio receivers which would enable one to tune in 8XK. This gave Westinghouse officials the idea that radio should be developed as a publicity medium rather than a straight communication service, and early in 1920 plans for operating KDKA were made.

This station opened in November of that year, and its first broadcast was of the election returns when Harding was elected President. The first audience consisted of amateurs, and few people who already had sets and the officers of the company, who were given receivers.

The control equipment of a modern station, showing the complicated panels and switches. The scene is in the control room of the Times Square studios of the National Broadcasting Co. At the switchboard is W. S. T. Redsern and at the monitor table Richard Stoddart

KDKA then went on a schedule that called for a daily broadcast between the hours of 8:30 and 9:30 p.m.

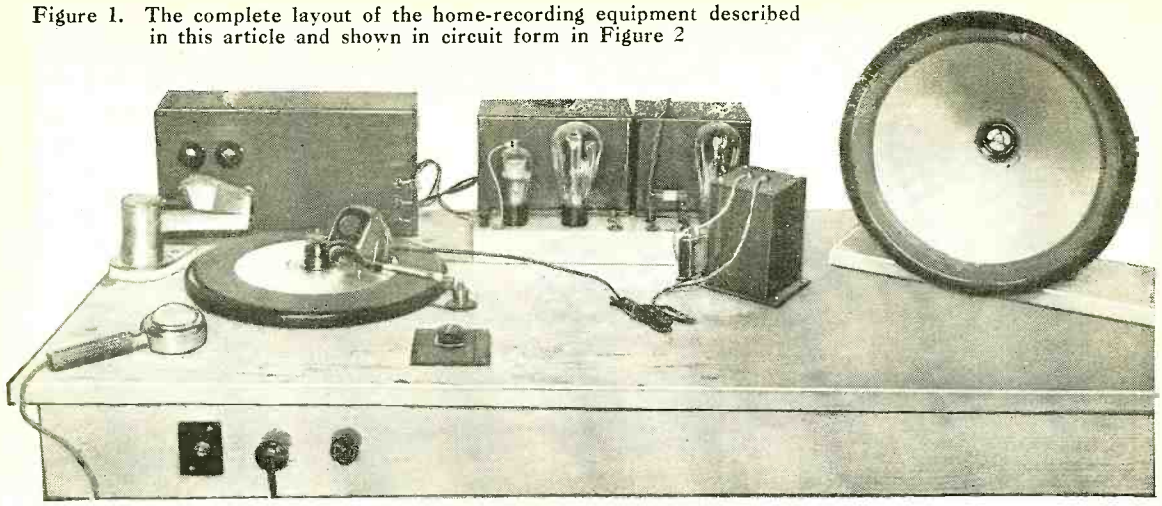
Old KDKA's first studio was a rough wooden shack built on the roof of one of the taller buildings. It housed, in one room, the transmitter, the phonograph (which supplied most of the program material), the announcers and whatever artists could be gathered. But room resonance marred the programs, so with the coming of summer the artists were moved out of doors, with a tent over them. This was fine until winter came again, and then the tent was moved into a large room. Thus the problem of resonance was overcome in the construction of radio's first indoor studio. Later the tent was removed and the room's walls hung with burlap to deaden the sound.

In these early days the crystal set, costing from $15 to $25, was the usual thing. The one-tube sets were too expensive for the average purse, considering how slightly better they were than crystal sets. But soon the regenerative receiver made its appearance. One of these, the MR-6, made by De Forest, was sold for approximately $150 without accessories. It consisted of a honeycomb-coil tuner and two stages of audio-frequency amplification. About this time Radiola came out with a model that resembled a small table model phonograph with lid and concealed horn. It operated on four WD-11 tubes.

Accessories were a luxury in those days, too. The little horn on which a head-set could be clamped, sold for $12.50. Rather tricky grid leaks and filament rheostats cost as much as $2.50 each, and when the 201A type tube came out it was worth whatever the dealer could get for it. A "bonus" price of $10 was not exceptional.

Despite the high cost of listening in, radio grew by leaps and bounds. In September, 1921, WBZ opened at Springfield, Mass., WJZ went on the air from Newark on October 12, and KWY of Chicago opened on November 11 of the same year. Programs were on the air! All that one had to do was buy the equipment in order to listen in, and as (*Continued on page* 86)

Figure 1. The complete layout of the home-recording equipment described in this article and shown in circuit form in Figure 2



Getting the Professional Touch in Home Recording

This article will provide an answer to the numerous questions in the minds of readers regarding home recording. The equipment described here has demonstrated that worth-while recordings can be made at home, even by a novice

By **H. G. Cisin, M.E.**

ALTHOUGH home recording is today considered to be the latest wrinkle, the idea itself is almost as old as the phonograph. In the days of the wax cylinder graphophone it was great sport to put on a blank cylinder, shout into the big, flaring horn and then listen to a squeaky caricature of your own voice. This fad lasted only long enough for the novelty to wear off, mainly because of the fact that the reproduction was inadequate and unnatural.

Today, however, it is possible to apply real power in home recording, due to the developments in recorders and audio amplifiers. As a result, professional recording is now possible in the home and hence a new field of entertainment has arrived which is destined to function, not as a fad, but as a permanent adjunct of modern home life. In addition to its entertainment features, home recording also presents numerous important instructive and useful possibilities.

At parties, the home recorder creates intense interest and amusement. Music and voice when "played back" are true to life and it is possible to recognize the pitch and timbre of a friend's voice, just as one would recognize his features on a photograph.

When a world-famous opera singer is scheduled to perform on the radio, it is a simple matter to record the rendition at home permanently, and thereafter to listen to the reproduction as many times as one pleases. In the same way, the history-making radio speeches of President, Pope or King may be recorded and preserved for all time.

Many other uses for home recording suggest themselves. A record can be mailed across the continent with a message to dear ones, conveyed in a personal way, with all the appeal and power of the spoken word. Birthday wishes, wedding congratulations, anniversary and holiday greetings, all can be sent effectively by records made at home.

In the field of utility, it is possible to practice a speech, perfect a language or a music lesson and in similar ways benefit through the use of home recording. Musicians, speakers, actors and teachers will find that home recording offers an ideal means of hearing themselves as others hear them.

The actual record making is greatly simplified through the use of a complete outfit, such as the Presto Record Maker. This particular one is a compact instrument, consisting of a recording head and feed mechanism, an electromagnetic pick-up, a booster audio stage employing a –27 type tube, a volume control, adapter plugs for connecting the recorder to the radio set, a one-button microphone, a microphone transformer, a microphone energizing dry cell, a powerful electric phonograph motor with speed control, a turntable, selector switch, and a radio-phonograph switch—all contained within a portable leatherette case.

This record maker is designed to use smooth metal discs, 6″, 8″, 10″, or 12″ in diameter. It cuts its own grooves as it records, assuring an accurate and a lasting record. This outfit is also used to convert the radio receiver into a modern electric phonograph, capable of playing all standard records.

The Presto Record Maker is shown in the accompanying illustration. It may be used in conjunction with any radio set employing either a single –45 type power output tube, two –45 tubes in push-pull, a single –50, or two –50's. Due to the use of the auxiliary booster

A portable unit which contains all equipment needed, in conjunction with a modern radio receiver, to record either radio programs or voice at home

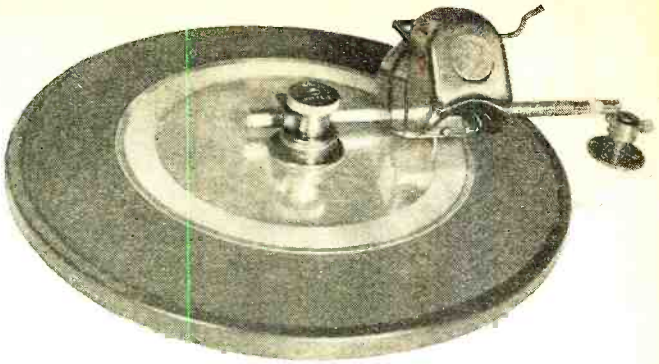
stage, adequate audio amplification for recording is pre-assured.

The method of operating this device is extremely simple and once it is connected to the radio set it need not be disturbed. In sets which have no provision for an electric phonograph pick-up, a five-prong adapter is plugged into the detector socket and the detector tube is then inserted into the top of this adapter. A novel feature of the adapter design is the use of a split "plate" connection, whereby it is possible to change from radio reception to "phono" play-back merely by flipping a toggle switch. In addition to connecting up the adapter, it is necessary to make a ground connection to a marked pin jack, on the panel of the recorder. Then a wafer adapter is connected beneath each of the –45 type tubes to make the plate connections, or if the set utilizes a single –45 tube, one adapter is placed beneath this tube, while the other is connected to the dynamic speaker voice coil transformer primary.

In the case of radio sets equipped with jacks for phono pick-up, the detector adapter is unnecessary and connections are made by means of flexible cords between the set jacks and two jacks provided on the record maker.

Having made these connections, the cord leading from the phonograph motor is plugged into a 110-volt, 60-cycle source and the outfit is ready for operation. For voice recording, the recording disc is placed on the turntable and the feed mechanism is fastened at the center of the turntable. The selector switch is thrown to the "Mic" position and the single-pole, double-throw toggle switch is thrown to the "Phono" side. The set is turned "on" in the usual way and the single-button hand microphone which comes with the recorder is plugged into the pin jacks provided for it. The microphone "on" switch is pressed and a preliminary test is made by talking into the "mike" and listening to the reproduction from the radio speaker. The volume should be adjusted if necessary, by means of the 250,000-ohm volume control on the recorder.

The phonograph motor switch is then closed and the motor is speeded up to about "82." The recording head is next placed on the threaded rod so that the threads sink into and grip the leather V-way. The recording head should be placed at such a point on the rod that the recording needle will touch the disc at about ⅛" from the periphery of the latter. The recording is then started by talking into the microphone. In recording a radio program, the microphone is switched "off," and the selector switch is turned to "Radio Rec." The loud speaker is left in the circuit during the recording.



If one already has a good phonograph, a recording head and automatic feed attachment can be easily installed as shown here

At the left this equipment is shown installed in a modern radio-phonograph combination

To play back the recorded records, the selector switch is turned to "Phono" and the toggle switch is also thrown to "Phono." The recording head is lifted off the threaded rod and the pick-up is put in position at the outer edge of the record. In playing back, the motor is slowed down to about 78. The identical position of the switches is also used in playing standard records—that is, in using the device to convert the set into an electric phonograph. To use the radio set for ordinary radio reception simply throw the toggle switch from "Phono" to "Radio" and tune the set in the usual way.

The picture wiring diagram shown in Figure 3 illustrates the wiring within the Presto Record Maker. The pick-up used has an impedance of 4200 ohms. This is the value of the recorder impedance also. The transformer primary is designed to match the impedance of the pick-up. The secondary impedance is 100,000 ohms. The control switch is of a unique design, closing two circuits at each position. The pin jacks shown at the upper right are for connection to the phono jacks of the radio set, while the two jacks at the lower right are for connecting in the microphone. The connections as shown are for a single-button microphone, although these can be altered readily to take care of a two-button "mike." Although this wiring diagram looks somewhat complicated, all this work is concealed beneath the turntable, and since the wiring is completed at the factory, all the user has to do is to throw the switches according to the simple directions given.

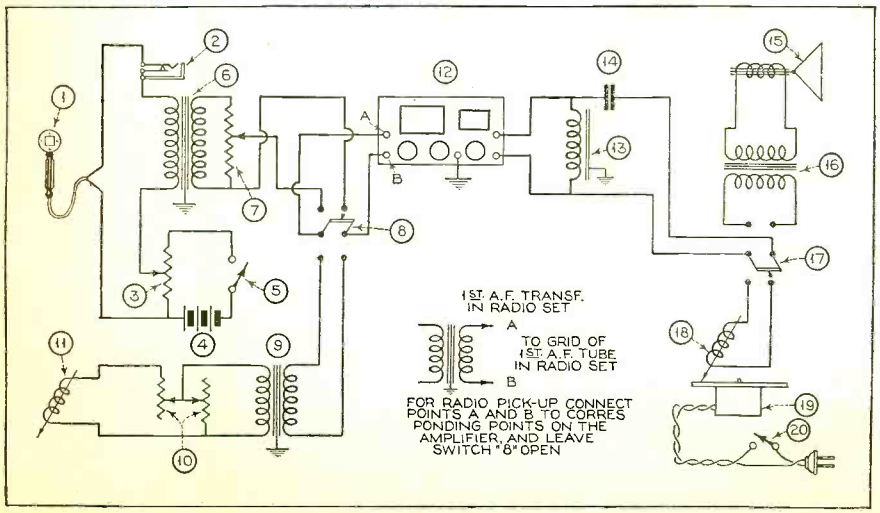


Figure 2. The circuit diagram of the complete installation shown in the photo at the head of this article

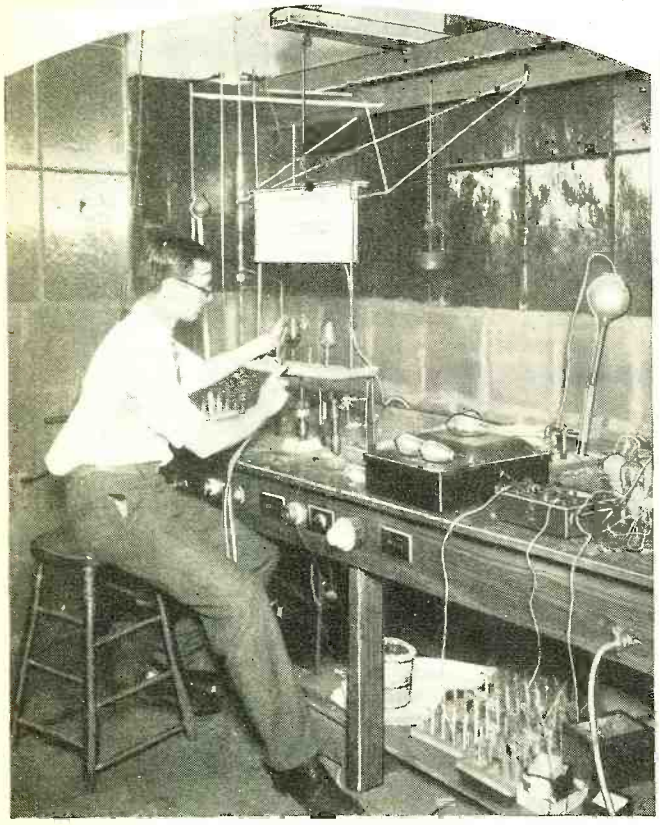
In certain instances it is desirable to employ a separate amplifier for actuating the recorder and for playing back. For example, the radio set may not be powerful enough for recording purposes. Many of the old-style radio sets depend on large amounts of incoming r.f. signal energy to give sufficient audio-frequency response. In such cases, the separate amplifier will be necessary for recording and, furthermore, its use will bring the old receiver up to date by making available a modern audio system. Many radio men have received requests for recording outfits for use in theatre lobbies, at amusement resorts, at charity bazaars, fairs, etc., and for such purposes, also, a separate amplifier is highly desirable.

The writer has spent a considerable amount of time in experimenting with various types of amplifiers for such recording and has (*Continued on page* 93)

The Chemist's Rôle in RADIO

Most of us think of radio problems as nuts for the electrical or radio engineers to crack. But chemistry is playing a surprisingly important part behind the scenes in radio development, as this article discloses

By Austin Lescarboura



Gaseous rectifiers are developed in the chemical laboratory at the hands of skilled chemists, aided by expert glassblowers. Complete pumping equipment, tanks with different gases, electrical testing instruments and other apparatus aid the designer of such devices in carrying out the work. In almost every branch of radio the unassuming chemical laboratory plays a vital rôle

There are ten thousand different grades of paper available for loud speaker diaphragms, complicating the manufacturer's problems. Here is Burtex, an impregnated cloth cone, which is a triumph of the chemist

IT may seem a far cry from the wonderful reproduction of a radio program in the delightful atmosphere of the modern living-room to the test tubes and beakers and vile smells of the chemical laboratory. Yet the two are closely knitted together as the practical basis of the present radio industry.

At every turn in the design and production of radio equipment there are chemical problems to be solved. In fact, the chemist today plays an ever-increasing rôle in the production of radio sets, accessories and parts, so that the larger radio manufacturing organizations are just as insistent on having the necessary chemical direction in their efforts as they are on having the best electrical and radio talent. From the radio vacuum tubes, based on electronic emission from specially coated filament wires, to impregnating compounds for condensers and sealed-in assemblies, and again to short-wave transmitters with extremely high-frequency conductors to be insulated, the chemist is called upon at every turn to pass judgment on the chemical aspects of the case. And so radio is a chemist's field, just as it is that of the electrical engineer, mechanical engineer, metallurgist and other technicians, quite in addition to being the supposed exclusive field of the radio engineer.

Perhaps the greatest work of the chemist in the field of radio is in connection with insulating problems. Here we are dealing not altogether with high potentials, which necessitate considerable electrical strength for the insulators in the case of transmitting practice, but also with radio-frequency losses that come about in radio receivers handling weak radio-frequency energy, and particularly in short-wave transmitters handling powerful radio-frequency energy.

Originally, hard rubber was the favorite material for radio insulation purposes. In recent years, however, the trend has been away from hard rubber, as chemists have found new materials. Bakelite, as well as other synthetic resinous compounds, has played a very important rôle in radio, and there is more bakelite being used in radio today than any other insulating material. Here the chemists have sought to produce various grades and kinds of bakelite, to meet specific requirements ranging all the way from simple mechanical considerations, perhaps involving beautiful moulding, to certain high-frequency insulation problems.

Interesting developments have been made in the field of synthetic ceramics, or ceramics made of pure chemical ingredients, mixed under laboratory supervision. Such new materials as Isolantite and Crolite have played a very important rôle in radio—in fact, they may be said to be essentially radio materials, since in no other electrical applications are their excellent insulating properties so fully appreciated. Chemists, specializing in these materials, have been able to develop all manner of special materials, differing slightly one from the other, so as to meet specific requirements. Thus in the case of high-frequency circuits, the aim has been to reduce the phase angle difference to a minimum, even exceeding that of hard rubber heretofore considered the standard of excellence. In the case of transmitting tubes, the aim has been to produce a material capable of withstanding severe heat with maximum insulation, together with the severe shock of rapid heating and cooling.

Both Isolantite and Crolite have their origin in a fine powder which is treated with a gas catalyst and pressed into various forms. These may be billets, which are machined to final shape in subsequent operations; extruded rods and tubes, which are cut to length and machined if necessary; and flat slabs or sheets. The roughly formed parts are dried, and then placed

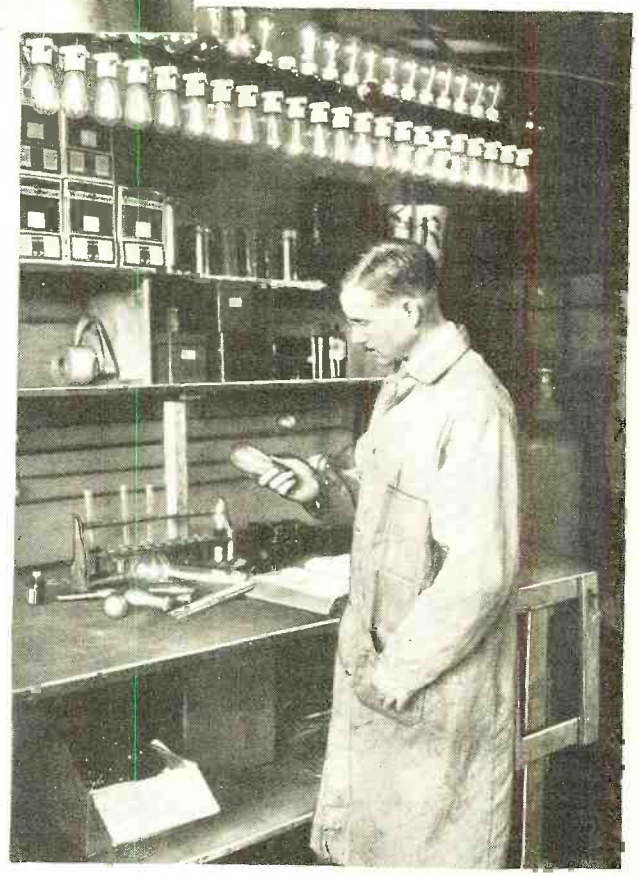
Huge impregnating vats employed in the production of paper condensers, one of the many contributions of the chemical laboratory in condenser manufacture. At the right is C. G. Smith, inventor of the Raytheon gaseous rectifier and an outstanding authority in the field of gaseous conduction and rectification. He has specialized in gaseous phenomena for many years

Did YOU Ever Stop to Think?

¶That the chemist has had almost as much to do with perfection of the radio as has the electrical and radio engineer?

¶That every single new development requires some contribution from the chemical laboratory?

¶That without the chemist's contribution of improved materials the vacuum tube would be little beyond the state of development it had attained in 1910?



in saggers and fired in a gas-heated furnace. After firing the parts are rock-hard, with remarkable mechanical, thermal, electrical and chemical properties.

Imagine an insulator which can be heated to incandescence, plunged into cold oil or water, again heated and plunged, over and over again many dozen times, without developing cracks or breaks. That is one of the achievements of the chemists working on these radio insulating materials. Imagine, if you will, a minute tube, about the size of an automatic pencil lead, containing two tiny parallel holes, 1½ thousands of an inch in diameter! That is what these chemists have produced for the heater type vacuum tube.

Special forms of glass have been developed, with remarkable insulating properties particularly at the higher frequencies. Pyrex has found many important applications in radio. Many of the short-wave antennas used in transoceanic radio work are Pyrex-insulated.

The extremely high frequencies used in very short-wave radio have caused no end of research into better insulating materials. Certain compounds of mica and binders have been developed, such as Micalex, which have proved excellent for the purpose.

There are still endless insulation problems in radio. Aside from those already mentioned, many skilled chemists are engaged in developing suitable enamel insulation for wire ranging from No. 14, which is fairly heavy, down to wire half the diameter of human hair. There are many problems involved in good enamel insulation, not only electrical strength but also ready application; flexibility, so as not to crack when bent, and so on.

Impregnating Compounds

Closely allied to insulating problems are the impregnating compounds. These serve to insulate, but must possess additional features such as sufficiently low melting point, so as not to heat the embedded components unduly; freedom from chemical action with the imbedded components; sufficient mechanical strength, permanency and so on.

The story is told in the radio industry how a certain form of superheterodyne assembly, representing the very heart of a remarkable radio receiver, had to be virtually embalmed in impregnating compound as protection against position displacement, moisture and so on. The task seemed simple enough to manufacturers accustomed to impregnating electrical windings. Hence the same treatment was given to the superheterodyne assembly, known as the "catacomb" because of the maze of wires. However, for some unknown reason, the catacombs did not stand up. They "went bad" in short order.

A chemist was set to work, and he soon discovered certain chemical action between the compound and certain metal parts imbedded therein. Because the impregnating compound was ideal in every other respect, the chemist worked out the solution in the form of a certain lacquer protective coating for the metal parts causing the trouble. The catacombs thereafter were entirely satisfactory.

Much audio transformer trouble has been traced to impregnating compounds. The wire in the secondary winding of the usual audio transformer is exceedingly fine and it does not take much corrosion to destroy the winding. Hence the chemist has been enlisted in this work, so as to provide transformers that really last.

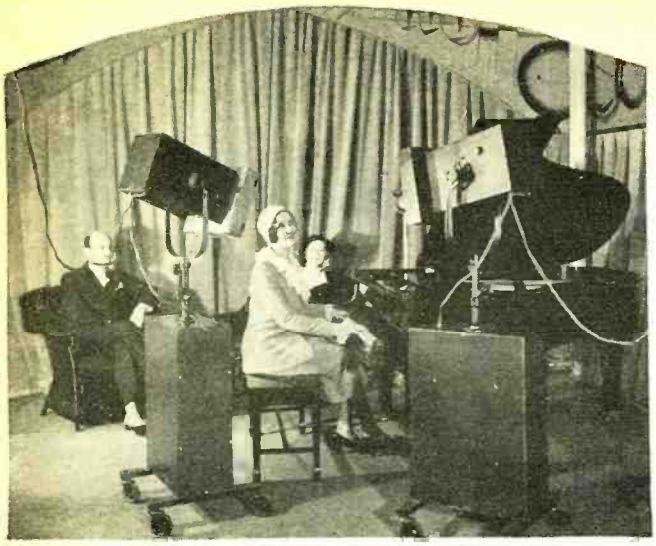
A Study in Rare Alloys

Much of the present-day radio work falls in the class of metallurgy, which is perhaps just (*Continued on page* 78)

New York

Television stepped out of the purely when television station W2XCR New York City for the synchronized on a regular daily

By D. E.



Interior of the New York studio of W2XCR of the Jenkins Television Corporation, with sound channel over the General Broadcasting Company's station WGBS, showing method of "picking up" pianist by means of photo cell banks and "flying spot" scanner

THE question has been asked of me, "How long will it be before we are able to receive television pictures in the home?" That question does not require considerable thought for answering, as a matter of fact it is today possible with apparatus available for the average layman to actually receive sight and sound programs within the confines of his home.

Those of us who have devoted ourselves to television for the past several years have seen the day-by-day progress of the science. So, although the novice may consider the present status but the beginning, I can assure them that present reality was a mere dream not so long ago. Last April we considered television sufficiently advanced to open the first television station ever operated on a regular schedule in New York City, transmitting sight simultaneously with sound signals, the visual transmission being done on television channels and the aural accompaniment on regular broadcasting frequencies.

The Federal Radio Commission has set aside a channel for television broadcasting, the 100-150 meter band. This permits both the experimentation which will lead to perfection and also, through the efforts of such stations as W2XCR in broadcasting programs of real entertainment value, will lead to the popularization of television, the acquisition of an audience, which will in time make television commercially extremely valuable. When that time comes I think we can count on the Federal Radio Commission granting commercial licenses to television broadcasters.

While the Federal Radio Commission has not yet granted authority to operate television stations on a commercial basis, at present we operate on experimental licenses.

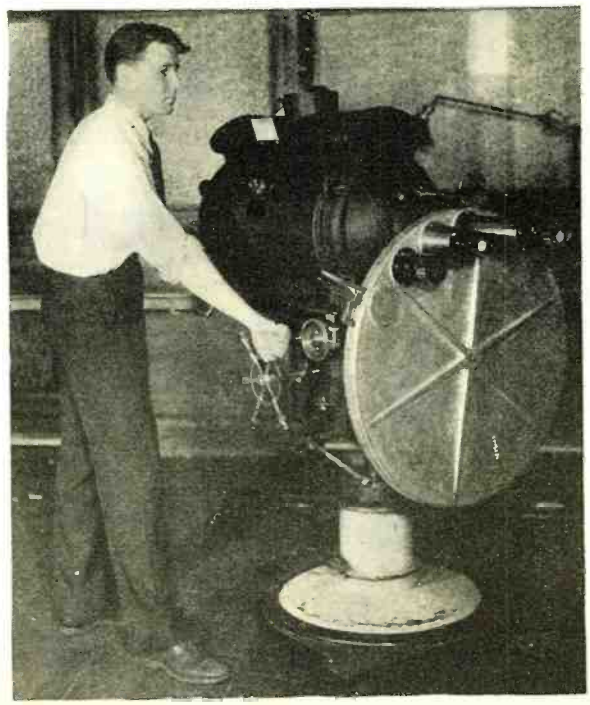
Under this arrangement the cost of television broadcasting is defrayed by the experimenters themselves, and consequently, inasmuch as considerable funds are necessary to carry on the development work, the amounts available for programs are somewhat limited. When television stations are established commercially, it will be possible for them to sell time on the air, just as sound broadcasting stations do today. They will have sufficient funds available not only to spend considerably more on the presentation of programs, but have an added source of income to devote to the refinement of technical television.

Television might be said definitely to have been offered for public acceptance last April, when the first radio talking picture studios were inaugurated in New York City. These studios virtually represent my original conception of television when I first began experimentation a number of years ago.

The studios of which I speak are located at 655 Fifth Avenue. Studios, control room, transmitter and reception room, comprising the New York radiovision headquarters of the Jenkins Television Corporation, are housed in several rooms on the sixth and fourth floors of the building, while station WGBS of the General Broadcasting System, located at Astoria, L. I., provides the very essential synchronized sound channel.

The radiovision studios on the sixth floor are a peculiar cross between a broadcasting studio and a motion-picture projection booth, for the reason that both direct pick-up of living subjects and pick-up of film subjects are employed in providing an entertaining program.

The direct pick-up is in the form of the well-known "flying spot." The subject poses before the projector that illuminates it with a sweeping beam of light, for the process known as scanning. The varying reflection of that beam of light by the subject on which it falls serves to actuate a battery of photo-electric cells, which in turn translate the varying light intensities into electrical impulses. By means of several stages of distortionless amplification, the electrical variations are impressed on the powerful radio waves propagated by the television transmitter in the same building. Meanwhile, a microphone placed near the subject picks up the voice or other sound for transmission over the WGBS transmitter. The flying spot apparatus employed in these studios is of the latest type, with a choice of several lenses, permitting close-ups and long shots of the performer without changing the relative positions of the projector on the subject.



Direct pick-up television camera of the Jenkins station. Three of the possible five lenses are mounted on the scanning disc housing, the desired lens being moved into position by the handle on the outer rim of the housing. The entire camera may be moved vertically by means of the foot pedal on the base. The operator is holding the wheel which tilts the camera vertically

The film pick-up apparatus is not unlike the usual motion-picture projector, except that the continuously moving film is projected onto a scanning disc behind which is placed a photo-electric cell. The film may be accompanied by synchronized sound records if desired or by unsynchronized records for incidental music, the sound being transmitted via the sound channel.

The control room adjoining

*Vice President, Jenkins Television Corp.

Looks-In

experimental stage early in April opened its special television studios in broadcasting of radio talking movies program basis

Replogle*

the studios contains a large switchboard with a variety of switches, lights, meters and monitors for the complete control of the sight and the sound channels. The operators not only monitor the sound pick-up, maintaining the desired level, but also monitor the direct or film sight pick-up by following the pictures through the monitor televisor that forms part of the switchboard equipment. Through the glass windows of the control room the operators may observe the artists before the flying spot and microphone, signalling any necessary changes in placement.

The 5,000-watt Jenkins television transmitter is located two floors below the studios, yet sufficiently near to minimize the length of conductors between pick-up and transmitting equipment. The transmitter is licensed for operation on 2050 kilocycles, or approximately 147.5 meters. The television transmitter is connected with its antenna on the roof by means of a radio-frequency transmission line. The transmitter, provided with a five-kilowatt water-cooled DeForest tube for the final or output stage, is of special design to handle the extraordinarily wide range of frequencies required for satisfactory pictorial detail. Station WGBS, on the other hand, operates on 1180 kilocycles or 254 meters, so that signals may be tuned in by the usual broadcast receiver.

The new studios were opened with an inaugural program on April 26th. Every day thereafter, morning, afternoon and evening, television features have been on the air. Elaborate plans are being developed so that the growing audience of lookers and listeners-in may be provided with an endless flow of entertaining programs, through the television transmitter W2XCR and the regular broadcast transmitter WGBS, which will operate jointly during several hours each day in providing radio talkies.

This is another scene taken in the interior of the Jenkins studio in New York, showing the WGBS "mike" picking up the voice, and, at right and left, the banks of photo cells for image pick-up

In order to receive the sight and sound broadcasts it is necessary to have a receiving set for tuning in the television signals as well as the standard broadcast receiver for reproducing the sound accompaniment. Special receiving sets have been designed for this purpose and consist of a sensitive radio-frequency tuner which operates on the television wave-band, and an audio-amplifier designed especially to reproduce the wide band of frequencies necessary to obtain a clear image.

In addition to this receiving set, it is necessary to have a simple scanning disc and neon tube for reproducing the images in the receiving aperture. The neon tube is connected directly in the output of the short-wave receiving set. The scanning disc consists of a motor-driven disc containing holes drilled concentrically in a spiral about the outer edge. When this disc is rotated at the receiving set in synchronism with a similar disc at the transmitting station, it reconstructs the image being transmitted. A magnifying lens enlarges the image.

To understand the operation of the television receiver, it is necessary to know something of how images are prepared for transmission by television. As stated in a previous paragraph, the radio talkie studio is not unlike the usual broadcasting studio with draperies and other acoustic treatment. However, in addition to microphones,

(*Cont'd on page* 89)

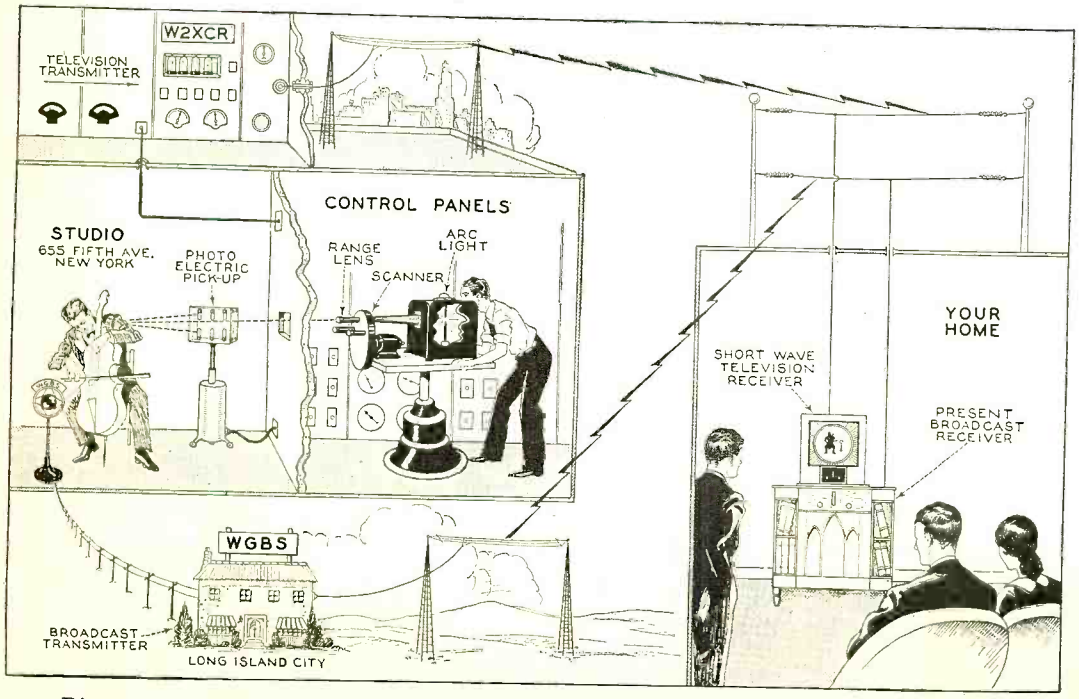


Diagram layout of W2XCR, showing how it is linked with the broadcast transmitter, WGBS

The New *Multi-Mu* Tube

What It Is and What It Does

This new type tube marks a distinct step forward in radio progress, as demonstrated by experiments conducted by the author and described in this article

By Everett S. Wright, M.E.

WHEN the screen-grid tube was introduced it was hailed by experimenters and receiver manufacturers as a boon to the radio industry. It not only provided for tremendously increased radio-frequency amplification, but also permitted better methods of volume control. Moreover, it provided the incentive for improved circuit design and more careful attention to shielding. The total result has been that the present-day receiver is far more sensitive and more stable in operation than receivers of three or four years ago.

But receiver development has disclosed certain inherent faults in the -24. The most important of these have been the cross talk and modulation distortion on powerful signals, resulting from the high amplification provided by these tubes. Tube manufacturers have been working for some time on the development of a new type of screen-grid tube which would provide all of the advantages of the -24 type without these disadvantages. This research work has borne fruit in the form of the new multi-mu tube which has been placed on the market by a number of tube manufacturers.

At the time of this writing the preliminary information sheets issued by the various manufacturers show that their tubes are alike in their fundamental characteristics although differing slightly in some details. By the time this article appears in print, however, it is highly probable that further developments will have resulted in more complete standardization so far as the electrical characteristics of the tubes are concerned. For the information of readers a tabulation given below represents the standard adopted by some manufacturers. The outstanding exception is found in the Arcturus type 551 and the De Forest type 451 multi-mu tubes, which call for a plate voltage of 180 volts with a resulting plate current of 5.5 mils. Characteristics on these and others are shown in "What's New at the Trade Show."

Rating	
Heater voltage	2.5 volts
Heater current	1.75 amps.
Plate voltage	250 volts
Screen-grid voltage (maximum)	90 volts
Control grid voltage	— 3 volts

Preliminary Characteristics	
Plate voltage	250 volts
Screen-grid voltage	90 volts
Control-grid voltage	— 3 to — 50 volts
Amplification factor	370
Plate resistance	350,000 ohms
Mutual conductance (E_{cg} = — 3)	1050 micromhos
Plate current	6.5 ma.
Screen-grid current	Not over 1/3 of plate current

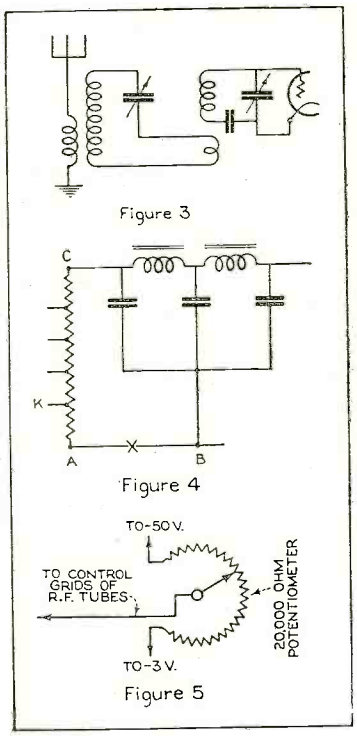


Figure 3. The single pre-selector circuit shown here, used with the new tubes, has been found by the author to provide adequate selectivity. Figure 4. The resistance network of a standard power pack. Additional "C" biasing resistor is connected at X. Figure 5. Method of controlling volume in an amplifier which employs the new multi-mu tubes

The type number generally adopted for this new tube is -35. Some of the individual manufacturers have their own type numbers, such, for instance, as Arcturus, who have designated this tube as their type 551.

The fundamental characteristics of the multi-mu or variable-mu tube is the variation of the transconductance with the grid bias. That is, the tube's amplification is controlled not by varying the screen-grid voltage between 0 and 90 volts, but by varying the control-grid bias ("C" bias) between — 3 and — 50 volts or thereabouts. Maximum volume is attained when the "C" bias is — 3 volts and minimum at — 50 volts.

Figure 1 shows this and indicates that the amplification of the -24 tube fell off sharply when grid bias was increased and became 0 at — 13 volts, while the amplification of the -35 tube diminishes much more gradually and more nearly in proportion to the "C" bias. In receivers employing automatic volume control the range of automatic control is extended by a factor of 20.

Modulation Distortion

Modulation (*Cont'd on page* 76)

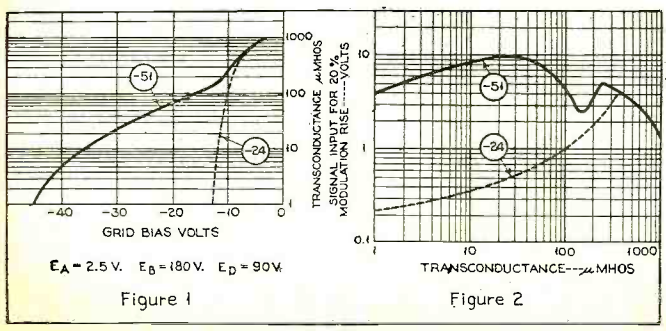


Figure 1. Transconductance of the Arcturus multi-mu tube, plotted against control grid-bias voltage. Figure 2 (right). Shows the modulation distortion limits for the -51 tubes as compared with the type -24

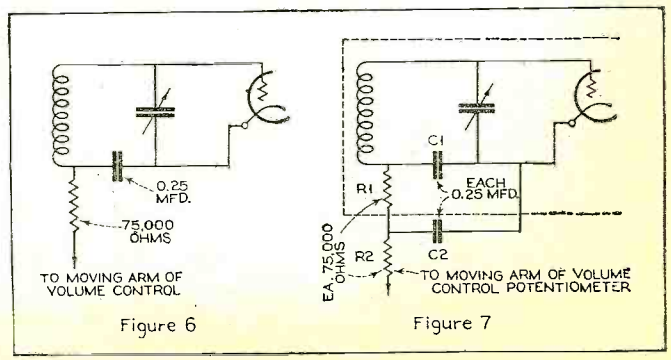


Figure 6. A normal filtering arrangement for grid return of -24 type tubes. Figure 7. The double filtering method recommended by the author for -35 tubes

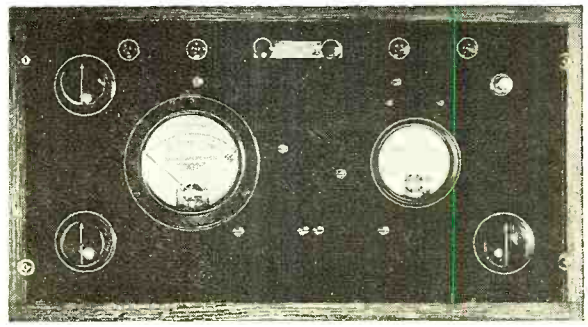
A *Vacuum Tube* Voltmeter *of* Outstanding Merit

A meter which is flexible in range, easy to construct and simple to operate. A "reset" adjustment is included to compensate for aging of the plate battery, thus insuring permanency of calibration

By I. O. Myers*

THE vacuum-tube voltmeter is one of the experimenter's and serviceman's best friends. It offers a means of measuring voltage very nearly independent of the drawbacks of a common galvanometer-type of instrument. It may be made so that its readings are to a high degree free from wave-form error, frequency error and power loss.

The theory of the vacuum-tube voltmeter has been related so many times that it will not be repeated in detail here. Briefly, let us say that a sensitive ammeter in the plate circuit of a vacuum tube indicates change of plate current for a definite value of applied a.c. grid voltage. The scale of the meter determines one limit of the range of the applied grid voltage. That is, in order to read small changes in plate current, we must use a rather delicate ammeter—a 0–200 microammeter was used in the meter described here. So, unless we have a means of extending the scale, we are limited to a change in plate current of 200 microamperes. Another limitation of the range is the fact that the grid must not go positive, because if this occurs a grid current flows and our meter would draw power. A safe idea is to keep the grid at least one volt more negative than the peak voltage applied to the grid.



Front view of the instrument. The knob at the upper left controls R1; that at the lower left, R2; and at the lower right R3. The reflexing switch is at the upper right

With the idea in mind of making a V. T. voltmeter which was more flexible, simpler in adjustments, and more stable, a hook-up was constructed using the circuit in Figure 1. The tube used is a -01A, but other tubes are also suitable.

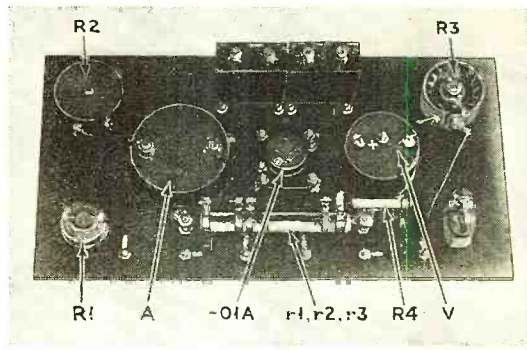
The long resistor at the right composed of r1, r2, and r3 is a wound wire resistor with adjustable bands or taps. It supplies all the various voltages needed except the filament voltage, which comes from a six-volt storage battery and is controlled by R3, an ordinary 15 ohm filament rheostat. The lower end of the wound resistor is connected to the negative of 90 volts of B battery, and a small current flows through the resistor. The drop across the section marked r3 gives the necessary negative grid bias. The drop across r2 gives us our plate voltage. Now, in order to set our plate meter to zero, we must force a current through it equal and opposite to the plate current which flows when no voltage is being measured. This is accomplished by means of the drop across r1, and is adjusted by R2.

In order to provide a low and high range, the resistor R4 is placed in the circuit between the plate and filament. It is shunted by a switch so that it may be shorted for the low range. When the switch is open, all the plate current flows through R4, thus increasing the grid bias as the plate current increases. The resistor also causes a drop in plate voltage proportional to the plate current, so that the calibration curve becomes very near linear. When using the vacuum-tube voltmeter, with the switch open, we have what is known as the reflex type.

The purpose of R1 is to adjust values of plate and grid voltages to the same point each time the meter is used. This will be explained later in the discussion.

The setting of the plate voltage, grid voltage and reset voltage, is determined by the range which we expect to measure. In the hook-up described here, the plate voltage was 57 volts, and the grid voltage was 6 volts negative. The reset voltage is not important—it merely being enough to cause about 200 microamperes to flow through the plate meter. The plate voltage was adjusted in the following manner:

(*Continued on page* 81)



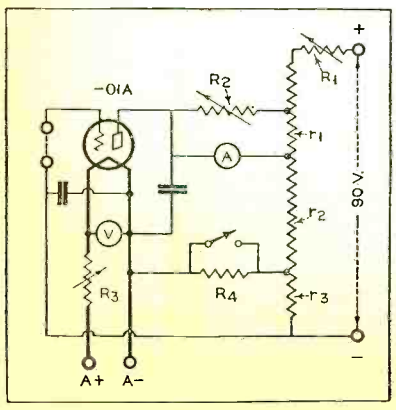
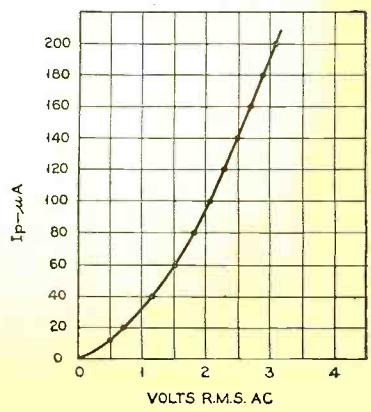


Figure 1. The circuit shown at the left is employed in this vacuum tube voltmeter

Above is the interior view showing the locations of all parts

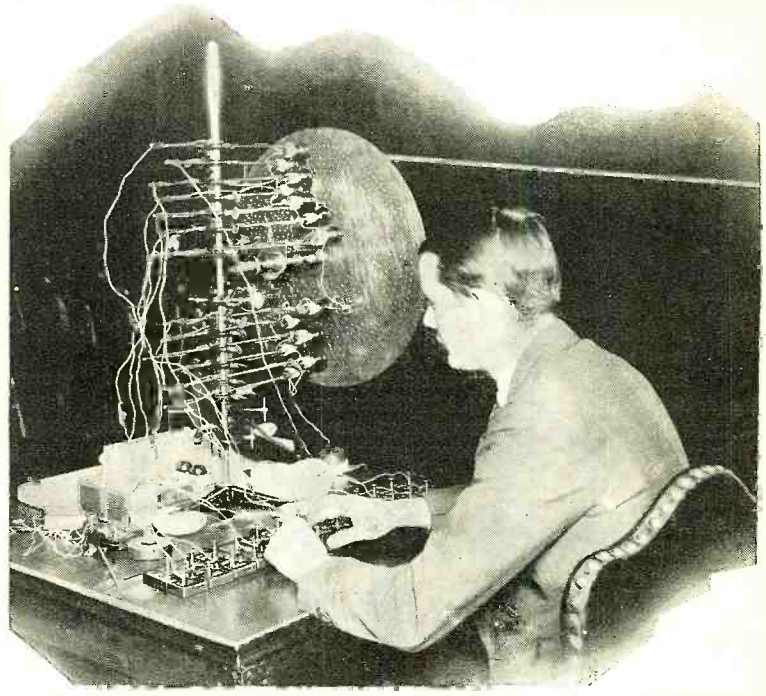
At the right is the calibration curve for low range



* Instructor, Physics Dept., West Virginia University.

The Electrical FUTURE

WHEN historians of science come to assay in future centuries the contributions of radio to civilization it is not improbable that one of the chief items to radio's credit will be that it brought together the art of music and the science of sound. There have been in every generation a few outstanding physicists who have been also musicians, like Professor Dayton C. Miller, who is an accomplished expert on the flute, Professor Vladimir Karapetoff, who is a distinguished pianist, or Dr. William Braid White, who adds to his wide competence in physical science an equal experience in musical criticism. But such men, in general, make of music merely their avocation. It is the service of radio science that it has brought professional physics and music together.

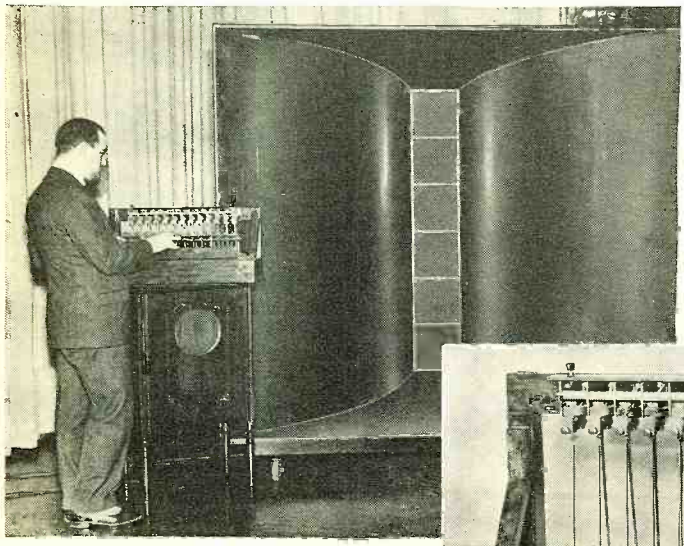


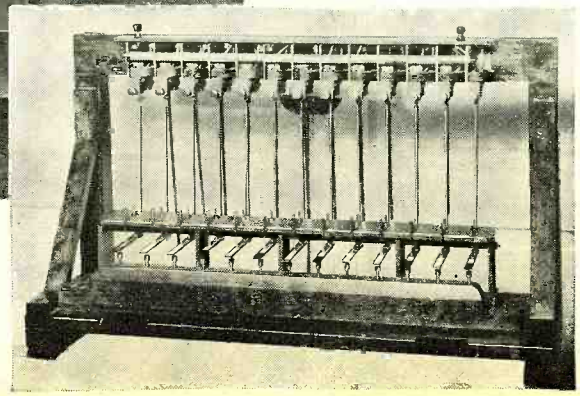
One new instrument is the photo-electric organ, devised in the E. E. Free Laboratories. The keys light small lamps which shine through the holes in the rotating disc

Union of Music and Science

The talking motion picture and the electric phonograph are outstanding examples of how this union of music and science is going on at the moment. Even more intimate relations are in prospect, as no unbiased observer can doubt, through the perfection of the many types of electrical musical instrument which now are under development in more than a score of laboratories all over the world. Even the radio engineer and in some degree the radio listener not interested in engineering have been forced by their interests in this subject to learn much more concerning the physical basis of music than was known even to professional musicians a generation ago.

Most of our modern knowledge of this physical basis of music rests upon the pioneer investigations of the famous German physicist, Professor Hermann Ludwig Ferdinand von Helmholtz, the same who developed the well-known Helmholtz resonators for sound analysis, who made good use of the manometric flame as another analytic device and who presented for the first time on something approaching a firm foundation the theory of how the human ear detects the difference between different sounds. Based upon von Helmholtz's researches, a single musical tone or similar sound usually is said to possess three separable physical characteristics. First is pitch, representing merely the number of vibrations a second. Second is loudness or amplitude, which represents in physical terms the amount of pressure created by the sound wave on the ear drum or any other detecting device. In modern visual pictures of sound waves, like those produced by an oscillograph, loudness is represented by the amplitude of the curve above and below its median line.





Dr. Alfred N. Goldsmith, of the Radio Corporation of America, demonstrating to the New York Electrical Society his electric carillon, shown at the right. Small hammers set steel bars into vibration, the tones being picked up magnetically and amplified

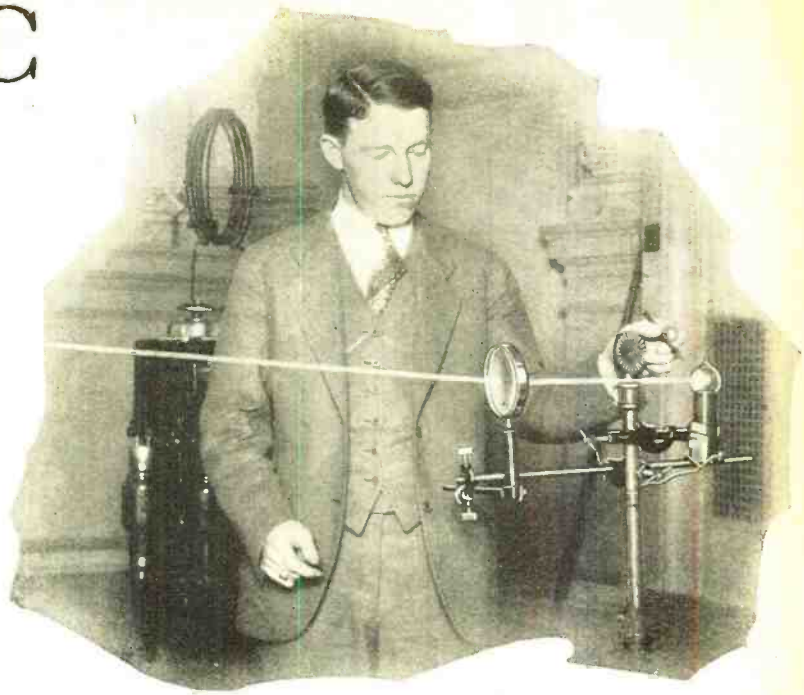
The third of the von Helmholtz characteristics of musical tones is quality, and it is about this that there have raged, these past few decades, the most violent arguments. What the musical physicist calls quality in an individual tone is related to what the radio fan means by the same word applied to the perfection of broadcasting or of reproduction, but it is not quite the same. By radio quality one means such tone character as correctly represents to the listener's ear what the same listener would hear were he actually present in the broadcasting studio. What the musician means by tone quality is really nothing but the physical composition of sound.

Very few musical sounds, if any of them, consist of one pitch only. In radio laboratories and elsewhere physicists manufacture for testing purposes what are called "pure frequencies" or "pure sine waves." This means merely that only one series of sound impulses exists, that these impulses follow each other with perfect regularity at a definite frequency, and that the alternation of sound energy back and forth between the extremes of the vibration follows the law of simple harmonic motion, which law is represented by the familiar sine curve. For physical purposes all this is

of MUSIC

Fewer than one hundred distinct musical instruments have been invented in all human history—until electricity entered the field. Now there are dozens of new ones, with more to come

By E. E. Free, Ph.D.*



The receiving end of the photo-electric organ. Interrupted light rays from the rotating disc at the left enter the photo-electric cell and are converted into musical tones

quite important. In music it is negligible. What it would make is a tone of a single pitch only, without any other variation whatsoever. Musicians are unanimous that such tones, when laboriously produced by physical apparatus, are "thin," "uninteresting" and generally unpleasing for musical purposes.

When a great violinist plays, for example, the tone of A on his violin he produces, as the chief of the sounds emitted, a vibration in the neighborhood of 400 cycles a second. However, the characteristics of the vibrating string and of the sound box of the violin are such that the emitted tone contains, in addition, a large number of other frequencies or pitches. These are variously called harmonics, overtones, and so on. They are represented on an oscillograph curve by relatively small ripples superposed on the simple sine curve which would represent a pure tone at the pitch selected. It is these accessory tones, whatever they may be, which determine the audible differences, for example, between the note A played on a violin, on a piano, on a trombone, on the human voice or on any other musical instrument. This it is that determines, Helmholtz and many other investigators have established, what the musician calls the quality of the tone.

All this would be much easier to understand were it possible to oust altogether from the science of music all such terms as "quality," "timbre" and the like, substituting for these metaphorical expressions a word which represents the simple truth. That word would be *composition*. Actually, every characteristic of any musical sound may be represented by this one word.

*E. E. Free Laboratories, Inc.

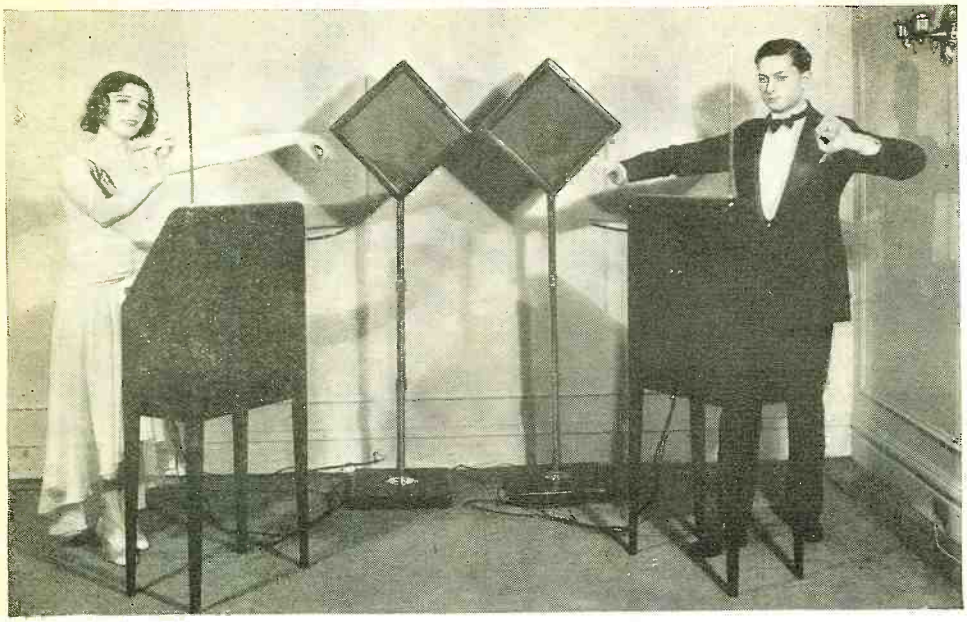
What is the composition of the sound? An analysis of this composition would consist, of course, of the familiar "frequency spectrogram"; that is, a curve which has pitch or frequency for its horizontal axis and which represents on its vertical axis the amount of energy on each frequency which is present in the tone. This is entirely analogous, of course, to the familiar color spectograms of the science of optics. Vastly more progress would be made both in music and in the science of sound if everything else were forgotten and all sound characteristics expressed in this single, simple way. Indeed, vastly greater progress *is* being made in this fashion, for it is now coming to be conventional in acoustic laboratories to represent the characteristics of sounds of all kinds by frequency spectrograms of this sort.

In the case of a violin tone, for example, the frequency spectrogram would indicate a high point at the frequency or pitch corresponding to the chief tone being sounded. Other lesser peaks of the curve would be presented at other frequencies corresponding to the harmonics or other tones, but these terms "harmonics" and so on could well be spared from modern acoustics.

All this nomenclature of "fundamentals," "harmonics" and the rest is an inheritance from the days when the mind of the acoustic expert was fixed primarily upon the character of the vibrating object, like a string or a bell rather than upon the character of the sound wave itself.

Probably it is impossible to wean the science of musical sounds suddenly from its habit of talking about fundamentals and overtones and harmonics. Nor is this necessary. What is necessary is that the modern student of acoustics realize clearly that the thing which really expresses what he wishes to know is the frequency spectrogram and that is an expression of the physical composition of the sound. Musicians, of course, cannot be expected to use the word composition, as this means, for them, a totally different thing. There is no reason, however, why the frequency spectrogram should not be adopted and understood in music just as it is in mechanical acoustics, in the study of city noise or in any other branch of the science of sound. Once

Shown above is an electric organ in the laboratories of the Westinghouse Electric & Manufacturing Company. It is energized by vacuum tubes. Mr. R. C. Hitchcock is seen seated at the console; at his left is the large control panel



The Theremin, an electric musical instrument invented by the Russian physicist of that name, operates by controlled oscillations in a vacuum tube circuit. One hand moves to and from a vertical rod, controlling the pitch of the note. The other hand, moving up and down above the horizontal loop, controls the loudness

this fact is accepted there is an interesting and stimulating analogy between music and another science—that of chemistry. In the science of chemistry all varieties of chemical compounds are thought of as composed of different numbers of atoms of 90 known elements. Water, for example, contains two parts of the element hydrogen and one part of the element oxygen. Hydrogen peroxide is composed of the same two elements but in different proportions—two of hydrogen to two of oxygen. All of the hundreds of thousands of chemical compounds that are known and the uncountable millions of such compounds that are known to be possible are built up in this same way out of definite relative amounts of the 90 definite elements.

In what might be called "musical chemistry" the composition of a musical tone may be thought of similarly as built up out of definite quantities of a definite series of "elements." These musical elements are the individual pitches or frequencies—256 vibrations a second for one C of the piano keyboard, 512 vibrations a second for the C one octave above this, and so on. Just as the composition of water or sugar or common salt or any other chemical compound may be expressed in the percentages of the elemental frequencies contained in it.

Just as is true of the real science of chemistry, so this "musical chemistry" has its two chief branches of analysis and synthesis. The analysis is the drawing of the frequency spectrogram. Within the last few years the art of radio has provided important new methods for this kind of analysis, with unexampled progress in practical acoustics in many fields. Musical synthesis, analogous to synthetic chemistry, includes the numerous recent attempts to put together tones, electrically produced or otherwise, in the various modern varieties of "modern synthetic music" like the music of the photo-electric organ, of the Theremin and of other devices of similar type.

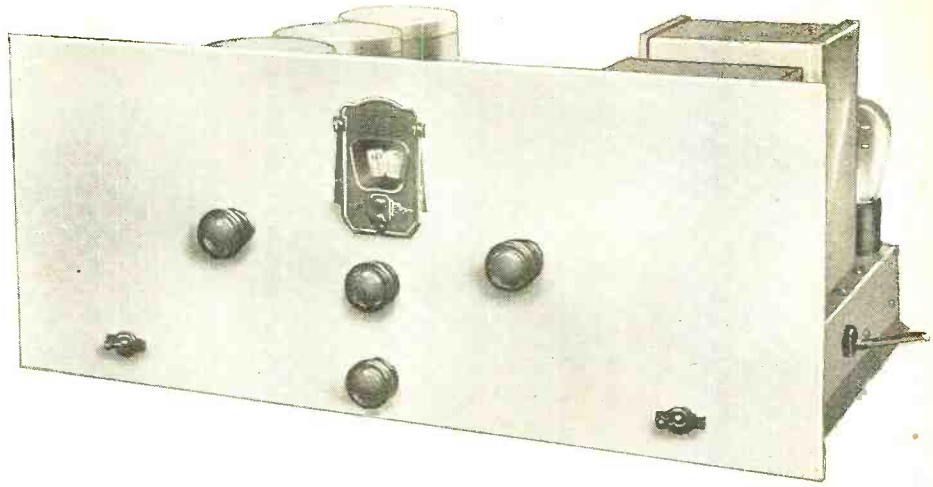
Just as the tool of chemical analysis has been responsible for much understanding of the world around us, so the tool of musical analysis is uncovering the real nature of existing music. And as synthetic chemistry has provided the world with innumerable new and valuable materials, so synthetic music is destined, it may be agreed, to provide the musical world with tones, production and effects previously undreamt of.

In this chemical viewpoint of music each "musical element" resembles each chemical element in being individual and unalterable in nature. That is, each single musical element has its own pitch just as each chemical element has its atomic weight, its internal vibrational characteristics, and so on. One of the two chief practical differences in the two cases is that the "musical elements" differ but slightly from adjacent ones in the series. A tone of 400 cycles per second, for example, may be thought of as shading gradually into the adjacent tones of 399 cycles and 401 cycles. The same is true, it may be remarked in passing, between chemical elements, and one of the important modern discoveries is that there may be many types of a single chemical element, differing slightly from each other, and that these types may grade into each other or even may bridge the gap between two distant elements by steps which are almost insensible. Nevertheless, it remains convenient for the chemist to regard his elements as individual, separable species, and it would be similarly convenient, I am convinced, for us to think of musical frequencies in the same separate fashion.

The actual separation between two "elements" should be fixed, of course, at the approximate discriminating ability of the average human ear. For practical purposes it is sufficient to regard each one-cycle step as an elemental separation. That is, a tone of 399 cycles is one element, a tone of 400 cycles is another, a tone of 401 cycles is a third.

This indicates at once the other important difference between the "musical elements" and the chemical ones. The chemist recognizes but 90 separate elements, with two additional places for elements still unfound, bringing the terrestrial list to a total of 92. The musical physicist must enlarge this number to at least 10,000, one for each one-cycle step from the lowest musical tones approaching one cycle a second to the highest of musical importance, which are something over 10,000 cycles a second. However, since we are less concerned with the detailed use of this viewpoint than we are with the improved understanding which the viewpoint (*Continued on page* 70)

L. M. Cockaday, Editor of RADIO NEWS, playing what is probably the world's only sound-proof piano, constructed so that all the sound of the piano could be picked up by a microphone inside the case for electrical study or loud speaker reproduction



The receiver is especially designed for television reception, but is also a first-class short-wave broadcast receiver

How to Build a Home Television Receiver

This article continues the story of "The Boston Television Party," which appeared in the May issue, with a constructional description of the short-wave television receiver. A constructional article on the televisor unit intended for use with this receiver appeared in the June issue

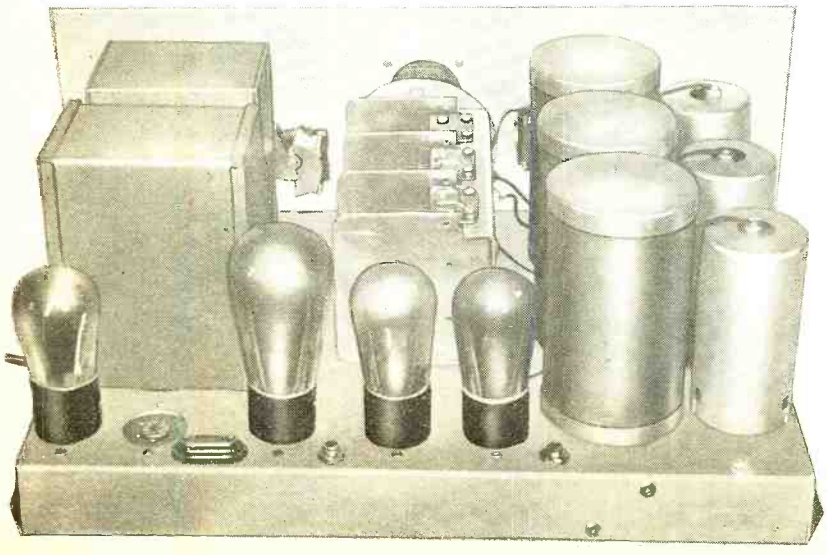
By **Joseph Calcaterra***

AT the present time the frequency band assigned to television program transmission is from 2000 to 2950 kilocycles (approximately 150 to 100 meters).

This means that, in order to receive such programs, a receiver must be employed which is capable of tuning in signals within that range. The average broadcast receiver is designed to cover a frequency range of 550 to 1500 kilocycles (550 to 200 meters) and is therefore not suitable for television reception.

In addition, the characteristics of the television signal require the use of a receiver with audio amplifier circuits capable of providing practically uniform amplification over a range of from 15 to 40,000 cycles as against a range of approximately 35 to 5000 cycles in the usual broadcast receiver. This requires the use of a receiver employing a highly efficient resistance-coupled audio amplifier if distortion is to be avoided.

*Aerovox Wireless Corporation



In appearance and construction the television receiver differs little from a broadcast receiver

The receiver described in this article has been specially designed to give maximum operating efficiency on the frequencies used in television broadcasting. This receiver, however, is not limited to the reception of short-wave television signals. It has been so designed that by simply changing the plug-in coils it becomes a highly efficient receiver covering a wave-band of from 16 to 550 meters, the entire range of short-wave and broadcast transmission.

The receiver is therefore universal in the full sense of the word, permitting short-wave and broadcast reception of musical programs from all parts of the world, in addition to bringing in the television programs.

There are more than 200 stations in the world which broadcast voice programs on short waves. The ones that are heard most consistently throughout the U. S. are located in Winnipeg, Man., Canada; Chelmsford, England; Paris, Berlin, Rome, Mexico City, Buenos Aires; Sydney, Australia; Honduras, and many others.

Radio listeners who have difficulty in getting distant stations on the most sensitive broadcast receivers have a thrill in store for them when they find how easy it is to tune in distant foreign stations with the receiver described in this article.

The schematic wiring diagram of the circuit used in this receiver is shown in Figure 8. It consists of two stages of tuned-radio-frequency amplification using screen-grid a.c. tubes, a screen-grid detector, and three stages of resistance-coupled audio-frequency amplification, with a –45 tube in the power stage. Three stages of low-gain resistance-coupled amplification have been used in preference to a fewer number of high-gain stages in order to keep distortion down to an absolute minimum.

A power transformer is employed to supply the filament voltages for all the tubes of the receiver and for the –45 tube used in the televisor amplifier. A center-tapped high-voltage winding feeds the BH type rectifier of the power unit.

Plug-in coils are employed to cover the range of from 16 to 200 meters. An illustration of the thirteen coils used with the receiver to cover this wide range of wavelengths is shown in Figure 11. The thirteenth coil,

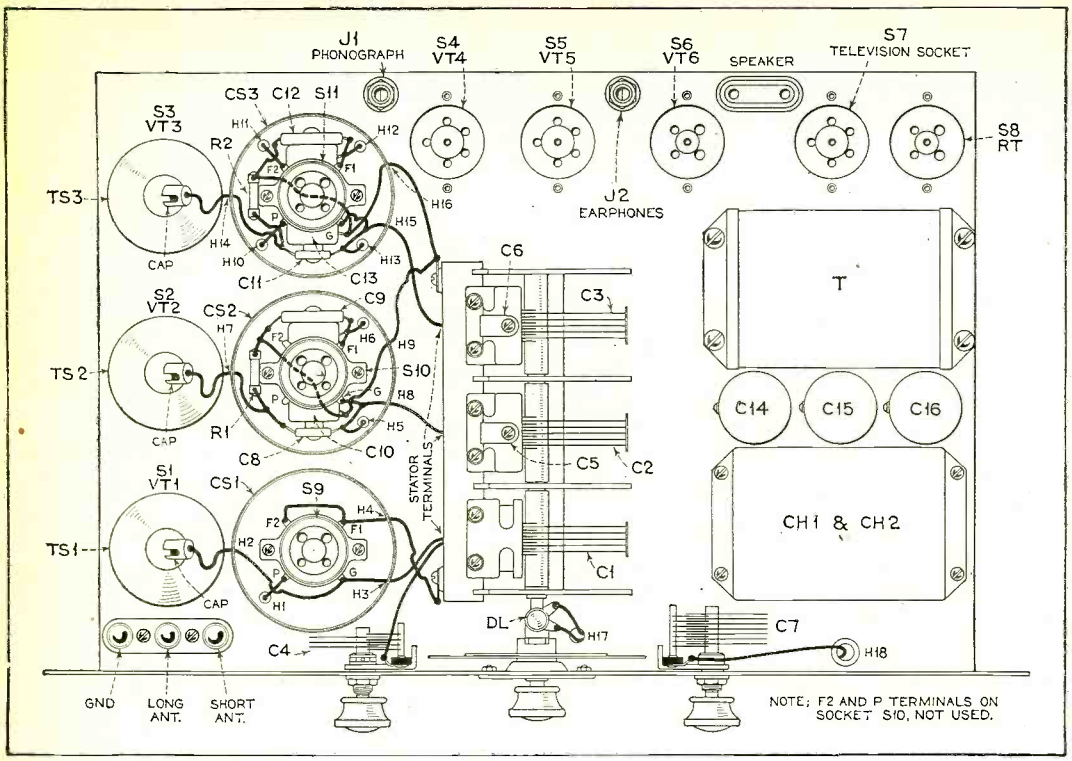


Figure 9. A picture diagram of layout and wiring above chassis

shown in the center, is the coil used in socket S11 of the third r.f. coil assembly when the receiver is used for television reception.

For television reception it is necessary to use a non-regenerative detector. The television coil has only one winding. When it is plugged into socket S11 the regenerative circuit (shown in dotted lines between the plate terminal of the detector socket S3 and the regeneration condenser C7) is opened and the detector becomes non-regenerative.

With switch SW1 open, the detector circuit operates as a power detector (plate circuit rectification). Since this type of rectification damps down the tendency toward regeneration and reduces distortion and overloading in the detector circuit, it should be used when operating the receiver with the television unit.

With switch SW1 closed, the grid bias resistor is shorted out of the circuit and grid circuit rectification takes place. Under such conditions maximum sensitivity is obtained, a desirable feature when tuning in foreign or distant short-wave stations.

A jack, J1, is provided to permit plugging a phonograph pick-up into the input of the audio amplifier. For operation direct into the input of this amplifier a standard pick-up having an impedance of 2000 ohms at 1000 cycles should be employed. If pick-ups having other characteristics are used, a matching transformer will be necessary to couple the pick-up to the input of the amplifier.

Another jack, J2, is used in the output of the second audio-frequency stage to permit the use of earphones for tuning in distant short-wave stations.

Switch SW3 is used to switch the output of the power stage from the speaker to the neon tube circuit, after the signal has been tuned in.

The 5-prong plug of the televisor is plugged into socket S7 of the receiver to establish the necessary connections between the two units.

A potentiometer, P, which permits a variation of the voltage applied to the screen grids of the radio-frequency tubes is used as a volume control. The a.c. switch is mounted on this potentiometer and is operated by the knob which controls the potentiometer.

Mounting the Parts

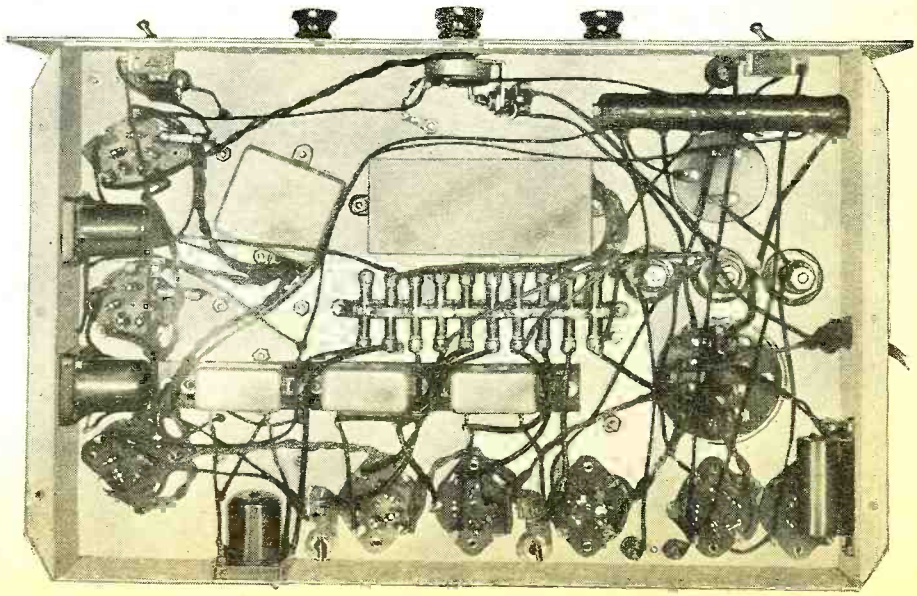
Every detail of the construction of this receiver has been so carefully thought out that the building of the receiver is a very simple matter. When finished, it provides a unit that is as fine in appearance, workmanship and performance as any factory-built receiver.

Every hole necessary to mount a part or bring a connection through the chassis has been punched to simplify assembly.

Sockets S1 to S3 inclusive and the bases of tube shields TS1, TS2 and TS3 are riveted to and furnished as part of the chassis. So also are the bases of the coil shields CS1, CS2 and CS3 and condenser C10 and C13.

The first step in mounting the other parts is to slip three 8/32 screws into the mounting holes of the gang variable condenser, with the heads on the inside of the condenser, and fasten them in place with nuts. The screws will then project outward from the condenser, thus providing three studs which fit into the holes provided for them in the chassis. The condenser can then be fastened on to the chassis with three nuts screwed on from the under side of the chassis. A soldering lug should be fastened at the rear mounting, as shown at G7, to provide a ground connection for the potentiometer, P. Soldering terminals should be attached to the frame of the condenser at the points indicated.

Sockets S9, S10 and S11, used for the plug-in coils, should then be mounted, care being taken that the terminals are mounted in the relative positions shown (the F terminals toward the rear of the chassis) and bent flat against the base of the socket to prevent touching the cans of the condensers over which they are mounted. Mounting is effected by using the long screws and insulating bushings to mount them at a



The under side of the chassis, showing neat arrangement of parts and simplicity of wiring

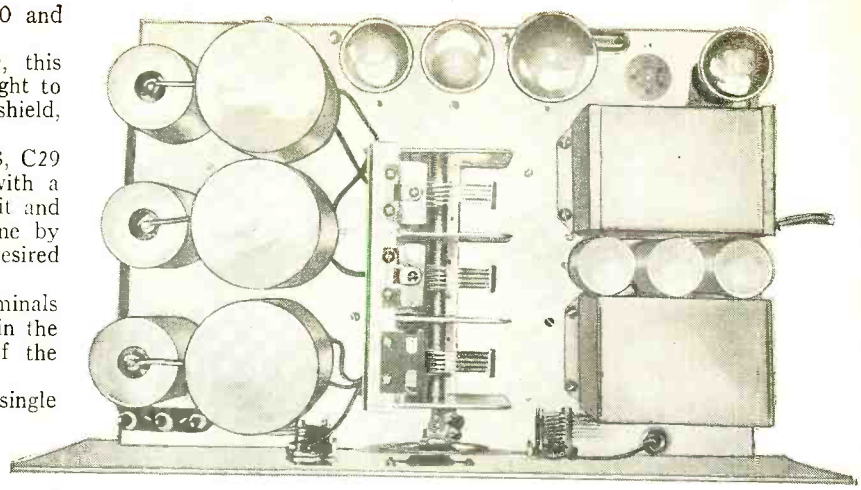
height sufficient to clear the condensers C10 and C13.

Although no condenser is used under S9, this socket must also be mounted at the same height to keep its relative position with respect to the shield, the same as that of the other coils.

The bakelite strip on which condensers C28, C29 and C30 are mounted should be mounted with a clearance of about one-quarter inch between it and the bottom of the chassis. This can be done by threading nuts on the mounting screws at the desired height to serve as supports for the strip.

Switch SW1 should be mounted with the terminals toward the left side of the chassis, as shown in the picture wiring diagram of the under side of the chassis, Figure 10.

Switch SW3 should be mounted with the single terminal end (terminal 2) toward the left and with the double terminal end (terminals 1 and 3) toward the right, as shown in Figure 10. The number 1 of switch SW3 (which terminal connects with the number 3 terminal of chokes CH1, CH2) is the terminal which will be nearest the subpanel and is hidden from view when looking into the chassis, as in Figure 10.



Top view of chassis. The tube and coil shields appear at the left. At the right are the shields housing the power supply

The connection to that terminal should be made by turning the switch around, soldering the connection and then turning the switch into position and fastening it firmly in place.

The body of each resistor, R5 to R14 inclusive, is insulated from the metal mounting strip which holds them in place. This mounting strip is automatically grounded when it is mounted on the chassis. The ground connections of resistors R5, R7, R8, R10, R11, R13 and R14 can therefore be made very easily by soldering one pigtail from each resistor mentioned to the mounting strip as shown in Figure 10.

It is important to note that the diameter of the resistor at one end of the resistor assembly is larger than the rest. The resistor assembly should be mounted so that this large-size resistor is located at R14. If this is not done, the values of the resistors will not be properly located and trouble will result.

Since the radio-frequency choke coils CH3, CH4 and CH5 are polarized, it is important that the choke coils be located as shown and connected as follows. The terminal marked "Hi-Freq." on chokes CH3 and CH4 should go to their respective radio-frequency transformers through holes H6 and H12 respectively.

The terminal marked "Hi-Freq." on choke CH5 should be connected with the P terminal of socket S3 and with resistor R6, as shown.

The location of the remaining parts on the chassis is shown so clearly on the photographs and layouts that detailed instructions for mounting them are not necessary.

It is important to mention, however, that the transformer, T,

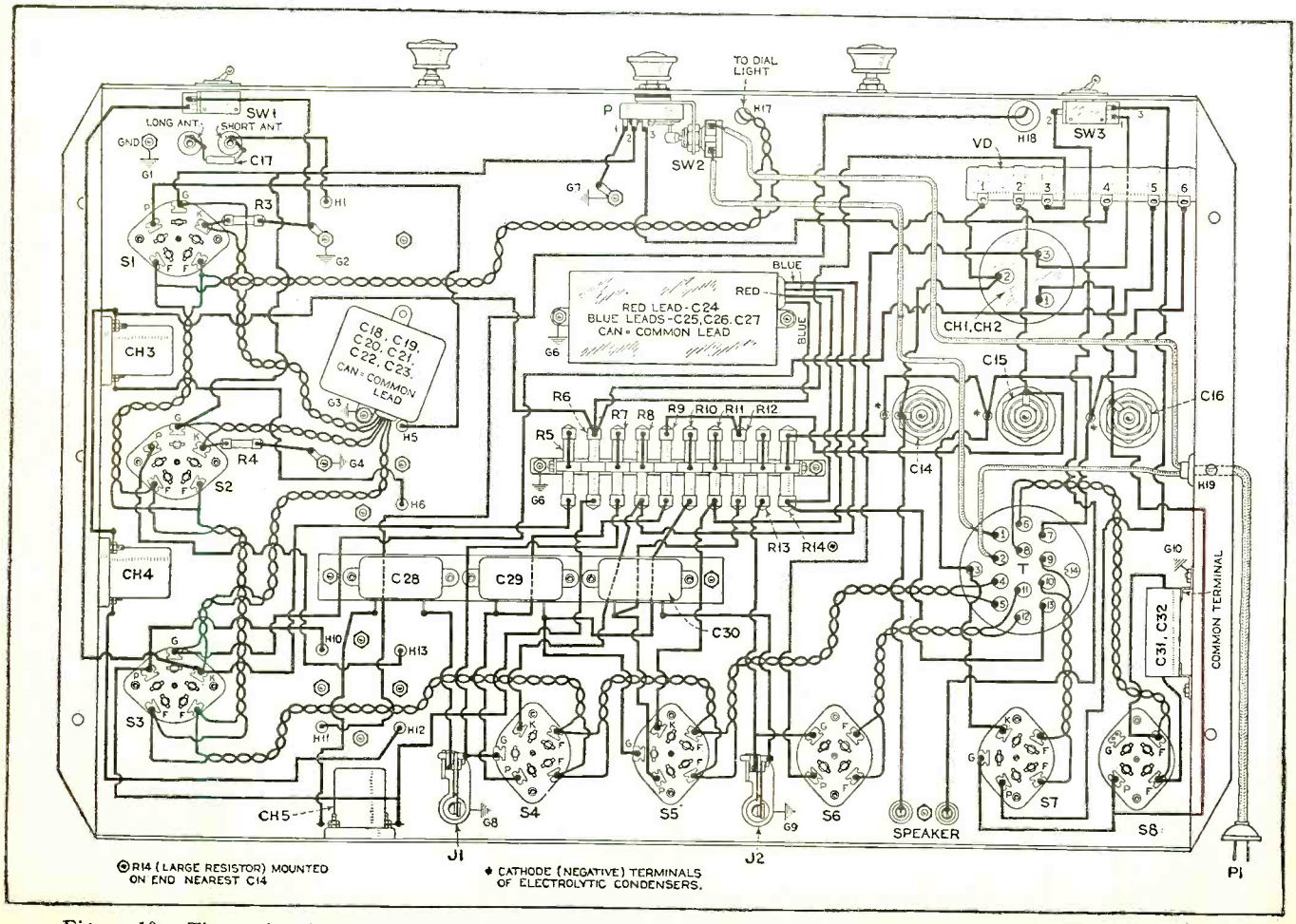


Figure 10. The under-chassis wiring appears somewhat complicated here, due to running leads in a roundabout manner for the sake of clarity. Note how much more simple the actual wiring appears in the photo at the left

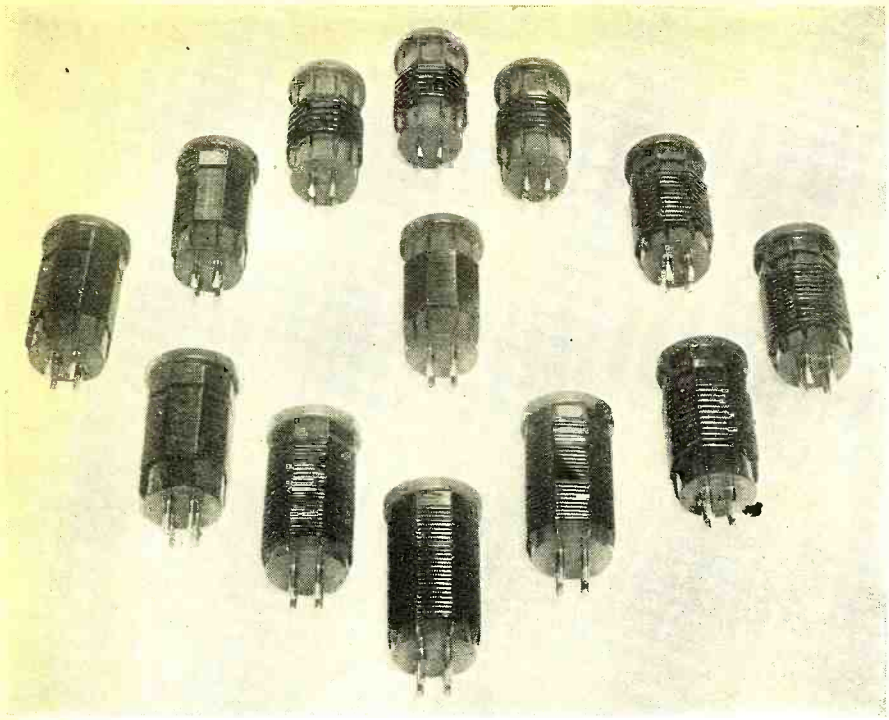


Figure 11. The complete set of coils used in the television receiver

and the choke unit, CH1 and CH2, should be mounted so that the terminal lugs point toward the center of the chassis in order to be sure that the relative locations of the terminals will be such as to make the connections as shown on the wiring diagrams. It is also important to bend up the terminals of both the transformer, T, and the choke unit, CH1, CH2, so as to be sure that they clear the edge of the hole in the chassis and so that there will be no danger of the wires leading to such terminals shorting to the chassis.

The set screws provided with condensers C4 and C7 should be removed to prevent any possibility of binding as the condensers are operated.

Condensers C18, C19, C20, C21, C22 and C23 are all contained in a single can, with their common lead grounded to the can. All the capacities in the can are equal and have the same voltage ratings. Pairs of leads from this condenser block should be twisted as shown in the diagram.

Condensers C24, C25, C26 and C27 are furnished in one block, with their common leads grounded to the can. Condenser C24 (red lead) is of higher capacity than the others in the block and should be connected as indicated on the diagram. Condensers C25, C26 and C27 are of equal capacity and are provided with blue leads which should be connected as shown.

In the cases of condensers C1, C2, C3, C4, C5, C6, C7, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C31 and C32, the connection to ground (chassis) is automatically made when the units are mounted.

This is also the case with the "GND" binding post terminal, the mounting strip of resistors R5 to R14 inclusive, and the frame terminals of jacks J1 and J2.

The G numbers, G1, G2, etc., indicate ground connections.

The H numbers indicate holes in the chassis or shields through which wires are passed to make connections between terminals on one side of the shields or chassis and terminals on the other side. These holes are marked with corresponding numbers on both sides of the chassis to indicate that the wires which pass through them continue to their respective terminals on both sides of the chassis.

The front panel is mounted on the chassis by means of the potentiometer P and the switches SW1 and SW2, which fasten them together.

Wiring the Receiver

Much time will be saved and mistakes will be avoided if each connection is traced over with (*Continued on page 72*)

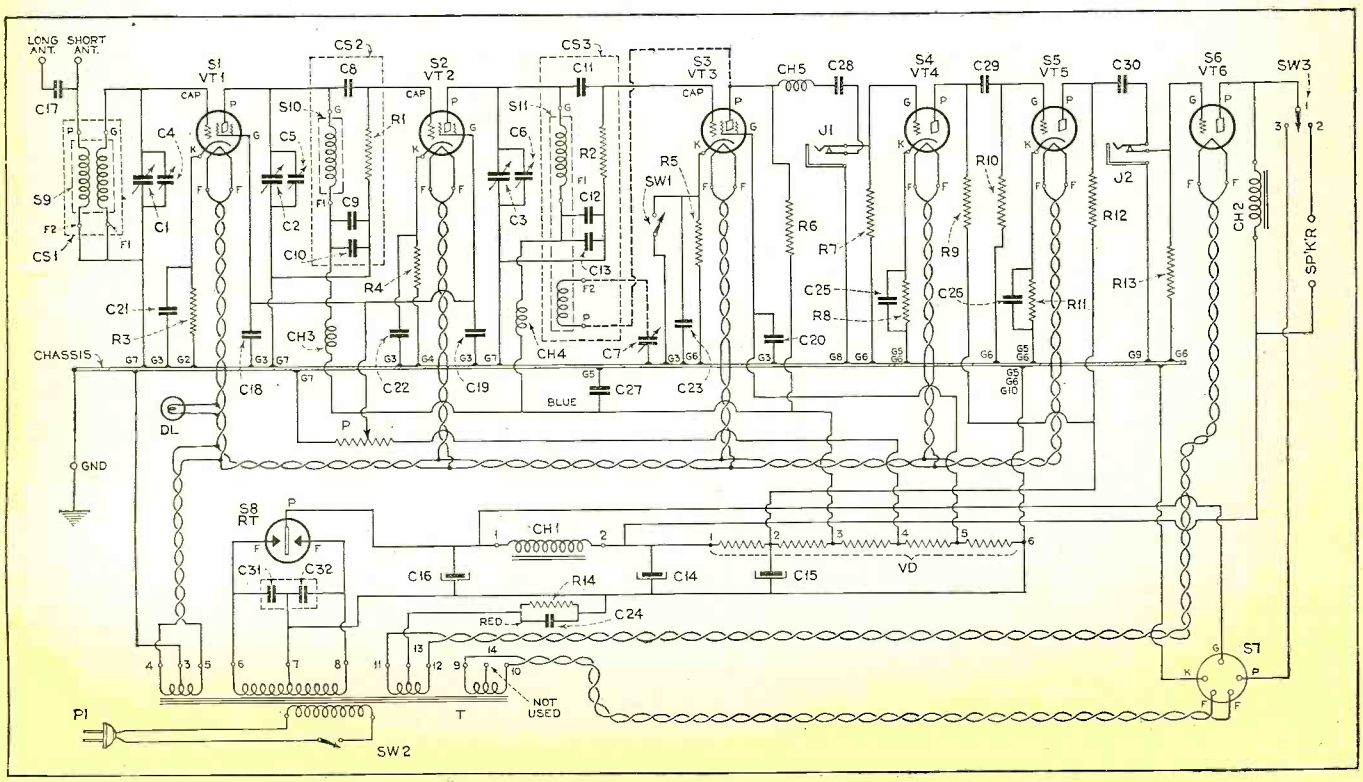


Figure 8. The complete schematic diagram

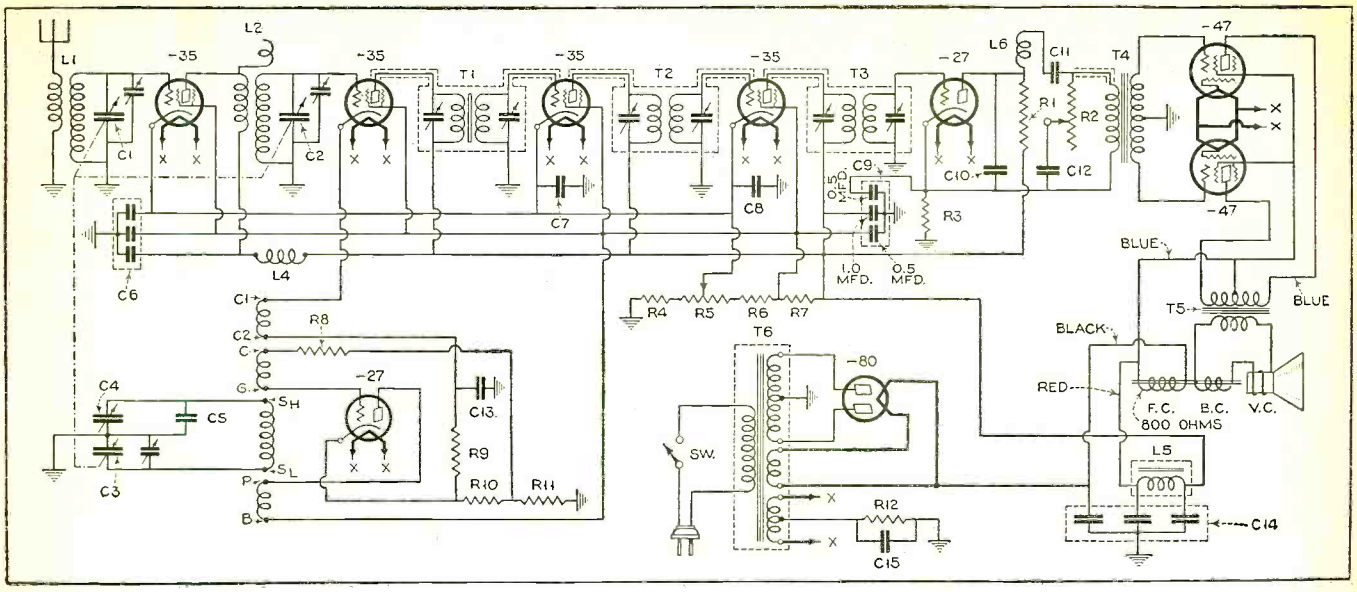


Figure 3. The complete schematic circuit of the new superheterodyne

A New Pentode Variable-Mu SUPERHETERODYNE

A new super that takes full advantage of the newest tube developments, employing four type –35 variable-mu tubes and a type –47 power pentode

By McMurdo Silver*

DURING something over eighteen years prior to July, 1930, in the radio game, the writer had always seen ways in which each year, radio receivers could be improved if only the means of accomplishing some, at the moment difficult, improvement could be found—which is just another way of saying that if certain new angles could be developed up to the point of practical use, then the next year it would be possible to build better radio receivers. It was therefore with considerable shock that after carefully and leisurely examining the four superheterodynes described by him in the last October, November, December, and January issues of RADIO NEWS he could see no manner in which these sets could be improved, for from the standpoint of selectivity, sensitivity, and fidelity, they left little, if anything, to be desired, barring the old dream of static elimination, which incidentally, their extreme selectivity had done much to accomplish. This was indeed an unprecedented state of mind, and gave rise to the question not of what would be a new improvement for the coming year, but of what could possibly be an improvement? The answer was apparently only minor mechanical and electrical refinements such as variable-mu tubes, pentodes, the elimination of plug-in coils for short wave receivers and converters, and the elimination of oscillator radiation. But these features seemed definitely to represent only rather minor improvements—certainly nothing radical.

It was therefore with great surprise that the performance of the new Silver-Marshall 726 vario-mu-pentode superheterodyne was found, upon direct comparative tests against the preceding 724 model, to be just as far ahead of the 724 as the 724 was ahead of earlier sets.

This improvement was manifest in the forms of finer tone quality with an incomparable gain of a far better signal to noise ratio, absolute 10 kc. selectivity even very close to a 50,000 watt station, freedom from oscillator radiation, the very unusual quality of equally good tone at high or low volume settings, the complete elimination of cross-talk or cross modulation, and the elimination of the need of a local distance switch to insure good tone in local reception.

While sensitivity, selectivity, or fidelity curves ordinarily tell the story of receiver performance, they fail in this particular case, for while they indicate performance distinctly superior to anything previously attained, the receiver really must be tuned and heard before full appreciation of the advances it represents can be had, and so here we are, in the season after it looked as though there would be nothing new in receivers, with a set offering performance distinctly new and better. But for the second time, in now over nineteen years of radio experience, the writer will hazard a guess that next year will bring no further radical improvements—simply because on the basis of performance alone, none now seems possible. But let the curves of Figures 4, 5, and 6 tell as much of the story as they can.

Figure 4 depicts the over-all selectivity of the receiver at 1000 kc., and inasmuch as the selectivity is determined almost entirely by the intermediate frequency amplifier, this curve may be taken as a representative for the entire broadcast band since the i.f. amplifier selectivity being constant, the over-all selectivity

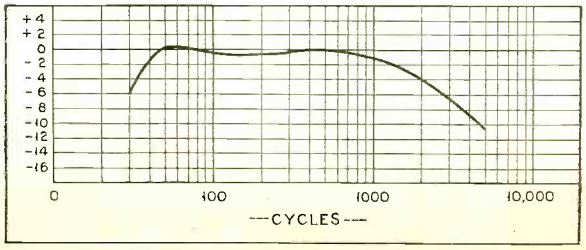


Figure 6. Fidelity characteristic of the model 42 chassis, checked at 1,000 kc., modulation 30 per cent., measured from antenna to load circuit

*President, Silver-Marshall, Inc.

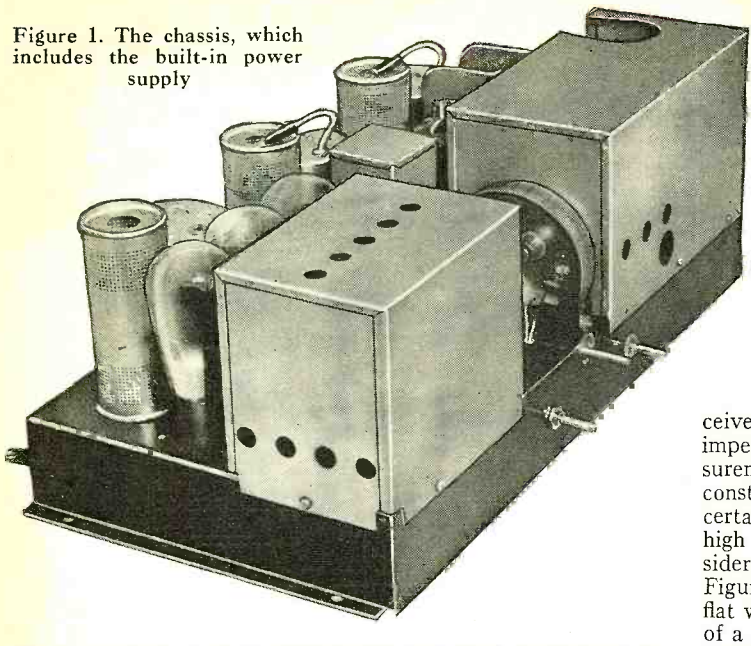


Figure 1. The chassis, which includes the built-in power supply

of the receiver must be substantially constant throughout the broadcast band. At 100 times down, or the point at which an interfering station would have to be 100 times as strong as a wanted station to give the same output, the curve would seem to be just 14 kc. broad, which means that an interfering station would have to be 7 kc. away from the wanted station and 100 times as strong to produce the same output—an almost impossible condition, since American broadcast stations are separated 10 kc., and not 7 kc. At 1000 down, the band width is just 24 kc., so that an interfering station 1000 times as strong as the wanted station would have to be within 12 kc. or less, of the wanted station to produce equal output and this is a very infrequently encountered condition. At 10,000 times down, the band width is just 26 kc. As a matter of fact, this selectivity curve checks practically exactly with that of the 724 superheterodyne described in the October, 1930, issue of RADIO NEWS—a receiver design of which many thousands are now in practical use.

Figure 5 depicts the sensitivity of the receiver in terms of absolute input rather than microvolts per meter, the customary way of rating receivers on the assumption of a 4-meter effective antenna height. The sensitivity is seen to range from 2.85 microvolts absolute input to produce a standard signal output of 50 milliwatts to 1.85 microvolts, depending on the wavelength. In terms of gain ratio throughout the broadcast band this is approximately 1½ to 1, and such a flat gain curve may reasonably be termed a uniform sensitivity curve. For comparison with receivers rated in terms of microvolts per meter for standard signal output, these figures would be divided by 4 and would give as a result, a sensitivity of .71 to approximately .416 microvolt per meter —higher than can be used in ninety-nine out of a hundred locations and high enough to receive any signal sufficiently above the prevailing noise to be intelligible. This sensitivity, coupled with 10 kc. selectivity, represents a considerable improvement over the original 724 superheterodyne and leaves nothing to be desired in terms of typical residential locations, or even particularly unfavorable residential locations. But what of fidelity?

Unquestionably, the selectivity of the receiver is such as to progressively attenuate side bands to a very marked degree. This side band attenuation, however, is compensated for in the audio amplifier and loud speaker and it is here that one of the advantages of the pentode tubes makes itself manifest. Due to the high output impedance of pentodes which must work into a relatively low impedance load in order to obtain maximum undistorted power output, the frequency curve of a pentode audio stage will be found to rise very rapidly with frequency since the load impedance in the form of an output transformer and dynamic speaker voice coil will rise with frequency. This is exactly the effect that is desired in a superheterodyne receiver, although it may result in excessive accentuation of high tones in a t.r.f receiver where side band cutting and consequently, sensitivity may not be carried to the same extreme in commercial design.

Figure 6 depicts the over-all fidelity of the receiver from antenna to load circuit with, however, a constant impedance load substituted for the speaker voice coil for measurement purposes. Actually the speaker coil impedance is not constant and increases with frequency and this, coupled with certain other features of speaker design result in boosting of the high end of the fidelity curve, taken from antenna to ear, considerably above the electrical fidelity which alone is shown in Figure 6. The electrical fidelity curve, however, is seen to be flat within 2 decibels (about the minimum perceptible variation of a pure tone observable to the ordinary ear), from 40 to 1300 cycles and to be only 9 decibels down at 4000 cycles, the maximum frequency it is necessary to reproduce for satisfactory and pleasing speech and music reproduction—and about the highest frequency it is safe to reproduce if absolute 10 kc. selectivity is to be assured.

As a matter of fact, the response curve of the speaker alone shows a rise from 1000 to 4000 cycles of a little over 9 decibels, so that in terms of over-all response through the speaker, the fidelity curve could be drawn as flat within less than 2 db. from 40 to 4000 cycles. Actually, however, the higher tones are somewhat over-compensated in order to insure the highest possible clarity of speech reproduction, this over-compensation being controllable at will by a tone control included in the audio circuit. This control progressively attenuates the higher audio frequencies to suit the taste of the individual listener and his home surroundings; and to permit of a reduction of static and of atmospheric noise which is predominately in the higher audio frequency range.

If this fidelity curve were analyzed in conjunction with the curve of Figure 4, the two would be found incompatible, for the high frequency compensation lies entirely in the audio end and loud speaker of the receiver and does not translate into decreased selectivity in practice. As a matter of fact, the cut-off above 4000 cycles is very sharp indeed—as it must be if real 10 kc. selectivity is to be obtained —which is simply another way of saying that frequencies above 5000 cycles must not be reproduced, for in any receiver where they are reproduced, the higher audio tones from stations on adjacent channels from the one being received will "splash over" and be heard. In practice this combination of fidelity and sensitivity curves represents the ideal rectangular over-all response curve-flat from 40 to 4000 cycles and with sharp cut off just below 5000 cycles to prevent interference from stations on adjacent channels.

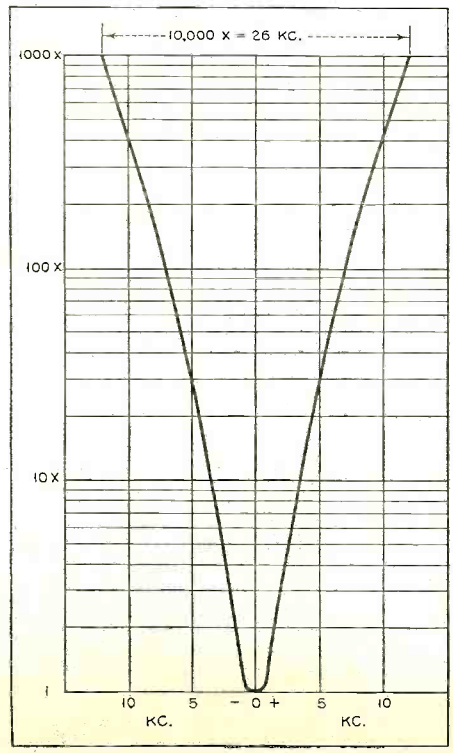


Figure 4. The selectivity curve of the receiver, measured at 1,000 kc.

Before considering the design of the receiver, it would be well to define exactly what improvement the variable-mu screen grid tubes and pentode power tubes represent.

In the past, due to the small grid excursions which might be handled by type –24 screen grid tubes, the possibility of cross-talk or cross-modulation in the first –24 tube of the receiver, if not preceded by one or more (usually two) very good tuned circuits, was quite

serious. In addition when it was attempted to receive a powerful local station on a high gain receiver with the volume control considerably retarded, poor tone quality was observed, due to the cut off at the bottom end of the grid-voltage-plate-current curve of the tube. Assuming that the customary method of control grid bias variation was utilized for volume control. For this reason it has been necessary to include a local distance switch in high gain receivers employing –24 tubes, in order that the effective gain of the receiver might be reduced to a point where in receiving local stations the volume control would not have to be retarded to an extent which would cause distortion of the signal.

Essentially the variable-mu tube is a screen grid tube with the negative portion of the grid-voltage-plate-current curve considerably extended so that cut off occurs only at very high value of negative grid bias. This effectively minimizes the possibility of rectification and, consequently cross modulation of one station being received by the signals on nearby channels of one or more other very powerful local stations. It also permits an effective control of volume by a single volume control even on very powerful local stations and eliminates the necessity of a local distance switch in order to insure this.

In general performance the variable-mu provides the advantages of considerably simplified volume control and much decreased cross modulation.

The pentode power output tube is essentially a screen grid tube with an extra space-charge-grid which effectively reduces the output impedance to a point where it may be used for a power audio amplification with a high value of audio power output. In practice a single type –47 pentode will give the same voltage amplification as does a –27 first stage audio tube and a –45 power output tube. It might therefore be said that one pentode output stage is equal to two ordinary stages—that is, one –27 and one –45, but actually this is a conservative statement since the undistorted output of the –47 type of pentode is from 2½ to 3 watts or considerably greater than that of a single –45 tube.

Judging from available engineering information, the trend of the receiver manufacturers this season will be toward the use of a single pentode tube, which, as compared with a pair of –45s operating out of a power detector, will show appreciably higher voltage gain but less power output, since a pair of –45s in push-pull will turn out approximately from 4 to 4½ watts undistorted power output, whereas a pentode will turn out only about 2½ to 3 watts. Obviously the use of a single pentode is therefore a step back in terms of maximum volume handling ability, from a pair of –45s, aside from the fact that the use of a single pentode introduces additional problems of by-passing bias resistors effectively in order to obtain good low frequency gain. A pair of –47 pentodes, however, in push-pull, eliminates this problem and in addition will give an audio power output of from 6 to 7½ watts, or considerably more than may be had with a pair of –45s. The obvious answer to high quality reproduction is therefore to use pentodes in push-pull, and this is exactly what has been done in the 726 superheterodyne.

The receiver is illustrated in Figures 1 and 2, and a schematic diagram appears in Figure 3. The circuit consists of a tuned stage of multi-mu screen grid r.f. amplification coupled to a multi-mu first detector to which in turn is coupled a –27 oscillator. The three-tuned circuit for these tubes is tuned by a 3-gang condenser of 410 mmfd. maximum capacity. The first detector feeds into two stages of dual tuned i.f. amplification employing multi-mu tubes operated at 175 kc. The i.f. amplifier showing a gain of 85 to 90 per stage feeds into a –27 second linear power detector—in turn coupled to a Clough tuned audio system feeding a pair of –47 pentode power output tubes, all power being supplied by an –80 rectifier. Frequent references to the circuit diagram of Figure 3 in reading the following description of the circuit and its parts will aid in understanding it.

Figure 1 shows the receiver as it appears from the left front. The extreme front housing encloses the power transformer which furnishes A, B and C power to the receiver and operates from 105 to 130 volts, 50-60 cycle a.c. power line, or if desired, special models can be had for from 25 to 40 cycle operation. To the right of this housing is another very similar housing enclosing the three-gang condenser, tuning the r.f. stage, first detector and –27 oscillator. The oscillator coil itself is shielded in a small aluminum can which in turn is enclosed within the housing of the gang condenser and oscillator tube so that the oscillator is doubly shielded to a point where practically no radiation effects have been observed in testing the receiver against very sensitive t.r.f. and superheterodyne sets located within four feet of it (due to blocking effect of the screen grid r.f. stage, radiation from superheterodynes does not take place from the antenna, but directly from the oscillator coil and condenser section themselves so that adequate shielding of these units effectively eliminates radiation which might otherwise disturb neighbors' reception).

The –27 oscillator tube is accessible through the slot seen at the top of the gang condenser and oscillator housing. The dial tuning is interesting, for besides being of the now popular translucent illuminated type, calibrated directly in kilocycles, it is of a design eliminating paralax. Paralax is the variation in dial reading which will be observed when the dial is viewed from different angles, as a result of the necessary mechanical separation between the pointers upon the window and the dial itself. In this new dial, the pointer is placed directly behind the dial scale rather than in front of it, as is customary, and in this position mechanical tolerances can be made much closer than in the customary case where the pointers are on the dial window. In consequence the problem of paralax is completely eliminated.

Four holes are visible in the front of the gang condenser housing, the three upper ones being to permit adjustment of the gang condenser trimmers while the large hole is to permit disconnection of the oscillator section of the gang condenser for alignment purposes. Directly behind this housing are the r.f. amplifier and first detector tubes, shielded from each other by the partitions affixed to the chassis and gang condenser-oscillator housing. The first detector feeds into the dual tuned, or siamese, i.f. transformer at the right rear of the chassis. This transformer in turn feeds into the first i.f. tube, thence into the siamese second i.f. transformer, through the second i.f. tube, into the third siamese i.f. transformer, thence into the –27 second detector at the rear of the chassis, and then into the two –47 pentode power tubes, which with the 80 rectifier,

(*Continued on page* 84)

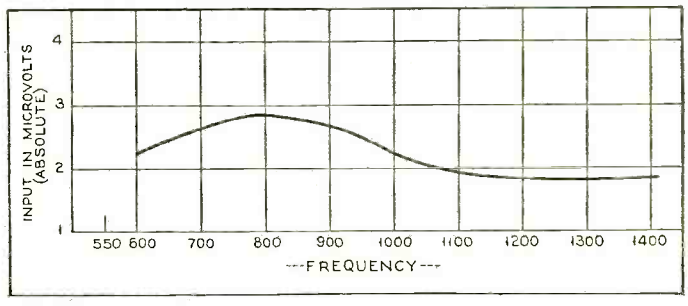


Figure 5 (at left). The sensitivity in terms of absolute input. To convert to terms of microvolts per meter, divide microvolts (absolute) by 4

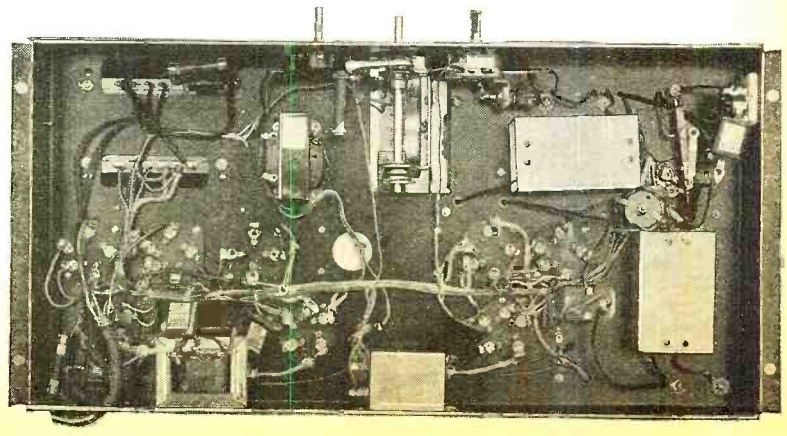


Figure 2 (at right). The under side of the chassis, where most of the chokes, by-pass condensers and resistors are located

Talking Movies *for* Schools

A New Field for the Serviceman

With the perfection of sound pictures, educators are becoming increasingly interested in their advantages as an educational medium. This discussion of the practical considerations involved in school installations is therefore most timely

By C. A. Johnson
and C. C. Clark*

NOWADAYS motion picture fans think of the talking motion picture as one of the necessities of life, whereas only three or four years ago the same group looked upon it as an interesting novelty at best. Technical improvement in the film record and sound projecting equipment as well as an improvement in the technique of the projectionists has probably been the largest factor in this change of viewpoint on the part of the public. As a result, sound pictures are not only in the theatre to stay, but are gradually spreading into educational, advertising and religious fields, and even into the home. This spread would be more rapid if suitable film and equipment were available at a reasonable cost.

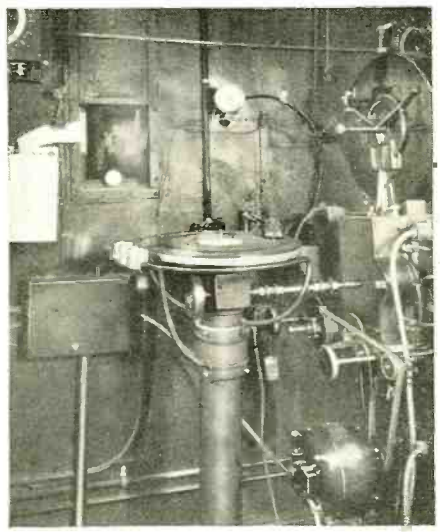
In the field of education in particular there is already quite a variety of suitable subjects on 35-mm. film with a sound track or with sound on disc. Some of the same subjects are on 16-mm. film with disc accompaniment, but there is nothing available as yet in the way of 16-mm. film with sound track.

At the present time anyone who is responsible for selecting and installing sound movie equipment for educational purposes in a public school or college or university is confronted with several perplexing problems. Probably one of the most important things to keep in mind in arriving at a solution to these problems is the psychological fact that sound pictures cannot be used successfully in education unless the reproduction is as good or better than in the average motion picture theatre. All students attend the theatre more or less and have their judgment conditioned by the quality of reproduction they have observed there. Other factors involved are the questions of the size of the auditorium available, whether the equipment is to be portable or permanently installed, and whether it is to be leased or purchased outright. Then, of course, there is always the question of the available funds to spend.

Considering the present status of film libraries on educational subjects, it is practically necessary to select equipment for use with 35-mm. film. If the auditorium or classroom available has a seating capacity of 100 or more, it certainly is desirable to make the installation a permanent one. In the first place, it is easier and more satisfactory to move classes than it is to move equipment as intricate and delicate as this is. Second, for even passable results, the equipment needs to be adjusted for the auditorium in which it is to operate. Finally, much better results can be obtained with the operating part of the system permanently housed in a suitable booth. This means that the best selection would be identical with standard equipment designed for a small theatre. There are plenty of such outfits available on the market ready to be installed. If sufficient funds are available, perhaps the simplest solution to the problem is to lease such equipment and have it permanently installed. The best ones usually cannot be bought outright. The user obtains the outfit on a lease, with definite restrictions and stipulations, one of which is to pay a service charge as well as the initial cost of installation. This often makes the cost prohibitive for the average educational institution. Cheaper equipment can be bought outright, but often the quality suffers proportionately.

There is a third alternative for those who have limited funds and some ingenuity. The various units of the sound system can be bought and assembled into a flexible equipment. If some care is used in selecting the parts and a little good radio and acoustical engineering applied in assembling them, the degree of quality obtained will be limited only by the films or disc records used. Moreover, the equipment will be restriction free and will cost only a fraction of what it would to buy the complete installation at the price charged to the theatres. This assumes, of course, that the person or persons in charge are willing to give a little time to a study of the problem. If they are going to use sound movies successfully in education, they will need to do this anyway.

When making a permanent installation of this sort it is good economy to study the problem thoroughly before proceeding at all with the work. Much unnecessary expense is connected with installing equipment "temporarily" and continually changing it, or selecting unsuitable equipment solely because it can be procured more readily.



Close-up showing synchronous turn and the method of coupling it to the projector

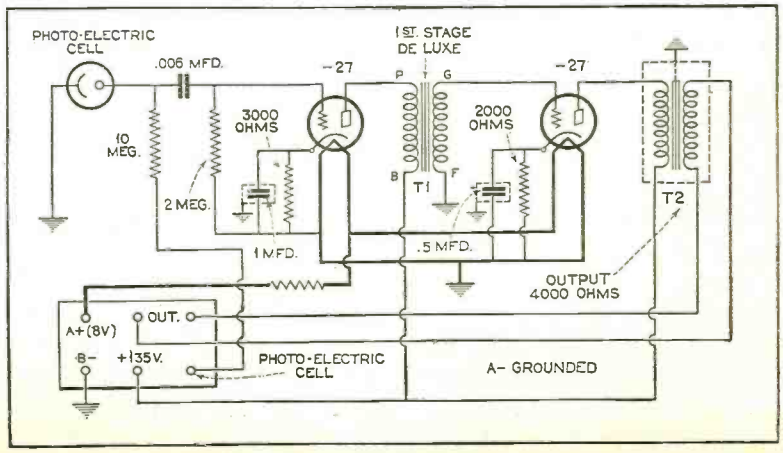
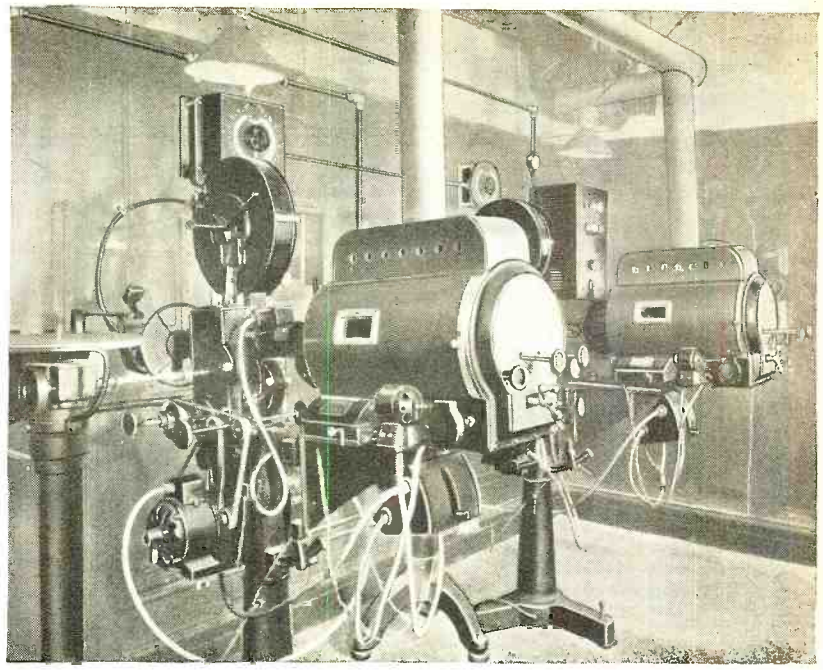
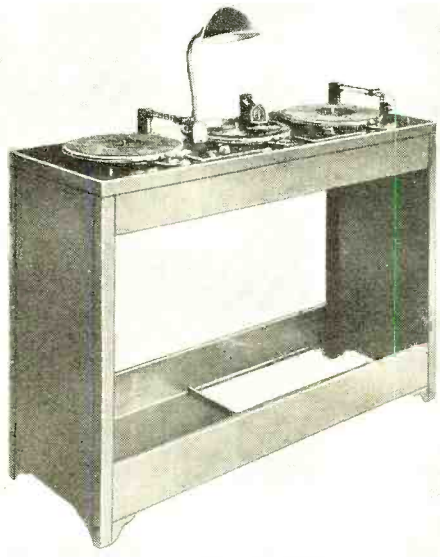


Figure 2. The circuit of the combination sound head and sound head amplifier unit, the output of which is fed into the power amplifier

*School of Commerce, New York University.

The auditorium or classroom available will not need expensive alterations, assuming it was reasonably well planned when built. A certain minimum amount of space will be necessary for the projection booth and to house the accessory apparatus. When there is already existing a projection booth for silent projection it usually can be adapted unless it is hopelessly too small. If there is no booth in the room to be used, one will have to be constructed. The best way to do this is to partition off the necessary space in the rear of the room, directly back of the space to be used for the screen, with a standard plaster partition. The space necessary depends first of all on the number of machines. Two machines are desirable if many of the showings are to include more than 2000 feet of film. Two machines mean considerable extra expense, and, since most educational subjects are short, one machine can be made to suffice. A space 12 feet by 10 feet should be ample for a one-machine installation, including amplifiers and batteries. The equipment may be crowded into much smaller quarters if precautions are taken to arrange the controls and various accessory apparatus for the convenience of the operator. Where two machines are to be used, about 4½ feet should be left between the machines and at least 4 feet between the right-hand machine and the wall. If other apparatus, such as stereopticons, epidiascopes or spotlights are needed in the booth at times, additional space must be provided for them. Each machine must be provided with a ventilation duct over the lamp house when a carbon arc is used. Detailed plans for theatre booths of various sizes may be obtained from the Society of Motion Picture Engineers and much helpful information can be gotten from them. There are certain requirements regarding the type of conduit to be used and certain other fire precautions which vary with the local fire regulations. Anyone responsible for the design of the projection booth should be sure that these regulations are complied with so that the booth will pass inspection. In designing a new booth when plenty of space is available, it is ideal to plan to put the amplifier and sound equipment in a separate room about 5′ x 8′. It is a good plan in general to keep as much of the accessory apparatus as possible outside the booth so as to leave plenty of operating space in the latter.





A booth with two projectors equipped for sound-on-film and sound-on-disc. At the left is shown a turntable rack for non-synchronous sound accompaniment

Where commercial a.c. is supplied to the house the d.c. or a.c. motor generator is unnecessary. When a motor generator is used to supply the amplifiers it may also be used to operate the synchronous motor which drives the projector. The voltage control on the generator will keep the speed sufficiently constant for good reproduction.

Figure 1 is a schematic plan of arrangement of the apparatus when two machines are used. The same general arrangement applies to a single machine installation. Note in particular the points to be grounded. All grounds should be connected by a No. 6 wire directly to a cold-water pipe. Without perfect grounding it is impossible to minimize background noise.

The quality of reproduction depends primarily upon the frequency response characteristic of the entire signal circuit from the photo-cell or pick-up to the loud speakers. If distortionless amplification is obtained all along the line, and if the output of the main amplifier and the speakers has sufficient capacity to handle the power, the quality must be good. If the units specified above or those of equal quality are selected, there should be no difficulty about the frequency response of each unit. The quality can be destroyed, however, by mismatching terminal impedances in connecting the units together. (*Cont'd on page 77*)

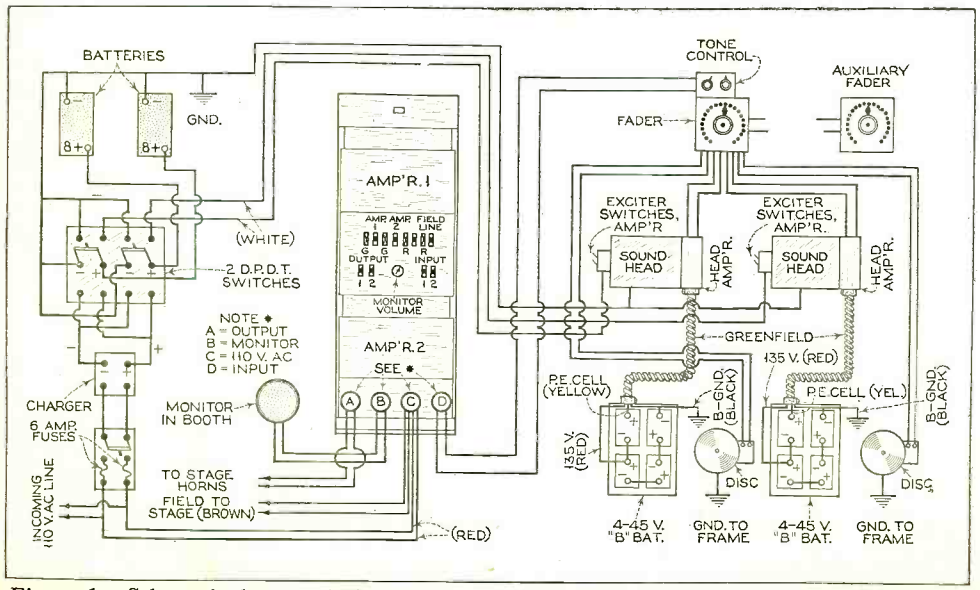


Figure 1. Schematic layout of the sound equipment for a two-machine installation. Each machine is equipped with turntable sound head and sound head amplifier, but the single power amplifier in center serves both

Stepping Out *for*

The author "dubbing in" notations on recordings of European short-wave programs tuned in on the Scott receiver

PART TWO

IN planning to write this article on short-wave DX reception with the new Scott All-Wave Superheterodyne I was impressed with the futility of trying to present in words a description of the results obtained. This is true of any verbal description of DX reception. Such reception can be classified only under two general heads—"headphone" or "loud speaker." The first classification we can leave out of consideration entirely, because at best reception is unsatisfactory if limited to headphones.

"Loud speaker reception" means little to the reader. If a program is received with such low volume that it can only be heard by putting one's ear into the loud speaker it represents far from good reception yet can legitimately be called loud speaker reception. On the other hand, a program may be heard fifty feet from the loud speaker and yet represent poor reception for the reason that there is no indication to the person reading such a description as to the fading, noise level or the other bugaboos of DX reception. As a matter of fact, a program which can be heard fifty feet from the loudspeaker may be accompanied by so much noise that the words and music are indistinguishable. All of these represent the doubts that are likely to occur to a reader as he reads any of the terms commonly employed in such descriptive articles.

In order to pass along to readers a description of DX reception with this new receiver, something more tangible and definite was considered necessary in order to permit readers to form their own opinions of the results. After considerable thought a scheme was hit upon which I believe comes very close to accomplishing the seemingly well-nigh impossible feat of offering real proof, not only of DX reception but of the quality of this reception.

The idea was this: To tune in a foreign broadcasting station and to record the reception on phonograph discs. Then later to play back these records with a stenographer sitting in to take down in shorthand the station announcements and other speech. If she were able to make a verbatim transcription of speech from these records it would provide positive proof of the quality of the reception. On the other hand, if reception were poor, due to excessive fading or high noise level, it would be impossible for her to provide a transcription.

One of the recordings of a short-wave program from Chelmsford, England. The wide outside margin was left to permit date and other notations to be "dubbed in"

The scheme seemed entirely logical, so such a test was planned for the afternoon of April 24th. The equipment set up consisted of the receiver and a Presto portable home recorder. The receiver was tuned to the wavelength of G5SW at Chelmsford, England, operating on a wavelength of 25.53 meters. As expected, the station was right there on the dot of 72.5, where it had been previously logged. This station was selected because, first of all, its program announcements would be in English and would therefore not require the services of a linguist in making a shorthand transcription; and secondly, because this is probably the station most "shot at" by American short-wave fans during daylight hours and therefore the one most commonly used in judging the ability of short-wave receivers. Radio Roma Napoli was coming in equally well just two degrees below G5SW on the dials so that either one could have been readily recorded.

When this station was exactly tuned in, the switch on the recorder was thrown to the "radio recording" position and the recording process started. It might be said here that this was the first time I had used this particular home recorder, for which reason I was not certain as to the proper volume level for best results. The result was that the first record proved to be unsatisfactory because of the tremendous volume of reception from this English station. Probably the psychological effect of receiving signals over such a great distance was the reason for keeping the volume control full on. In any event, a second record was made with the volume control turned down to provide reasonably comfortable signal strength. When this record was played back the reproduction was all that could be desired.

When the recording was started an opera program was being presented, and this carried on through the middle of the second record, including the interval during which the first record was played back. Along about the middle of the second record the opera program ended

World-Wide Reception

Here is more dope on an all-wave receiver which brings in European stations well enough to put on phonograph records and with such clarity that a stenographic transcription of speech can be made from the records

By S. Gordon Taylor

and was followed by a storm of applause which continued for several minutes. This applause was recorded until the end of the second record and then the recording process was stopped to await the resumption of the program. Then came a speech. We had been hoping for some speech other than station announcements in order to provide a really thorough test of our scheme. Unfortunately, we did not get the recorder into operation promptly enough to record the speech from the very beginning or to get the speaker's name, but only a few words of the speech itself were missed. A little further on in this article a complete transcription of the third record will be found.

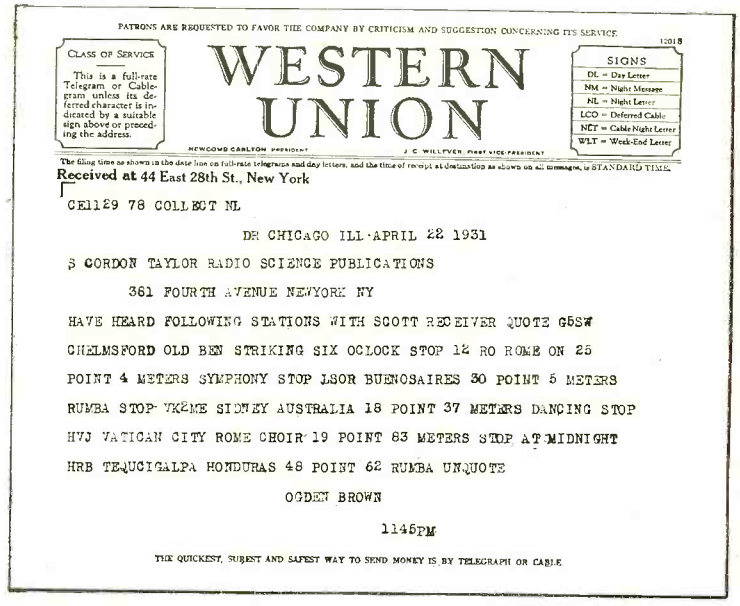
This speech carried on through the third and fourth records and was followed by station announcements and musical programs of which six additional records were made. The selections were interspersed with station announcements. One of these announcements is transcribed here because it mentions the station, location and wavelength. This announcement was made during the last hour of the program or a few minutes after five o'clock American Eastern Standard Time.

"This dance music is being relayed to you by G5SW on 25.53 meters or 11,750 kilocycles. We continue now until 12 midnight British summer time or 11 p.m. British Standard Time. G5SW returning to London for dance music from the Grosvenor House Prospect.

"That was a number called the 'Peanut Vendor' played to you by Jed Harris' band at the Grosvenor House Restaurant, and now we are going to have a waltz called 'You Will Remember Vienna' and, after that, 'Moonlight on the Colorado.'"

The next day the whole outfit was moved to the office and there the records were played back in order that the transcript could be made. There is no need for showing, nor does space permit the transcript of the entire two and a half hours of recording. One record of speech will be sufficient for our purpose here. This transcription follows:

"—and one of the oldest broadcasting stations in this country. Mr. Noel Ashbridge, chief engineer of the B. B. C., has lately given to you two most clear and most interesting accounts of recent progress in broadcasting. He has kindly left it to me to say something upon what is happening internationally, though the fact remains that he himself is taking an active and valuable part in the studies for the solution of international broadcasting problems. Where shall I commence? I think it will help most to an understanding of what is done and what has been happening during the last six years of the international broadcasts in different parts of Europe and in the daily routine of the office of this Union at Geneva and the observation post of the Union at Brussels, if we examine some of the technical problems. Although broadcasting stations are built to cater to the listeners of their own countries, the electric waves do not stop short on reaching their national boundaries. Just as there are no Straits of Dover in the broadcasting world to attenuate the wireless breakers from the Continental stations, so also the rocky coasts of Netherlands and Normandy, the dunes of Holland, the forests of Belgium and Germany, the mountains of Norway and Sweden, fail to arrest the progress of the waves sent out by the British broadcasters. You are probably a listener who has been troubled by the exceptionally strong signals from the new German station on the border of the Black Forest to which Mr. Ashbridge made reference a fortnight ago. This German high-powered station, like the British and other high-powered stations, has sought to provide a service over a large area for those who cannot afford——"



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DR CHICAGO ILL APRIL 22 1931

S GORDON TAYLOR RADIO SCIENCE PUBLICATIONS

361 FOURTH AVENUE NEWYORK NY

HAVE HEARD FOLLOWING STATIONS WITH SCOTT RECEIVER QUOTE G5SW CHELMSFORD OLD BEN STRIKING SIX OCLOCK STOP 12 RO ROME ON 25 POINT 4 METERS SYMPHONY STOP LSOR BUENOSAIRES 30 POINT 5 METERS RUMBA STOP YK2ME SIDNEY AUSTRALIA 18 POINT 37 METERS DANCING STOP HVJ VATICAN CITY ROME CHOIR 19 POINT 83 METERS STOP AT MIDNIGHT HRB TEGUCIGALPA HONDURAS 48 POINT 62 RUMBA UNQUOTE

OGDEN BROWN

1145PM

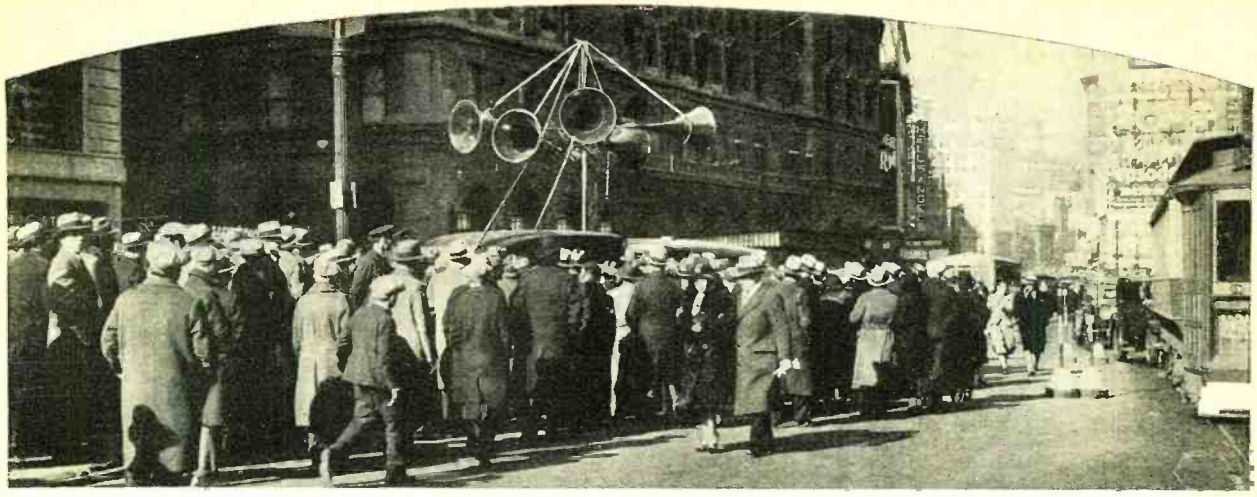
THE QUICKEST, SUREST AND SAFEST WAY TO SEND MONEY IS BY TELEGRAPH OR CABLE

Wire received from Chicago fan in response to inquiry from author when checking up on results obtained with this receiver in other parts of the country

This station finder with its revolving scale makes it a simple matter to determine the receiver dial setting for any station whose wavelength is known

So much for this test, which must be conceded to be one of the most severe tests to which DX reception could be subjected. Strange as it may seem, it was not the fading or noise level, but rather the pure "King's English" employed by the speaker, which caused the stenographer a little trouble in the transcription. This should not be taken as any criticism of the speaker. Those who have witnessed plays by English actors realize the difficulty in understanding them at first. Naturally, to take this speech down in shorthand is just that much more difficult.

In addition to the European stations mentioned, others were tuned in from South America, Honduras, Mexico and Western Canada at different times. In other words, just about all of the world was heard or at least that portion of the world where radio transmitters are in operation during the hours of the tests. The European stations are on the air during our (*Continued on page* 82)



The amplifier truck "on location" at Times Square. The loud speakers are elevated over the truck roof and provide coverage extending several blocks in all directions

Public Address on Wheels

With mobile amplifier systems available, no public gathering, indoors or out, need be without the advantages of a complete public address system

By William C. Dorf

NEW YORKERS in the vicinity of Times Square recently heard a novel demonstration when sound engineers with an amplifier truck of the most modern design reproduced a two-way conversation between persons on the top of a skyscraper and passengers in the Navy blimp J-4, which flew 2,000 feet overhead. The entire program was clearly reproduced at such volumes that the radio voices could be heard distinctly over a radius of several city blocks, above the noise of traffic.

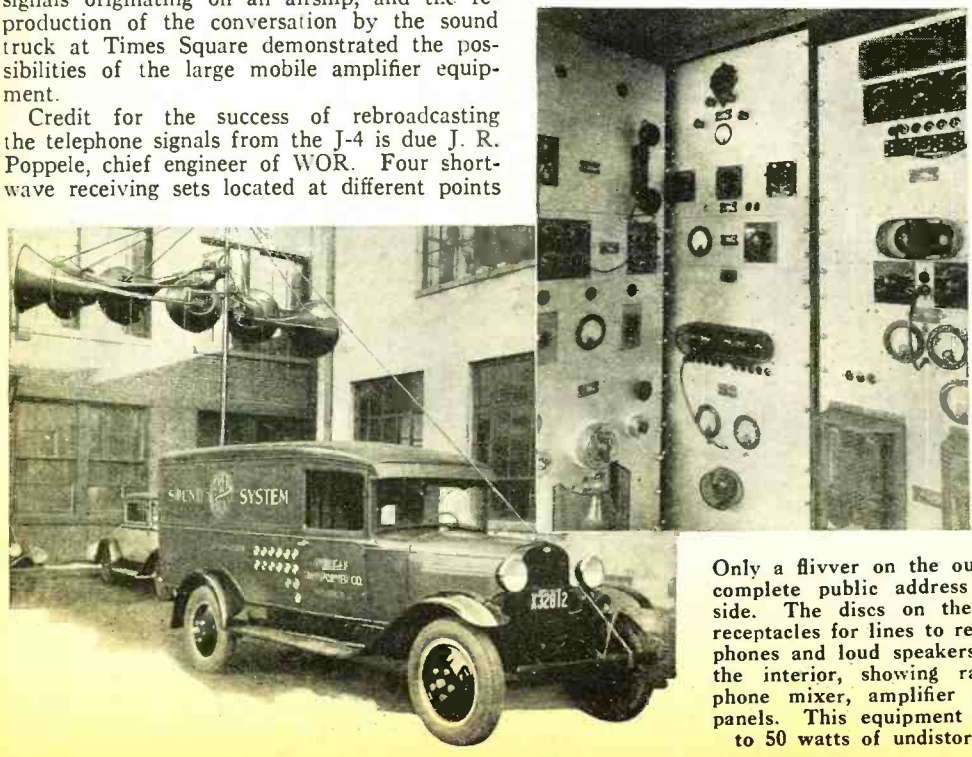
This program, which was placed on the air by station WOR, marks the first entirely successful attempt to rebroadcast radio signals originating on an airship, and the reproduction of the conversation by the sound truck at Times Square demonstrated the possibilities of the large mobile amplifier equipment.

Credit for the success of rebroadcasting the telephone signals from the J-4 is due J. R. Poppele, chief engineer of WOR. Four short-wave receiving sets located at different points in the metropolitan area were used to pick up the 49.6 meter signals which were transmitted by the airship The careful selection of the points of reception, it is explained by station officials, made possible rebroadcasting without fading. On the other hand, if only one receiver had been used it would have been impossible to pick up the entire program, due to the highly directional characteristics of the blimp's antenna.

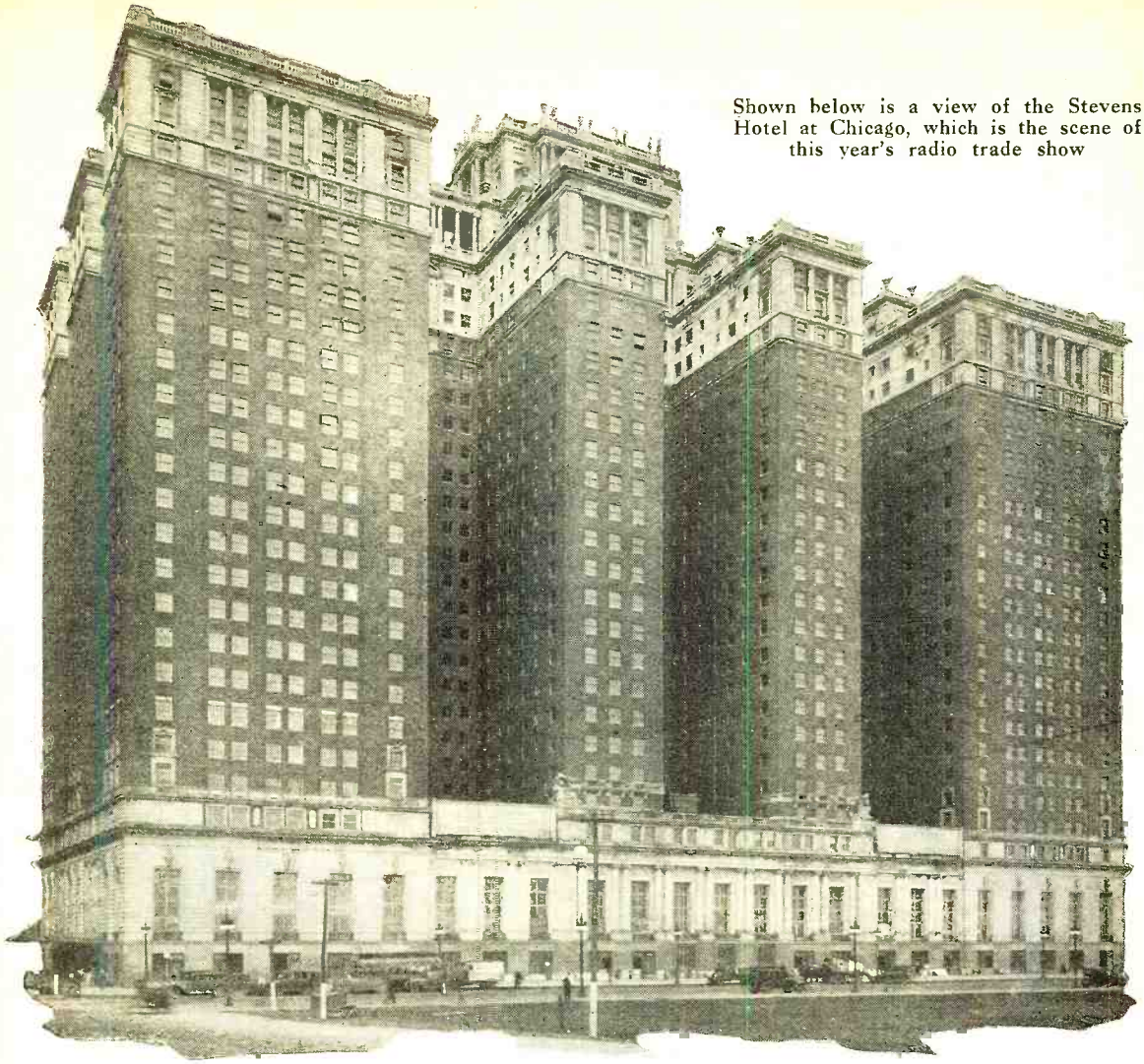
Although only an experiment, Navy officials have expressed themselves as very well pleased with the results. They feel, it is reported, that the demonstration has proved the practicability of dependable intercommunication between an airship and its base or other members of its fleet. However, it is admitted that there is still room for considerable improvement. In this connection, engineers state that at the present time best results cannot be obtained with the blimp's motors running at top speed.

Almost as interesting as the radio demonstration were the new features of the sound truck which amplified the program for the crowds. This equipment was designed for experimental field service by Walter Garlick, amplifier engineer of the American Transformer Company, and it contains complete apparatus for amplifying sound to any desired volume and under all conditions. Nothing is missing, for, in addition to the actual amplifier panels, it carried batteries, motor generator, loud speaker mast, six 6′ 6″ trumpet type loud speakers, one directional airport loud speaker employing four dynamic units, field telephone sets, bat-

(*Cont'd on page 73*)



Only a flivver on the outside, but a complete public address system inside. The discs on the side cover receptacles for lines to remote microphones and loud speakers. Above is the interior, showing radio, microphone mixer, amplifier and control panels. This equipment provides up to 50 watts of undistorted power



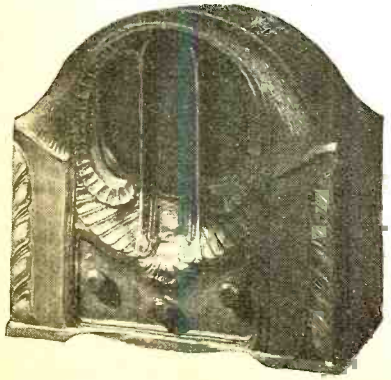
Shown below is a view of the Stevens Hotel at Chicago, which is the scene of this year's radio trade show

What's New *at the* Trade Show

As a service to dealers and servicemen, the following pages are devoted to descriptions of new radio apparatus to be seen at the trade show

Midget Receiver

Description—The new Super Buddy Boy is an eight-tube superheterodyne midget receiver using a pentode tube in



the power output stage, multi-mu tubes in the radio-frequency and intermediate-frequency amplifiers. The oscillator is of the pliodynatron type. The receiver is provided with a dynamic speaker, a continuous (stepless) static control and a variable tone control. It is also equipped with the new development known as the "tennaboard," which eliminates the necessity for both antenna and ground on local and powerful distant stations. The receiver and reproducer are housed in a one-piece moulded cabinet.

Maker—The Crosley Radio Corporation, Cincinnati, O.

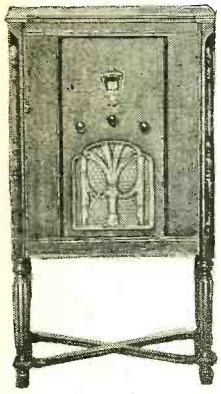
Midget Receiver

Description—This model No. 69 superheterodyne midget receiver utilizes eight tubes, which include three –24 screen-grid tubes, two –27 type tubes, two –45 type tubes and one –80 type rectifier tube. It is equipped with a full-range tone control and a Magnavox dynamic speaker. A highly polished, matched walnut cabinet with a recessed panel of burl walnut houses

the receiver chassis and reproducer.

Maker—Jackson-Bell Company, Los Angeles, Calif.

A Compact Receiver



Description—This Junior Console 8-tube superheterodyne receiver is particularly adapted to small apartments. It is a full-range set and does not sacrifice performance for size. The receiver is equipped with the newly perfected super-control (multi-mu) tube, which minimizes cross talk, cuts down distortion on strong signals and eliminates the necessity of a local-distant switch. It is provided with phonograph input terminals and an eight-inch dynamic speaker. The sets, with tubes in place, are tested at the factory and are shipped without removing the approved tubes from the sockets. This model measures 38½ inches high by 21¼ inches wide by 11¾ inches deep.

Maker — General Electric Company, Bridgeport, Conn.

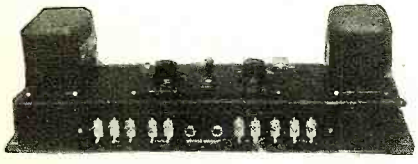
Mantel Receiving Set

Description — A five-tube midget receiver which employs two –24 type screen-grid tubes, one –27 type tube, one –80 type rectifier tube and one of the new type pentode tubes in the power output stage. It is equipped with a Rola dynamic speaker and a tone control. A walnut cabinet of modern design measuring 18 inches high by 15 inches wide by 9½ inches deep houses the receiver chassis and speaker unit.

Maker—Dubilier Clock Corp., 40 West 17th St., New York.

Master Control

Description—A control panel for use with any Amertran series 80 amplifier or other standard amplifier having a 500-ohm input circuit. The function of this unit is to control volume, select signals from a 500- or 200-ohm source, and to regulate

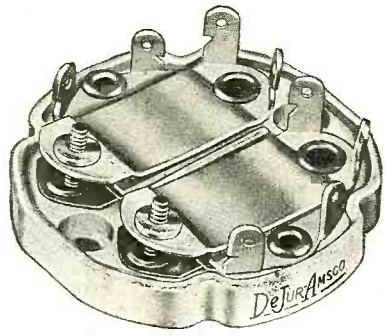


operating current to the 200-ohm source. The volume control is a T-pad attenuator of constant impedance, which provides a zero to maximum control of volume without distortion. A potentiometer controls the operating current and jacks are provided for a meter to measure the current in each half of the circuit. A battery switch and a two-way selector switch are also furnished with the instrument. It measures 19 inches in width.

Maker—The American Transformer Co., 178 Emmet St., Newark, N. J.

Small Fixed-Variable Capacitor

Description—This new line of condenser units is designed to meet the requirements for semi-variable or fixed-variable capacitors in radio-frequency and superheterodyne circuits. These semi-variable capacitors or "Varitors" are made in single



and duplex units with individual variable sections of 70 mmfd. These variable sections may be supplied either alone, with a minimum capacity of 4 mmfd., or in combination with an integral fixed capacity of 70 mmfd. They are mounted on an insulating base of isolantite and have been so designed as to be easily adapted to a variety of convenient mountings.

Maker—DeJur-Amsco Corp., 95 Morton St., New York.

Radio Set Tester

Description—A carefully designed radio set tester and analyzer with separate meters to simplify the operation of the instrument and to provide complete readings on screen-grid circuits. The follow-

ing new developments have been incorporated in this device: A self-contained ohm meter, a capacity meter, resistors for reading line voltages and transformer secondaries up to 160 and 800 volts, pin jacks for the external use of meters and complete switching and pin jack arrangement for effecting connections to the various circuits.

Maker—The Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland, Ohio.

A.C. Pentode Tube

Outstanding feature: Good power handling ability and high voltage amplification.

Usage: Output power amplifier.

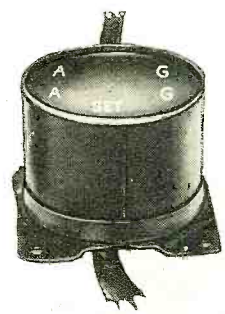
Type Number –47.
PZ (Arcturus).

Filament voltage	2.5 volts
Filament current	1.5 amperes
Plate voltage, recommended	250 volts
Screen voltage, recom. & max.	250 volts
Grid voltage	—16.5 volts
Plate current	32 ma.
Screen current	7.5 ma.
Plate resistance	38,000 ohms
Mutual conductance	2500 microhos
Load resistance, approximate	7000 ohms
Power output	2.5 watts

MAKERS

Arcturus Radio Tube Co., Newark, N. J.
DeForest Radio Company, Passaic, N. J.
CeCo Mfg. Company, Providence, R. I.
E. T. Cunningham, Inc., New York, N. Y.
National Carbon Co., Inc., (Eveready Raytheon) New York, N .Y.
Sylvania Products Co., Emporium, Pa.
RCA Radiotron Co., Inc., Harrison, N. J.

Antenna Filter



Description—This antenna filter is useful for hotel and apartment house radio installations or in large homes where there is more than one radio receiver. This device is designed to permit a number of receivers to operate from a single antenna without interfering with one another. It is easy to install, and measures 2½ inches by 1¾ inches.

Maker—Varion Products Co., Inc., 402 West Broadway, New York.

A Compact Superheterodyne Midget Receiver

Description: This is an eight-tube superheterodyne receiver. It utilizes three screen-grid tubes and has a push-pull power output stage with two type –45 tubes. A feature of this set is the pair of extension speaker jacks that will per-

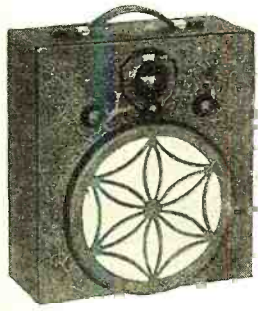
mit the operation of extra speakers beside the receiver speaker contained in the cabinet. No tools or changes in the circuit are required in connecting the extra speakers. Simply plug the speaker cord of the extra reproducer in the extension jack.

Usage: For the reception of broadcasting.

Maker: Silver-Marshall Company, Chicago, Ill.

A Portable Radio Receiver

Description—A car-electric radio set for use in an automobile or for the many occasions where a portable receiver is desired. This receiver is so designed that it is possible to operate it from the automobile storage battery or from the electric light supply line by simply plugging



in the proper one of the two connector cables provided for the purpose. The set uses four –24 type screen-grid tubes, one –71A type power tube, and one –80 type rectifier tube. The receiver and reproducer are enclosed in a cast aluminum case measuring 14 inches high by 12 inches wide by 5 inches deep.

Maker — Crescent Radio Mfg. Co., Minneapolis, Minn.

Screen-Grid Automobile Radio Tube

Outstanding feature: Designed for d.c. use in automobile receivers or sets operated from the direct current house supply lines. Freedom from microphonic disturbances. Cathodes are indirectly heated and are designed to provide satisfactory operation over a wide variation of filament voltages.

Usage: For radio-frequency amplifier and detector.

Type Number –36.

Heater voltage	6.3 volts d.c.		
Heater current	0.3 ampere		
Plate voltage	90**	135	135* volts
Screen voltage	55**	67.5	75* volts
Grid voltage	–1.5**	–1.5	–1.5* volts
Plate current	1.8	3	3.5 ma.

Screen current..not over ⅓ of plate current
Plate resist. 200,000 300,000...250,000 ohms
Amplification fac. 170..315..... .. 275
Mutual conduct. 850.1050.1100 micromhos
Approximate interelectrode capacitances:
Grid to plate .....0.010 max. uuf.
Input .....4 uuf.
Output .....9 uuf.
*Recommended values for use in automobile receivers.

**Recommended values for use in receivers designed for 110 volt d.c. operation.

MAKERS

CeCo Mfg. Co., Providence, R. I.

E. T. Cunningham, Inc., New York, N. Y.

National Carbon Co., Inc., (Eveready Raytheon) New York, N. Y.

RCA Radiotron Co., Inc., Harrison, New Jersey.

Type Number SY-236.

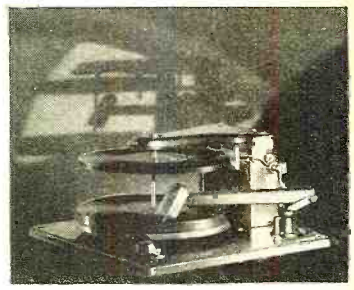
Filament volts	6.5
Filament amps	.275
Plate volts	135
Screen volts	90
Control grid bias	–2.5
Plate current	4.0 ma.
Screen current	(approx.) .5 ma.
Mutual conductance	1200
Amplification factor	300

Same base connections as standard 224 tube

Maker: Sylvania Products Co., Emporium, Pa.

Automatic Record Changer

Description—This new automatic record changer provides a means for modernizing radio receivers and is particularly adapted to public address installation. It is capable of providing an uninterrupted program of ten of either 10-inch or 12-inch records. A recording may be repeated by simply raising the record magazine to a perpendicular position. The instrument is provided with a rejecting device and record unloading lever and is available with a special five-terminal



pick-up matching transformer which permits the matching of the pick-up impedance with most radio sets and amplifiers. The base dimensions are 14¼ inches by 14¼ inches, the height above mounting board 7¼ inches and the depth below mounting board 3 15/16 inches.

Maker—The Capehart Corp., Fort Wayne, Ind.

Complete Television Kit

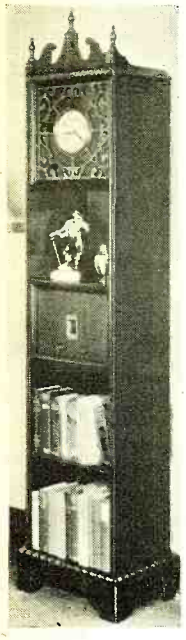
Description—The accompanying illustrations show a complete outfit for building a television receiver at home. One of the two kits shown includes all

the necessary parts for the televisor itself. The other includes the parts for short-wave television receiver and the power pack. Complete directions are included with the kits so that the average handy man can assemble the components

with a high-grade television outfit as a result of his efforts.

Maker—Jenkins Television Corp., Passaic, N. J.

An Attractive Radio Receiver



Description—This colonial grandfather clock model offers a unique and attractive appearance, with its space for books and bric-à-brac above and below the radio receiver. Seven tubes are employed in the radio set, four of which are of the screen-grid type. It is equipped with a full-range tone control and power dynamic speaker. The compartment for the reproducer contains an electric clock measuring approximately 5½ inches in diameter, which is mounted in the center of the speaker grille. The case is finished in mahogany veneer and measures 78½ inches in height by 17½ inches wide by 13½ inches deep.

Maker—Ottawa Furniture Company, Holland, Michigan.

Metallized Resistors

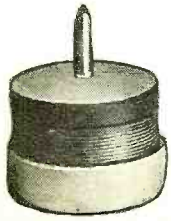
Description—A series of metallized resistors employing the new type of element known as the "K" filament. The new resistor is more rugged and durable and capable of handling a heavier load, and it is

possible with the new type of "K" filament to obtain closer tolerances. The metallized resistors are available in ½, 1, 2, 3 and 5 watt ratings and can be supplied in either the cartridge or pigtail types.

Maker—Lynch Mfg. Company, 1775 Broadway, New York.

Level Glides

Description—Adjustable rubberized level glides attached to the feet of a cabinet to absorb or take up the many jolts and jars that would be ordinarily



transmitted from the floor, through the legs of the cabinet to the tubes and parts of the radio receiver. They are a means for improving radio reception and assist materially when moving heavy radio receivers. These units are adjustable for uneven flooring. A hammer is the only tool necessary for installing these level glides.

Maker—The Standard Cushion Co., P. O. Box 753, Bridgeport, Conn.

The New Variable Mu Tube

Outstanding features: Reduces cross-modulation and modulation distortion. Smoother volume control. Better adapted for use with automatic volume control.

Usage: Radio-frequency amplifier or detector.

Type Number R. C. A. 235—Cunningham 335.

Heater voltage .....2.5 volts a.c. or d.c.
Heater current.....1.75 amperes
Plate voltage ....180.....250 volts
Screen voltage.....75....90 volts maximum
Grid voltage, var. –1.5.....–3 volts minimum

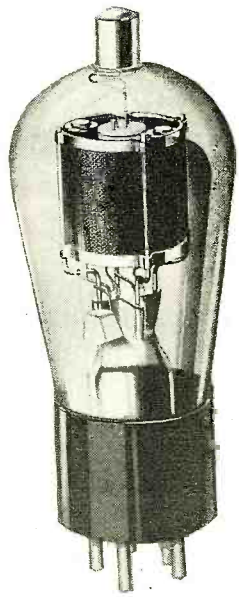


Plate current.....5.8.....6.5 ma.
Screen cur. (max.) 2.5.....2.5 ma.
Plate resist....350,000.....350,000 ohms
Amplif. factor....385..... 370
Mut. Conduct...1100.....1050 micromhos
at –40 volts bias 5.....15 micromhos
at –50 volts bias..... 1 micromho
Direct interelectrode capacitances:
Effective grid to plate cap. 0.010 uuf. max.
Input capacitance.....5 uuf.
Output capacitance.....10 uuf.

MAKERS

E. T. Cunningham, Inc., New York City.

RCA Radiotron Company, Harrison, New Jersey.

Type Number 235.

Heater voltage .....2.5 volts
Heater current .....1.75 amps.
Plate voltage .....250 volts
Screen-grid voltage (max.).....90 volts
Control-grid voltage.....—3 volts
Amplification factor.....300
Plate resistance .....300,000 ohms
Mutual conductance .....1000 micromhos
Plate current .....7 ma.
Screen-grid current, not over ⅓ of plate cur.
Effective-grid plate capacitance..0.010 max.
Input capacitance .....5 uuf.
Output capacitance .....10 uuf.

Maker: National Carbon Co., (Eveready Raytheon) New York, N. Y.

Type Number 235.

Filament voltage .....2.5 volts
Filament current.....1.75 amps.
Plate voltage .....180 volts
Plate current .....5.75 ma.
Screen grid voltage.....90 volts
Screen grid current.....less than 2.0 ma.
Control grid bias.....–3 volts
Mutual conductance .....1050 micromhos
Plate resistance.....350,000 ohms
Plate grid capacity..... .01 mmfd. max.

Maker: Sylvania Products Co., Emporium, Pa.

Type Number 451.

Filament voltage a.c.....2.5 volts
Filament current.....1.75 amperes
Plate voltage recommended.....180 volts
Screen voltage recommended.....90 volts
Mutual conductance at grid bias= –3..
.....1000 micromhos
Mutual conductance at grid bias = –20..
.....80 micromhos
Plate current at grid bias = –3....5.5 ma.
Plate current at grid bias = –20..0.65 ma.

Makers: DeForest Radio Company, Passaic, N. J.

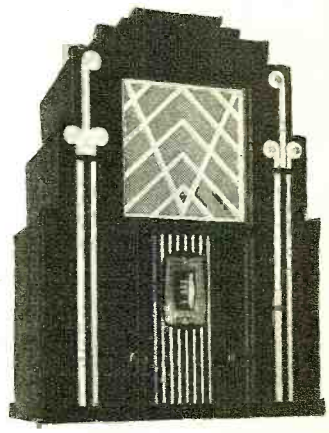
Type Number 551.

Filament voltage.....2.5 volts
Filament current.....1.75 amp.
Plate voltage .....180 volts
Screen grid voltage.....90 volts
Control-grid bias .....–3 volts
Plate current .....5.5 ma.
Screen current .....less than 2 ma.
Transconductance.....1000 micromhos
Plate resistance.....300,000 ohms
Plate-grid capacity ..... .006 mmfds.

Maker: Arcturus Radio Tube Company, Newark, N. J.

A Midget Receiver for A.C. and D.C. Supply

Description—This compact receiver is made in three types, namely, a.c., d.c. or battery type. The a.c. model utilizes three –24 type tubes, one –45 type tube and one –80 type rectifier tube. The d.c. and battery models employ three –32 type tubes and two –31 type tubes. The receiver is equipped with a dynamic



speaker, tone control and illuminated dial. Provision is made for electrical phonograph pick-up attachment. The cabinet is 19 inches high by 13¾ inches wide. It is modernistic in design, finished in ebony black with silver trimmings.

Maker—The Simplex Radio Company, Sandusky, Ohio.

Midget Receiver

Description—A new model No. 90 Radiette nine-tube superheterodyne receiver offering several features usually encountered only in larger type receivers. It is equipped with push-pull audio amplification using two –45 type tubes, an antenna

pre-selector, local-distance switch, tone control and phonograph connection. It also includes a tandem detector which provides an improvement in tone quality and permits the use of greater volume without overloading. The receiver chassis and speaker unit are encased in a cabinet measuring 19 inches by 14 inches by 10 inches.

Maker—Keller-Fuller Mfg. Co., Ltd., 1573 West Jefferson Blvd., Los Angeles, Calif.

Audio Amplifier

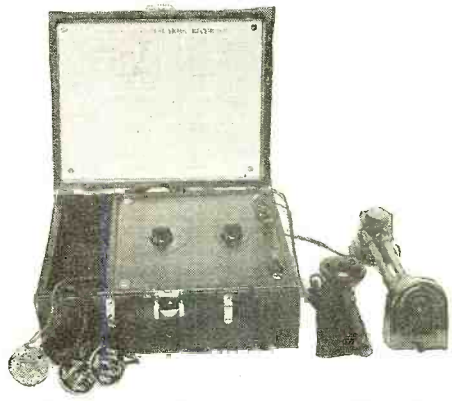
Description—A series of base type audio amplifiers especially designed for use in homes, small auditoriums and wherever portable audio-amplifying equipment is desired. The tubes employed are one –27 type tube, two –45 type tubes and one –80 type rectifier tube. This

type of amplifier is compact, light in weight and measures 13¾ inches by 6¾ inches by 6 inches. Three models are available and may be used with either a.c. or d.c. dynamic speakers.

Maker—Webster Electric Company, Racine, Wis.

Home Recorder

Description—It is a simple matter to install and operate the new model HR1 home recorder. It is possible with this device to make recording of your own voice or a record of your favorite radio program. The home recorder consists of a microphone, recording head, pick-up and a control cabinet complete with matching transformers, controls, connecting cords and adapters. This equipment, used with a suitable turntable and any modern radio receiver, makes a modern



radio-phonograph combination. Complete operating instructions are furnished with the instrument.

Maker—Best Manufacturing Co., 1200 Grove St., Irvington, N. J.

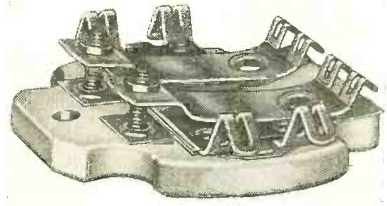
Line Voltage Control

Description—The automatic or self-adjusting line voltage regulator tube is suitable for use in all types of a.c.-operated radio receivers. It is possible with this device to maintain a uniform voltage to the radio set, irrespective of line voltage fluctuation between 100 and 140 volts. The automatic line voltage control may be installed without changes to the radio receiver, beyond simply connecting a mounting socket for the control unit in the power supply cable. A voltage control tube is also available for receivers operating on 220-volt line supply.

Maker—Amperite Corp., 561 Broadway, New York City.

Intermediate Tuning Condensers

Description—An intermediate tuning condenser designed for superheterodyne and other similar circuits. They are made in both single "ICS" type and in the dual "ICD" type. The dual type condensers are made in two sizes, 1 15/16 inches and 2⅜ inches. The single condenser base measures 1¾ inches by 15/16 inch. The capacity of these condensers ranges as follows: 10 to 70 mmfd., 70 to

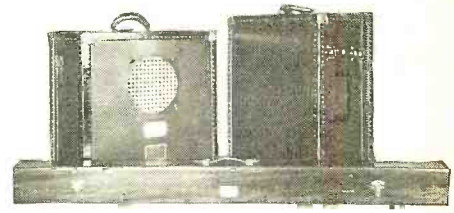


140 mmfd., and 140 to 220 mmfd. To provide stability the condenser is mounted on an insulating base of isolantite.

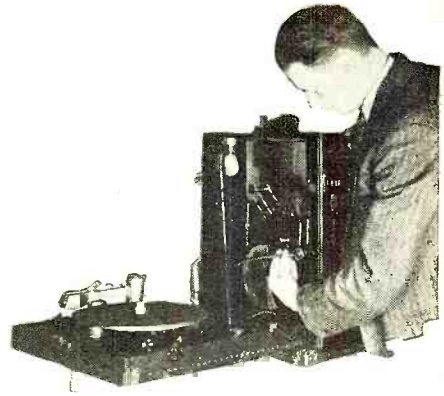
Maker—The Hammarlund Mfg. Co., Inc., 424 West 33rd St., New York.

Portable Sound Amplifying System

Description—The portable sixteen-millimeter, sound-on-disc projection equipment illustrated here comprises a carefully designed 16 mm. movie projector,



capable of showing a picture measuring 6½ feet by 8½ feet, a synchronized turntable, a type A audio amplifier, a full-range dynamic speaker and a sound screen. The turntable is synchronized with the projector by means of a flexible drive shaft. This sound system is capable of serving an audience of 150 people and

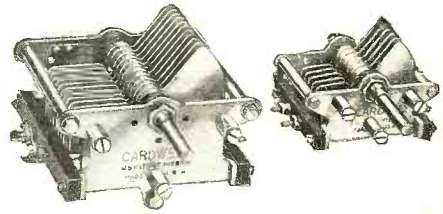


the same equipment is available with a more powerful amplifier for covering an audience up to 300 persons. The equipment is designed to operate on 110-volt, 60-cycle a.c. current; for d.c. current a converter can be supplied. The entire equipment, including roll screen, weighs 127 pounds and is contained in three carrying cases.

Maker—Pacent Reproducer Corp., 91 Seventh Ave., New York City.

Lightweight Variable Condensers

Description—These compact "Midway" variable condensers are adaptable for both transmitting and receiving purposes. They are only slightly larger than so-called "midget" condensers but feature the sturdy construction found in full size variable condensers. The maximum



capacities of the receiving condensers range from 26 mmfd. to 365 mmfd. The transmitting condensers range in capacity from 22 mmfd. to 150 mmfd. The overall mounting space required is only 2¾ inches by 2⅛ inches and the largest condenser weighs but 7 ounces.

Maker—Allen D. Cardwell Manufacturing Corp., 81 Prospect St., Brooklyn, N. Y.

The Band-Spread Coil

Description—A new coil unit designed for short-wave receivers which permits a spread of 50 dial divisions on the 20, 40 and 80-meter amateur short-wave bands. It can be made up to spread any other wave bands. In general appearance the band-spread coil is similar to the conventional short-wave plug-in coil except for the lead that comes out at the top for connection directly to the cap of the

screen-grid tube and the small grid leak, grid condenser and the variable trimmer condenser mounted inside the coil form. It is a simple job to apply these band-spread coils to home-built short-wave receivers, thereby providing the opportunity for more accurate control of tuning.

Maker—National Co., Inc., 61 Sherman St., Malden, Mass.

Aerial Lead-in Wire

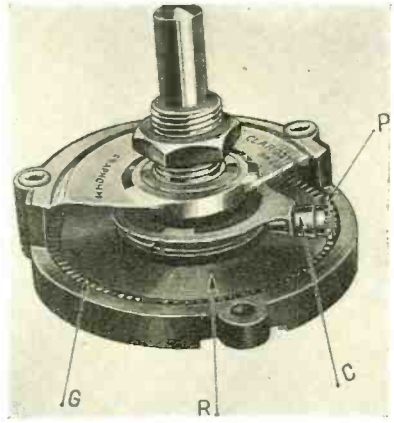
Description—This stranded copper wire is cotton wrapped and encased in gutta percha and cotton-braided covering, impregnated for dampproofing. It may be used for aerial, lead-in and ground wires. When this type of wire is used in one continuous length for the antenna it eliminates the separate lead-in wire and

window strip connector, as well as troublesome joints. It is non-corrosive and moisture proof. The sturdy insulation of the wire permits it to be used with equally good results as an indoor aerial.

Maker—The Holyoke Company, Inc., 621 Broadway, New York City.

Volume Control

Description—This graphite element volume control has a positive rolling contact which elimihates the possibility of erosion of the resistance element. The photograph below illustrates the principle by which a rotating motion is imparted to the contact roller (c) by means of a small pinion (P) secured to the contact

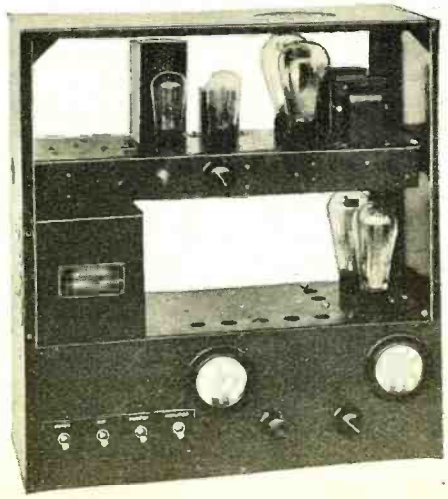


roller and engaging the gear tract (G) which is moulded at the outer periphery of the resistance element (R). This type of device will provide an accurate and noiseless volume control. They are available as rheostats or as potentiometers, and can be obtained tapered or without taper, with insulated or grounded shafts and in the usual resistance values from 1000 ohms up to 1 megohm.

Maker—Clarostat Mfg. Co., Inc., 285 North Sixth St., Brooklyn, N. Y.

Portable Projector Amplifier

Description—This new portable amplifier, type No. 408, is designed especially for use with sound projection equipment in combination with a photo-electric cell of the casium type. It is not necessary to employ a separate photo-electric cell amplifier with this device. There are no external batteries required, as this instrument is complete a.c.-operated, including the necessary voltage for

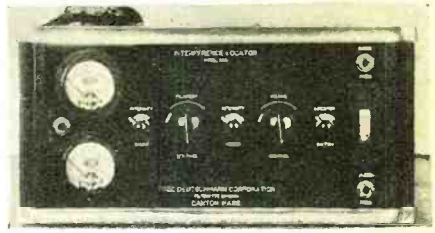


the photo-electric cell as well as the filament voltage for the exciter lamp. It measures 21 inches high by 19 inches wide by 8 inches deep.

Makers—Operadio Mfg. Co., St. Charles, Ill.

Interference Locator

Description—A new interference locator model No. 230 employing four stages of radio frequency using three –32 type screen-grid tubes, a –30 type tube for the detector and two –30 type tubes for the two stages of audio frequency. The output circuit of the audio amplifier includes a transformer feeding an intensity meter through a copper oxide rectifier. This meter provides a visual indication of interference intensity. The associated apparatus for the instrument includes a portable sectional antenna constructed of a hardwood handle, split bamboo section and resonance coil, completely wired and insulated to withstand 2200 volts, a separate inductive pick-up coil,



and a long, wide strap for carrying the locator. The instrument is enclosed in a special aluminum and bakelite case measuring 7 inches in width by 12½ inches in height and 13½ inches in length. The instrument, complete with batteries and tubes, weighs 35 pounds.

Maker—Tobe Deutschmann Corp., Canton, Mass.

A Dynatron Oscillator

Description—This oscillator, model 303, for the amateur wave band, employs the dynatron circuit, which is well known for its stability. It is provided with a meter to keep the space charge current constant and a micrometer dial for frequency variation. A coil for the 165-meter band is mounted externally and the harmonics of this coil provide the frequency signals for the 20-, 40- and 80-meter bands. The careful construction

and the use of high-grade parts insure against frequency variations. The unit measures 10 inches by 8 inches by 7¼ inches and it is supplied with a calibrated curve chart.

Maker—Wireless Egert Engineering, Inc., 179 Greenwich St., New York.

Oil Burner Filterette

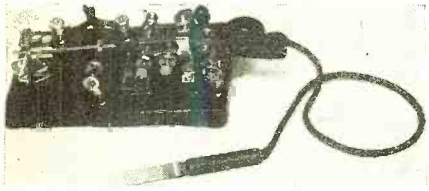
Description—This filterette is a carefully designed filtering device, comprising a balanced combination of capacity and inductance, to prevent the feed-back of radio interference from oil burners into

the power lines. It is available in either 110 volt or 220 volt types and is approved by the Underwriters Laboratories. The components are housed in a steel cabinet measuring 10 inches by 6⅜ inches by 3⅜ inches.

Maker—Tobe Deutschmann Corp., Canton, Mass.

Semi-Automatic Key

Description—A new transmitting key of the semi-automatic or "bug" type which is adjustable for speeds of eight to forty words per minute. A simple adjustment of the weights regulates the speed at which the dots are made. A shorting switch is provided for use on land lines where the circuit must be



closed. The contacts are sturdy and they will withstand the average load encountered in practice. Where the power is in excess of 15 watts a relay should be used. This type of key will provide a better signal with equally spaced dots and with less fatigue to the operator.

Maker—Brooklyn Metal Stamping Corp., Brooklyn, N. Y.

Midget Mica Condensers

Description—In general appearance the condensers shown here (type Nos. 1462 and 1463) are similar in electrical and

mechanical characteristics to the standard type No. 1460 condenser, except the condenser type No. 1462 has no insulated mounting holes while the condenser type No. 1463 has a single mounting hole. These condensers are moulded in bakelite which seals and protects them against extreme temperature, moisture or chemical action. They are made in capacities up to .006 mfd.

Maker—Aerovox Wireless Corp., 70 Washington St., Brooklyn, N. Y.

General Purpose Automobile Radio Tube

Outstanding feature: Designed for battery operation in automobile receivers and for sets operated from the direct current house supply lines. Freedom from microphonic disturbances. Cathodes are indirectly heated and are designed to provide satisfactory operation over a wide variation of filament voltages.

Usage: Detector, amplifier or oscillator.

Type Number –37.

Heater voltage		6.3 volts d.c.
Heater current		0.3 ampere
Plate voltage	90**	135* volts

Grid voltage	–6**	–9 volts
Plate current	2.7	4.5 ma.
Plate resistance	11,500	10,000 ohms
Amplification factor	9	9
Mutual conductance	780	900 micromhos
Load resistance***	14,000	12,500 ohms
Undistorted p'w'r output	30	75 milliwatts

Approximate interelectrode capacitances:

Grid to plate	2.0 uuf.
Grid to cathode	3.3 uuf.
Plate to cathode	2.3 uuf.

*Recommended values for use in automobile receivers.

**Recommended values for use in receivers designed for 110 volt d.c. operation.

***Optimum load resistance for maximum undistorted power output as given.

MAKERS

CeCo Mfg. Co., Providence, R. I.

E. T. Cunningham, Inc., New York, N. Y.

National Carbon Co., (Eveready Raytheon) New York, N. Y.

RCA Radiotron Co., Inc., Harrison, New Jersey.

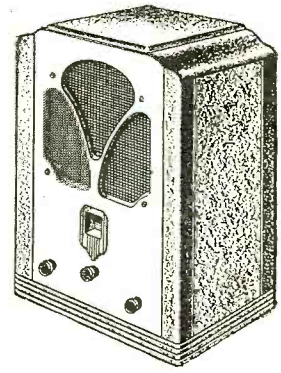
Type Number SY-237.

Filament volts	6.5
Filament amps	.275
Plate volts	135
Grid volts	–9.0
Plate current	4.5 ma.
Mutual conductance	1100
Amplification factor	10.0

Maker: Sylvania Products Co., Emporium, Pa.

Table Model Receiver

Description—A new eight-tube superheterodyne receiver, of the table model size, to be known as the "Columette." The controls on the front of the cabinet include the station selector knob, a volume control and a tone control. The on-

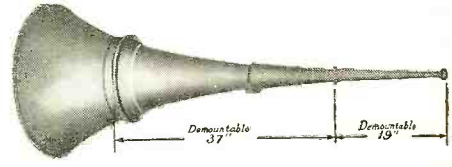


off switch is mounted on the side of the cabinet. The receiver chassis and loud speaker are contained in a two-tone American walnut cabinet measuring less than a foot square at the bottom and only 19 inches in height.

Maker—Westinghouse Electric & Mfg. Co., Mansfield, O.

Portable Trumpet Horn

Description—A six-foot stormproof portable horn which is in three demountable sections. This type of horn is adapted to sound-amplifying equipment, especially on sound trucks where storage space is limited. It is provided with a cast aluminum throat and cast aluminum sections at all joints. This same style of



horn is made in non-demountable type. The horn measures 6 feet in length, the diameter of the bell is 30 inches and it weighs 27 pounds.

Maker—Racon Electric Co., Inc., 18 Washington Place, New York City.

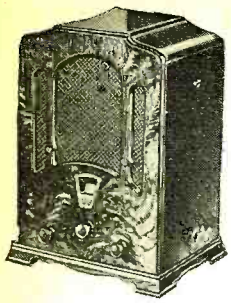
Service Equipment Set

Description—This convenient kit of neutralizing, balancing and aligning tools for the serviceman, radio experimenter or dealer is constructed so the tools telescope for portability. The screwdriver fitting inside the duplex socket wrench.

The set comprises a large and small socket wrench, a screwdriver and a special magnet steel for placing or retrieving bolts, nuts and other small hardware. The wrenches and screwdriver are fully insulated for making adjustments under operating conditions.

Maker—Insuline Corp. of America, 78 Cortlandt St., New York.

A Midget Superheterodyne

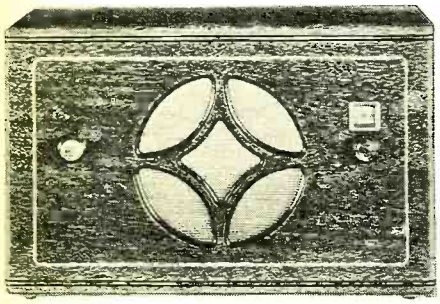


Description—A new mantel type eight-tube superheterodyne receiver which employs the new multi-mu tube in the first stage of radio-frequency and in the intermediate-frequency stage. These new multi-mu tubes reduce cross-talk interference and make possible a smoother control of volume without the use of a local-distance switch. The oscillator and second detector use a –27 type tube, for the first detector there is a –24 type screen-grid tube, two –45 type tubes are utilized in the power output stage and a type –80 tube for the rectifier. The receiver is equipped with a tone control.

Maker—RCA-Victor Company, Inc., Camden, N. J.

A Compact Radio Receiver

Description—A tiny five-tube radio receiver, measuring only 14¾ inches long by 8¾ inches high by 6¾ inches deep, which is capable of providing radio reception to compare favorably with the reception available from full-size sets. The



receiver chassis and reproducer are contained in a solid mahogany cabinet. The front of the cabinet is finished with a decorative border inlay, and has a plain circular grille opening for the electro-dynamic speaker.

Maker—United American Bosch Corp., Springfield, Mass.

Dry Cell Pentode Tube

Outstanding feature: Designed for battery receivers. Capable of handling a large amount of power. Provides high voltage amplification.

Usage: Output power amplifier.

Type Number –33.

Filament voltage	2.0 volts
Filament current	0.260 amperes
Plate voltage	135 volts
Screen voltage	135 volts
Grid voltage	13.5 volts
Plate current	14 milliamperes
Screen current	3 milliamperes
Plate resistance	45,000 ohms
Mutual conductance	1400 micromhos
Amplification factor	63
Load resistance	7500 ohms
Undistorted power output	650 milliwatts

MAKERS

E. T. Cunningham, Inc., New York, N. Y.

National Carbon Co., (Eveready Raytheon) New York, N. Y.

Sylvania Products Co., Emporium, Pa.

RCA Radiotron Co., Inc., Harrison, N. J.

Automobile Radio Pentode

Outstanding feature: Designed for use in automobile receivers or sets operated from the direct current house supply lines. Good power handling ability. High voltage amplification.

Usage: Output power amplifier.

Type Number –38.

Heater voltages	6.3 volts
Heater current	0.3 ampere
Plate voltage, recommended	135 volts
Screen voltage, recommended	135 volts
Grid voltage	–13.5 volts
Plate current	8 milliamperes
Screen current	2.5 milliamperes

Plate resistance	110,000 ohms
Amplification factor	100
Mutual conductance	900 micromhos
Load resistance	15,000 ohms
Undistorted power output	375 milliwatts

MAKERS

CeCo Mfg. Co., Providence, R. I.

E. T. Cunningham, Inc., New York, N. Y.

National Carbon Co., (Eveready Raytheon) New York, N. Y.

RCA Radiotron Co., Harrison, N. J.

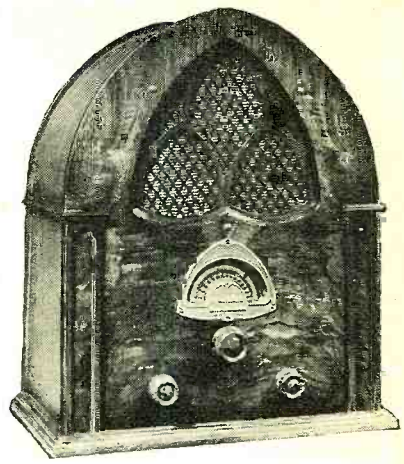
Type Number SY-238.

Filament volts	6.5 volts
Filament amperes	.275 amp.
Plate volts	135 volts
Grid volts	–13.5 volts
Screen volts	135 volts
Plate current	9.0 ma.
Mutual conductance	1000 micromhos
Power output	425 milliwatts

Maker: Sylvania Products Co., Emporium, Pa.

New Compact Receiver

Description—Model No. 84, six-tube midget receiver which employs the new pentode tube in a superheterodyne circuit. The receiver utilizes three –24 type screen-grid tubes, one –27 type tube, one –80 type rectifier tube, and the new pentode tube in the power output stage. The receiver features a quick vision dial, an antenna adjuster and an armored chassis fully shielded to prevent radiation. The

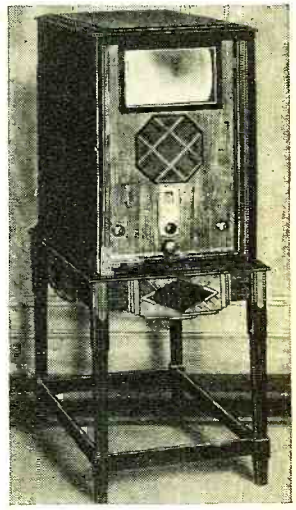


cabinet is of cathedral Gothic design and measures 19 inches by 15⅝ inches by 9⅝ inches.

Maker—Atwater Kent Mfg. Co., Philadelphia, Pa.

Standard Television Receiver

Description—A new television console for the regular home reproduction of television pictures. It includes a short-wave television receiver, which can also be used to pick up short-wave broadcast programs for reproduction through the loud speaker which is a part of the console. The televisor portion of this set employs



a neon tube with a plate 2 by 2⅛ inches, and a wide angle, especially corrected lens system which provides pictures 8 by 10 inches in size. The set is marketed complete for operation from a.c. lines.

Maker—Short Wave & Television Corporation, 70 Brookline Ave., Boston, Mass.

Mantel Receiver

Description—The Lafayette Duo-Symphonic six-tube, tuned radio-frequency receiver employs four –24 type screen-grid tubes, one –45 type power tube and

(*Continued on page* 96)

Backstage in Broadcasting

Chatty bits of news on what is happening before the microphone. Personal interviews with broadcast artists and executives. Trends and developments of studio technique

By Samuel Kaufman

TERMED "an experiment to awaken a desire for self-expression in music," the National Broadcasting Company has launched a unique series of semi-weekly programs to promote the study of piano playing. Sigmund Spaeth and Osbourne McConathy, prominent authors and lecturers on music, are conducting the programs. Mr. Spaeth directs the Saturday "Keys to Happiness" periods, while Mr. McConathy supervises the Tuesday "Music in the Air" programs.

The programs are neither "sponsored" nor "sustaining." A network representative tells us they come under the classification of "institutional." The broadcasts are offered free of all charges to associated stations, the NBC paying the wire-line tolls. In the case of "sustaining" programs, the member stations pay these costs.

Sigmund Spaeth

The Radio Music Company, a network subsidiary, is prominently identified with the series and had published, for free distribution to listeners, charts bearing keyboard diagrams and specimen music bars to supplement the received programs. Requests for 55,000 charts reached the chain's offices within a few weeks. The charts are designed to fit into the slot behind the piano keyboard to facilitate the instructions of the invisible radio tutor.

Special emphasis has been placed by network officials on the fact that the series is not a "course," but merely a group of programs to prove the ease of learning to play. All applicants for charts are strongly urged to continue their piano studies under the guidance of a personal instructor. As a gesture of good will to music teachers, the network recently invited 600 piano instructors of the New York area to the Times Square studio for one of the Tuesday broadcasts. In addition to witnessing the microphone presentation, the assemblage was addressed by Merlin H. Aylesworth, president of the NBC.

A BROADCASTING executive recently remarked to us that all of the smash-hits in radio were men. There have always been many female broadcasters who maintained high standards of popularity, but we must agree that no artist of the fairer sex ever approached the marks set by Amos 'n' Andy, Floyd Gibbons and Rudy Vallee. Now, a National Broadcasting Company spokesman whispers in our ear that his network has realized this situation and is endeavoring to introduce new female artists on featured program spots.

Among the female headliners recently added to the NBC schedule are the Boswell Sisters — three of 'em — namely,

The Boswell Sisters

Martha, Connie and Vet. A network scout spotted the trio of Louisiana belles on a movie lot in Hollywood. After a brief tryout on a San Francisco station, the sizzlin', jazzin', harmonizin' sisters were dispatched to New York and network stardom. They arrived in New York in February and in two months their fan mail equaled that of stars of much longer standing. When we interviewed the girls in their own studio, we were surprised to find that they play every instrument used in a dance orchestra. Connie expects to conduct her own orchestra on the air in the near future. They compose music and frequently arrange their own orchestrations for radio programs and phonograph recordings. Their greatest pleasure in facing the microphone is the knowledge that Pa Boswell, down in New Orleans, is listening to them.

DALE WIMBROW, the Columbia Broadcasting System's veteran songster and ukulele player, has designed a six-string ukulele recently put on the market. We ran into Dale in the WABC studios and he serenaded us with his new instrument. Dale tells us that he's not any longer publishing all the songs he composes for his programs. "While comedy and novelty songs may click far and wide on the radio," Dale remarks, "there is a limited demand for published copies." Dale carries a ledger-size scrap-book containing a complete record of his radio career. Ask him a question, and he thumbs the pages until he reaches the spot revealing the answer.

BEING in the vicinity of the Columbia studios one recent Wednesday evening, we decided to pay a visit to Miss Evangeline Adams during her astrological broadcast. We expected to find Miss Adams in the small studio usually designated for speakers and were somewhat surprised to be conducted into the largest of the chain's seven studios. Here were assembled the members of a sizable orchestra for the purpose of playing a musical prelude and finale to the program. Miss Adams, herself, sat at a desk and spoke into a cylindrical microphone lowered from the ceiling by a pulley arrangement. Miss Adams' thrice weekly program makes her the recipient of thousands of fan letters following each broadcast. The noted astrologer attributes her long study of the Zodiac to her scholastic love for mathematics, history and philosophy. She saw astrology as a field that included all of the subjects she favored, she said.

STARTING at the top and proceeding downward would not readily indicate progress. Yet in the instance of the Columbia Broadcasting System it reflects rapid growth and expansion. When the chain's headquarters were moved into the CBS structure on Madison Avenue, they occupied some of the tower floors. When additional space was needed, expansion to

(*Continued on page* 94)

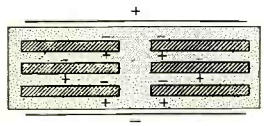
Latest Radio Patents

A description of the newest patented inventions on radio, television, acoustics and electronics as they are granted by the United States Patent Office. This information will be found a handy radio reference for inventors, engineers, set designers and production men in establishing the dates of record, as well as describing the important radio inventions

Conducted by

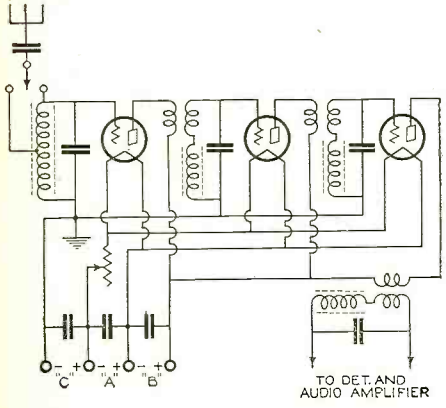
Ben J. Chromy*

1,798,101. ORIENTATION OF COMPONENT CRYSTALS IN COMPOSITE PIEZO-ELECTRIC DEVICES. ALEXANDER MCLEAN NICOLSON, New York, N. Y., assignor to Communication Patents, Inc., New York, N. Y., a Corporation of Delaware. Filed Dec. 20, 1926. Serial No. 155,902. 10 Claims. (Cl. 171—327.)



1. A composite piezo-electric crystal device comprising a plurality of symmetrical crystal sections, arranged in line parallel to the *a*-axis and with the *c*-axes parallel, and physically secured into a single entity by means of a hard and resilient binder enveloping said crystals.

1,798,012. ART OF RADIO SIGNALING. LOUIS COHEN, Washington, D. C., and AUGUST HUND, Battery Park, Md. Filed Mar. 2, 1927. Serial No. 172,016. 6 Claims. (Cl. 179—171.)

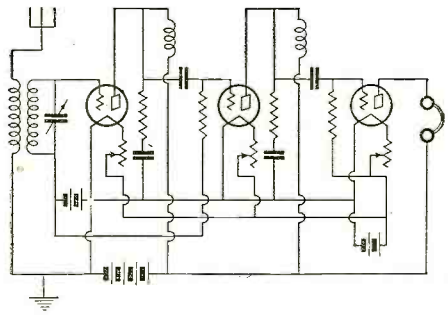


1. In a multi-tuned circuit system comprising several independent tuning circuits, each of said independent tuning circuits consisting of an inductance coil and condenser, a metal tube surrounding each of said inductance coils, means for connecting all of the said metal tubes whereby the tuning of all of said tuning circuits may be effected simultaneously by a movement of the metal tubes over the said inductances.

1,797,371. RADIO STATIC ELIMINATION. CHARLES H. SEYMOUR, Kansas City, Mo. Filed Feb. 23, 1929. Serial No. 342,312. 16 Claims. (Cl. 250—20.)

1. In radio static elimination, the process consisting in heating to a red heat and cooling by contact with oleoresinous material, an electric conductor, which, when so treated, has the characteristic of reducing static disturbances in a radio receiving set, when used therein as a radio wave receiving element.

1,797,988. RADIO RECEIVING SYSTEM. EARL L. KOCH, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill., a Corporation of Illinois. Filed June 1, 1926. Serial No. 112,739. 2 Claims. (Cl. 179—171.)

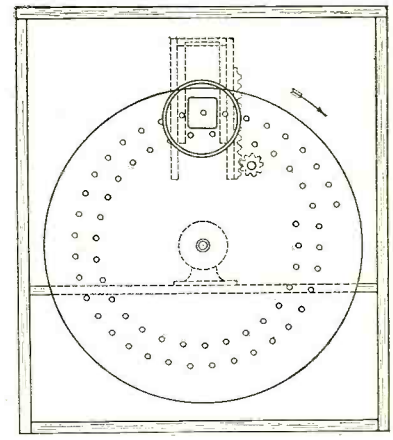


1. A circuit combination including a pair of vacuum tubes provided with cathode, grid and plate elements for amplifying high-frequency currents, a source of potential having its one pole connected directly to the cathodes of said tubes, an individual high-frequency choke coil connected between each of said plates and said source of current for preventing high-frequency currents from passing through said connections to said source of potential, another connection extending directly from the plate of one of said tubes to the cathode of said tube and including a resistance and a capacity for completing the plate cathode circuit, a third circuit extending directly from the plate of said first tube to the grid of said second tube and including only a condenser, and biasing circuit for the grid of said second tube extending directly from said grid to the cathode of said first tube and including potentializing means.

1,797,778. ELECTROSTATIC DEVICE FOR SOUND REPRODUCTION. COLIN KYLE, Geneva, Ill., assignor, by mesne assignments, to United Reproducers Patents Corporation, St. Charles, Ill., a Corporation of Nevada. Filed Oct. 5, 1928. Serial No. 310,474. 7 Claims. (Cl. 179—111.)

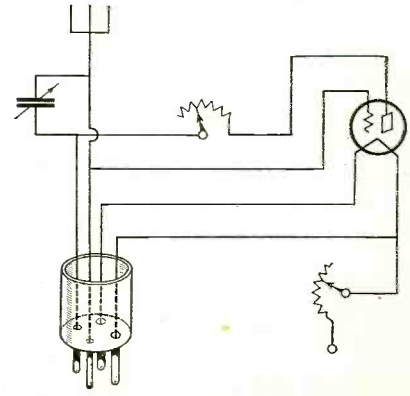
1. An electrostatic sound reproducer comprising conductors and an interposed dielectric having a slight amount of conductivity for the rapid dissipation of static charges tending to remain residually in the dielectric.

1,797,259. TELEVISION. ROBERT L. DAVIS, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Company, a Corporation of Pennsylvania. Filed June 23, 1928. Serial No. 287,823. 6 Claims. (Cl. 171—6.)



1. In a television receiver, a scanning device, motive means for said device, a viewing assembly and means for moving said viewing assembly bodily in a radial direction with respect to said scanning means, whereby the effect of a change in the amplifier relation between said scanning device and said motive means is obtained and the received picture may be framed.

1,797,307. INTERFERENCE ELIMINATOR FOR RADIO RECEIVERS. ANDREW M. WIEHL, San Francisco, Calif., assignor of one-half to Harry R. Baumann, Oakland, Calif. Filed July 2, 1929. Serial No. 375,492. 1 Claim. (Cl. 250—20.)



In combination with a radio receiving set having a radio-frequency amplifying stage, an electron tube having a plate, a grid, and a filament, a condenser connected in parallel with the said plate and the said grid, antenna means connected to the said grid, conductor

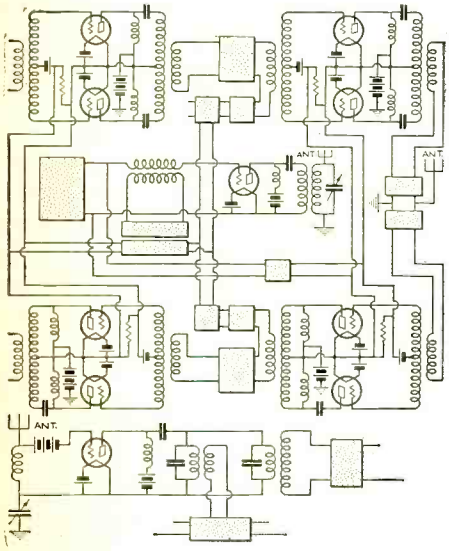
*Patent Attorney, National Press Building, Washington, D. C.

means connecting the said plate, grid and filament respectively to the plate, grid and filament terminals of the tube socket of the radio-frequency amplifying stage of the receiving set and from which socket an electron tube has been removed, and a rheostat connected between the filament of the first named electron tube and the antenna terminal of the receiving set.

1,797,317. BINAURAL PHASE-DISCRIMINATION RADIO SYSTEM. SMART BRAND, Brooklyn, and PIERRE MERTZ, Bellerose Manor, N. Y., assignors to American Telephone and Telegraph Company, a Corporation of New York. Filed Dec. 20, 1928. Serial No. 327,382. 7 Claims. (Cl. 179—15.)

4. In a high-frequency signaling system the method of receiving messages which comprises modulating the transmitted side bands together without the corresponding carrier, selecting from the product of such modulation one of the harmonics of the carrier frequency to which the side bands correspond, and utilizing said selected harmonic frequency to control the phase and frequency of the local carrier frequency utilized for detection.

1,797,284. HIGH-FREQUENCY SIGNALING. ROY E. CORAM, Newark, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a Corporation of New York. Filed Nov. 24, 1923. Serial No. 676,842. 20 Claims. (Cl. 250—9.)

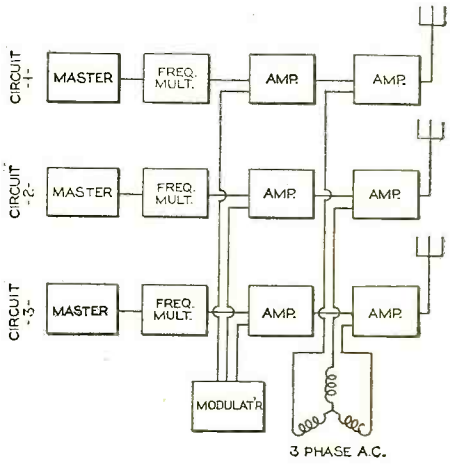


3. The method of radio signaling between two stations which consists in transmitting suppressed carrier modulated carrier waves of the same carrier frequency from the two stations, and controlling the frequency of the carrier wave at one station by a control wave transmitted from the other station, said control wave being derived and transmitted independently of said modulated carrier wave transmission.

1,797,587. CURRENT RECTIFYING APPARATUS. LESLIE HURST PETER, London, England, assignor, by mesne assignments, to The Union Switch & Signal Company, Swissdale, Pa., a Corporation of Pennsylvania. Filed Mar. 29, 1927, Serial No. 179,275, and in Great Britain May 10, 1926. 13 Claims. (Cl. 175—366.)

2. In combination, a rectifying element comprising a metallic body having a coating of a compound of the metal formed thereon, a container surrounding said element, and a mercury under pressure in said container around said element.

1,797,746. MULTIPLE-CHANNEL MULTIPHASE ANTI-FADE SYSTEM. LEO C. YOUNG, Washington, D. C., assignor, by mesne assignments, to Federal Telegraph Company, a Corporation of California. Filed July 20, 1928. Serial No. 294,286. 20 Claims. (Cl. 250—2.)



1. In a transmitting system the combination of a plurality of individual sources of energy each source having frequency characteristics different from the other, a plurality of load circuits, and a polyphase actuating circuit for rendering said individual sources of energy successively effective upon said load circuits.

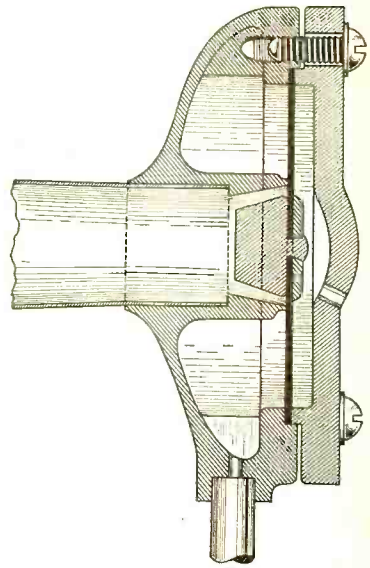
1,789,521. TELEVISION SYSTEM. SAMUEL FEINGOLD, Brooklyn, N. Y. Filed Apr. 10, 1928. Serial No. 268,912. 17 Claims.

1. In a television system, a transmitting station, a receiving station, an image located at said transmitting station, a piezo electric crystal at said transmitting station arranged to scan said image, a piezo electric crystal at said receiving station, means common to said piezo electric crystals at each station for operating said crystals in synchronism, a photo-electric cell at said transmitting station, means including said scanning crystals at said transmitting station for subjecting said photo-electric cell to light rays from successive portions of said image, means including said photo-electric cell for transmitting currents to said receiving station in accordance with the intensity of light from said image to which said photo-electric cell is subjective, and a piezo electric crystal at said receiving station responsive to said picture current for varying a source of light thereat in accordance with the variation of said current.

1,797,424. SOUND PRODUCER. CECIL S. KELLEY, East McKeesport, Pa., assignor to The Westinghouse Air Brake Company, Wilmerding, Pa., a Corporation of Pennsylvania. Filed June 18, 1930. Serial No. 461,962. 4 Claims. (Cl. 116—142.)

1. A sound-producing device comprising a flexible diaphragm adapted to be operated by fluid under pressure, a weight mounted on one side of said diaphragm for controlling the operation thereof, the portion of said weight facing said diaphragm having a surface of relatively small area bearing against the diaphragm and a surface of greater area spaced slightly from the diaphragm when the diaphragm is in its normal inoperative position, and means for rigidly fastening the weight to the diaphragm, comprising a washer disposed on the side of the diaphragm opposite to the weight, said washer having an area greater than the area of the bearing surface of the weight, and a headed shank projecting rearwardly from the weight and passing through the diaphragm and washer.

1,797,349. SOUND PRODUCER. CECIL S. KELLEY, East McKeesport, Pa., assignor to The Westinghouse Air Brake Company, Wilmerding, Pa., a Corporation of Pennsylvania. Filed June 18, 1930. Serial No. 461,961. 4 Claims. (Cl. 116—142.)



1. A sound-producing device comprising a casing having a chamber, a flexible diaphragm subject to the pressure of fluid in said chamber, a vent tube normally in engagement with said diaphragm, a weighted member carried by said diaphragm for regulating the vibratory movement of said diaphragm, and means on the weighted member for damping the movement of the diaphragm.

1,791,377. ELECTRIC FILTER DEVICE OR SYSTEM. JULIEN J. PROSKAUER and HAROLD SHEVERS, New York, N. Y. Filed Feb. 20, 1929. Serial No. 341,437. 1 Claim.

In an electric filter device for eliminating extraneous oscillations from a radio apparatus and adapted to be inserted in the circuit connecting said radio apparatus to a main power supply circuit, the combination with the said power supply circuit of a plurality of rectangularly shaped choke coils, each of said coils comprising a plurality of rectangular turns and rectangular stiffening members, means for connecting one end of each of said choke coils to said power supply circuit, a pair of rectangular condensers connected in series relationship to the other ends of said choke coils, means for binding said condensers together to form a compact unitary structure, means comprising a cylindrical container provided with an opening and adapted to receive and protect said choke coils and said condensers, means carried by a part of said container for establishing a connection from said radio apparatus to the common connection between said choke coils and said condensers, and means for establishing a ground from the common connection between said condensers, said ground establishing means and said connections to the power supply circuit comprising flexible leads passing through said opening in said container.

(*Continued on page 68*)

The Service Bench

by ZEH BOUCK

Selling Service—Making Money with the New Tubes—Tool Kit for the Sound Expert—Profits in Phonograph Pick-ups—Silencing Dial 'Phones —A Noisy Freed NR-95—Servicing S-M's

Merchandising Radio Service

H. A. Pearson

REGARDLESS of how good a commodity may be, it will rarely sell itself. And no instance exists where intelligent exploitation, involving various forms of advertising and publicity, will not put over a product more rapidly than the momentum slowly developed by its own merit. In this sense, radio service is a product, and, in the large majority of instances, a good product. But left to nature like a weed, without the cultivation of modern business methods, it will rarely blossom forth in the generous proportions so glowingly described by correspondence schools soliciting enrolments in radio service courses. Emerson once said something to the effect that if a man made a better mouse trap than anyone else, the world would beat a track to his door even if he lived in the wilderness. This may be so, but the world will find its way there a lot sooner if, after having perfected his mouse trap, the inventor puts in a concrete road, installs a few neon signs pointing in the general direction of his shack and puts on a coast-to-coast program describing the merits of his rodent eliminator.

The benefits of the application of sound merchandising principles to radio service are well demonstrated in the instance of the "Ray-de-o-Ray" organization, of Sioux City, Iowa, whose general methods are well worth considering by the serviceman convinced that his trade has little to offer aside from the daily plugging in of the soldering iron and the weekly counting of thirty to forty dollars in a cigar-box cash-register.

R. A. Kennedy, manager of this service organization, shows that the logical development for the serviceman en route to economic independence is from personal servicing with direct contacts to an extended system in which most of the servicing is under contract with radio dealers who find it uneconomical to support their own service staff.

"We firmly believe that with the tremendous volume of radio distribution and its probable continued expansion, that there is not only room for an organization dealing exclusively with servicing, but that such organizations are essential to the development of radio potentialities.

"Thus our sole function is to meet the needs of radio service. It is not surprising, therefore, that in the comparatively brief period of existence our system is being recognized in our territory as the most practical and convenient means for dealers to obtain efficient radio service.

"Although the market for radio accessories has gradually dwindled with the increased sale of a.c. receivers which require neither batteries nor exterior loud speakers, it is far from dead. There is still demand for such parts which can be capitalized by service stations.

"We handle all phases of the business within our shop, including the wholesale and retail service of Sioux City, the wholesale work of the Sioux City trade territory, and factory service for General Motors Radio Corp. of Iowa, Nebraska, South Dakota and Minnesota.

R. A. Kennedy

Trade Territory Service

"Perhaps we have an advantage over other service stations in this phase of the business, as we have here one of the largest trucking centers in the world. Connections with the local trucking depot bring to us daily all sets and accessories under 100 lbs. at a flat rate charge of $.50, enabling us to do service work for dealers within 100 miles of Sioux City and still give them one-day service on their sets.

"We have at present contracts with 114 dealers in the trade territory who send their work to us. Mr. Pearson is the field manager of our territory service and obtains dealers only through direct mail advertising. (*Continued on page* 85)

Sell the Prospect a Phonograph

A TOOL KIT
for the Sound Expert and Engineer

By Charles Felstead

THE increasing use of sound pictures and public address systems in rural districts, where their maintenance necessarily falls within the province of the radio serviceman, prompts our welcome of the following contribution by Mr. Felstead—who, by the way, is a sound engineer with Universal Pictures.—THE EDITOR.

IT is hardly necessary for the motion picture transmission engineer or sound equipment serviceman to have an elaborate or bulky kit of tools for ordinary maintenance work. If the kit is reduced to essentials, it can be made quite small and, because of its size, so much the more convenient and practicable to its owner. The most necessary tools are pliers and screwdrivers, of course, because the engineer's work is confined mostly to the repairing and maintaining of apparatus that is already installed and in use. Most of this work is of a delicate nature, so only small tools are needed. Practically the same tool kit can be used by the radio serviceman, for his line of work is very similar to that of the sound engineer.

The tools specified in the lists are of the best. Cheaper tools can be substituted, and will serve the purpose practically as well. However, in the long run, it pays to buy better tools. The following are essential tools, and form the foundation upon which the second and more flexible tool kit is built. The serviceman can purchase the tools given in the first list, and then add to them later as the need for further tools arises. The approximate prices of these tools are indicated:

Klein 6-inch side-cutting pliers—No. 201-6. $5.60.

Klein 6-inch long-nose pliers—No. 301-6. $4.00.

Klein 5-inch oblique-cutting pliers—No. 202-5. $4.50.

Electra 4-in-1 screwdriver, with insulated handle—a combination screwdriver having four blades. $1.50.

Heinisch radio shears—5-inch, $1.25.

American Beauty soldering iron—100 watts. Cat. No. 3138, $8.00.

Strong pocket knife, such as the Remington UMC, No. R-6393, $3.00.

The total cost of this kit of tools is $27.85.

A small hand-bag of canvas or leather will be found useful for keeping the tools together and for carrying them. A two-handled leather shopping bag, such as women carry, is excellent and is not expensive. Some Kester rosin-core radio solder, friction and rubber tapes should also be carried.

There are two instruments that were not included in the list because they could hardly be called tools, but that are so important to the engineer that this service kit would be but half complete without them. These instruments are a combination voltmeter and ammeter, and a pair of headphones with a special plug attached to their terminals. The recommended meter is the Weston, model 280, volt-ammeter. It is a d.c. table instrument and is equipped with seven binding posts which permit its use for full-scale ranges of 3, 15 and 30 amperes, and 3, 15 and 150 volts. The list price of this combination meter is $34.50. A multiplier that will increase the maximum voltage range to 600 volts can be purchased for an additional $9.00. This voltage multiplier is useful when reading the plate battery voltages of power amplifiers, but it is not strictly necessary. Two 4-foot long flexible leads, each equipped with spade terminals on one end for fastening to the binding posts on the meter, are desirable. The insulation on the wire to the common positive terminal of the meter should be red, or carry a red tracer. The free ends of the wires can terminate in pin plugs or test prods.

If the engineer is working entirely with Western Electric sound equipment, an extremely handy plug for patching the phones into different jacks for testing the amplifiers and circuits can be made from part of a "patch" cord. A patch cord is a length of double conductor cord, about eighteen inches long, with double plugs connected to each end. The recording amplifiers in most public address and sound motion picture equipments have double-hole jacks connected to their inputs and outputs, and the patch cords are used in making connection from one jack to another for special circuit combinations. By removing one plug from a patch cord and connecting the phone leads to the free ends of the wires, a phone plug will be formed which will make it easy to plug the headphones into the outputs of the different amplifiers and lines.

The second set of tools comprises the first list of tools together with the following additions:

4-inch Crescent wrench—No. A14.

6-inch Crescent wrench—No. A16.

Large screwdriver—such as the Stanley 100 plus No. 1001-4 with insulated wooden handle.

Small pocket magnifying glass for examining sound tracks and record cuts.

Small flat file with handle.

Pocket flashlight for working in inaccessible places—such as the Eveready No. 6993.

Small fuse puller for cartridge fuses—made by General Electric Co., Cat. No. G.E. 2497.

Starrett 12-inch combination square, (*Continued on page* 95)

Pickup—A Real Opportunity for the Serviceman

ALL IN THE DAY'S WORK

THE Hygrade Lamp Company of Salem, Mass., describes apparatus of their design for the testing of tubes to be used in automobile and other forms of mobile radio where the effects of vibration may be serious. The details will be of interest to the serviceman who may find, aside from the specific purpose for which the devices are designed, a general utility in the spotting of mechanical imperfections which would give rise to electrical difficulties in the course of normal operation.

To simulate the actual conditions that tubes will encounter in auto radio sets, four new types of life test racks have been designed that will test radio tubes scientifically in an effort to predetermine what are the effects of the following mechanical conditions:

1.—Swaying motions, combined with a series of sudden shocks and continuous vibrations.

2.—Violent vibration without sudden shocks.

3.—Severe shocks.

4.—Mechanical resonance.

The first test rack consists of a framework or carriage made of iron, upon which three shelves of tubes are mounted. The carriage is suspended from four heavy steel springs, which serve the double purposes of providing freedom of motion and of holding a small wheel mounted on the carriage in contact with an overhead cam. The cam is about fifteen inches in diameter and its periphery is irregularly indented. The cam is driven through a train of pulleys at various speeds. The severity of the shocks and the frequency of vibration are determined by the cam surface.

To check the effect of violent vibrations without sudden shocks, a special platform is mounted on four cushioned legs. A motor is bolted to the platform and turns a heavy but incorrectly balanced flywheel, resulting in pronounced vibrations of a strenuous order.

To study the effects of severe shocks alone, a rack of tubes is so arranged as to be struck a heavy blow periodically.

This is accomplished by the fall of a heavy weight on the end of a lever, which is raised by means of a cam.

To determine the effect of mechanical resonance, a rack has been designed which may be subjected to harmonic vibration of any audio frequency. The rack is fastened rigidly to the core of a transformer which is free to vibrate inside of the winding. The winding of the transformer (or more properly the solenoid, for only one winding is required) is secured to a base. The core of a device will impart to the rack a vibration of the frequency sent through the winding, the amplitude of which will be proportional to the power input.

How Much Is a Trade-in Worth?

(The following article, considering a subject of vital importance to the serviceman, has been prepared for the readers of RADIO NEWS *by Russell L. Woolley, of Seattle, Washington, a consistent contributor to the Service Bench.)*

How much is the trade-in worth? This question often occurs to the independent serviceman, usually after he tries to resell his trade-in set and loses most of his profit—profit that he should have made without having had to consummate two sales.

The trouble is that he is primarily a mechanic and fails to appraise correctly the market value of the receiver. In respect to market value, we must take into consideration the fact that it is the woman of the home who has the final say in the choice of a radio set. She wants cabinet furniture that is conservative, yet symmetrical in design and which harmonizes with other furnishings.

This being true—and experience indicates it is—we are forced to overrule as being worthless all table models, breadbox cabinets, battery and eliminator operated sets, many so-called "custom-built" receivers, dime store junk, and various kinds of "nationally known" bargain store orphans. The result is that the console and consolette standard-made receivers are about the only types of receivers worth considering as a trade-in allowance.

(The serviceman may, of course, make a concession on any receiver whatever, if he is willing to write it off as a total loss. In some cases his profit may justify this.—*Ed.*)

Suppose, as an example, you know a man who wants to trade in a Stewart-Warner "Model 715" consolette. This particular receiver is, of course, a standard make. It is two years old, or rather has been used two years. The owner finds that it does not compare in many ways with the more modern types. Now, he has paid a list price of $225 and wants what he believes a "reasonable" allowance.

If we do not stop to think, we are apt to forget our experience and knowledge of market values and pay the owner what he thinks is a reasonable price—just to make a sale; to turn over a new set in which we have already invested our hard cash, hoping to resell the trade-in and, thereby, make our profit on the original sale, a process commonly known as "horse trading" but unfortunately characterized by little of what is known as "horse sense."

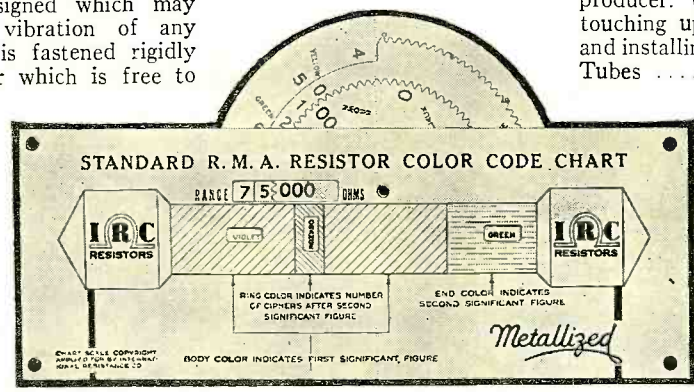
From the serviceman's point of view, a reasonable allowance should be about 60% of the amount for which the receiver may be resold, less, of course, all expenses incurred in making the sale.

In the case of the above mentioned set, the expenses are: (1) A full set of new tubes. (2) A dynamic reproducer. (3) Labor charges (which include touching up the cabinet with stick shellac and installing the speaker). Listed, they are:

Tubes	$8.68 net
Speaker	9.00 "
Labor (approx. 2 hours)	2.32
Total	$20.00

At the present time this receiver may be sold with tubes and installed for (top price) $75. At this market value it is apparent that we can offer but $25—if we expect, and we should, to make the regular 40% gross profit on the trade-in.

However, will the owner of a Stewart-Warner Model 715 consider $25? It seems he doesn't. How much, therefore, is the trade-in worth?



SO many manufacturers of radio sets have adopted the R.M.A. standard color code for resistor marking that the determination of resistance values by the serviceman who finds it necessary to make replacements has been greatly simplified. Now the International Resistance Company, to still further simplify the serviceman's job, has developed a chart or scale by means of which the value of any resistor marked according to the R.M.A. standard color code can be instantly ascertained.

This scale, shown directly above, is of celluloid and is sufficiently small to slip into one's pocket. It has four windows and three revolving discs. These discs are rotated until the three colors of the unknown resistor appear in the corresponding windows. The resistor value then appears in the upper window.

Five hundred of these scales have been placed at the disposal of RADIO NEWS, *for distribution, without charge, among its readers who are bona fide servicemen. Here is a chance for you active servicemen to obtain a decidedly useful device for the cost of a two-cent stamp. The only requirement is that your request be written on your own letterhead, or if you are employed by a dealer or service organization your request may be written on your employer's letterhead. Address all requests to Department L,* RADIO NEWS, *381 Fourth Avenue, N. Y. City.*

A Noisy Freed

Russell L. Woolley, of Seattle, Washington, sends in the following dope on a Freed type NR-95:

Such sets are often noisy when dialing through 950 kc., the trouble invariably being caused by a defective contact on the automatic switch that shunts the antenna variometer with a

(*Continued on page* 87)

The Junior RADIO Guild

LESSON NUMBER TWENTY-ONE

Using Mathematics in Radio

Geometry and Its Application in Radio

PART EIGHT

TO beginners in radio the importance of the fact that the common ordinary garden variety of mathematics (the kind of mathematics which to some seemed so pointless when taught in the elementary and lower classes of high school) is quite necessary to the later assimilation of a knowledge of geometry, trigonometry and calculus cannot be stressed too much. For the truth of this it is only necessary to question those in the radio game who have been unfortunate enough to have slipped up on this part of their education and now wish that they had the opportunity to go back to school again.

RADIO NEWS is glad to present to its readers this eighth of a series of articles prepared by Mr. J. E. Smith (President, National Radio Institute) on the use of mathematics in radio. The first of the series appeared in the December, 1930, issue of RADIO NEWS.

THE EDITORS.

WE now come to a very important application of using mathematics in radio—that is, the study of areas. A review of radio shows us that there are numerous examples of the necessity of calculating the effective surfaces of constructed models, their various shapes, and their application to many popular formulas.

Thus, the capacity of a condenser is dependent upon the area of its plates, the inductance of a coil is dependent upon its cross sectional area, the current density allowed in a wire is dependent upon the cross sectional area of the wire, the flux density allowed in an iron core is dependent upon the cross sectional area of the iron, and the allowable watts dissipation of various electrical apparatus is dependent upon the surface areas of these devices. These are only a few of the areas which are encountered, and it can be appreciated that these may take the shape of squares, circles, cylinders, oblongs, or any other structures. We shall see later how some of the more important electrical formulas as used in radio employ the use of the area.

With reference to the areas of surfaces bounded by straight lines, a review of a few definitions will be of interest here.

(1) A quadrilateral is a portion of a plane bounded by four straight lines.

(2) A parallelogram is a quadrilateral which has its opposite sides parallel.

(3) A rectangle is a parallelogram which has its angles right angles.

(4) A square is a rectangle which has its sides equal.

(5) The altitude of a parallelogram is the perpendicular distance between its bases. Thus, in Figure 16, EF, which is perpendicular to the bases BC and AD, respectively, is the altitude of the parallelogram ABCD.

(6) The altitude of a triangle is the perpendicular from the vertex to the base, or to the base produced.

Proposition—Theorem

The area of a rectangle is equal to the product of its base by its altitude.

This proposition is self-evident, for with reference to Figure 17, let the base contain 10 linear units and the altitude 6 linear units. These linear units of length form the sides of the units of surfaces, and it is seen that the total area is equal to a × b. Then there must be 60 units of surface contained in the rectangle.

Therefore, the area of a rectangle is equal to the product of its base "b," by its altitude "a."

Proposition—Theorem

The area of a parallelogram is equal to the product of its base by its altitude.

In the parallelogram ABCD, Figure 18, let ED be its altitude, and draw AF parallel to ED, meeting BC produced to F. Then AFED is a rectangle having the same base and the same altitude as the parallelogram.

In the right triangles AFB and ECD we have AB is equal to CD (the opposite sides of a parallelogram are equal), and AF is equal to ED. Therefore, the two right triangles are equal (two right triangles are equal if a leg and the hypotenuse of the one are equal, respectively, to a leg and the hypotenuse of the other).

Since these triangles are equal, it is obvious that the parallelogram ABCD is equal to the rectangle AFED. But the area of the rectangle is equal to the product of its base by its altitude, so, therefore, the area of the parallelogram is equal to the product of its base "b," by its altitude "a."

Proposition—Theorem

The area of a triangle is equal to half the product of its base by its altitude.

In the triangle ABC, Figure 19, let BD be its altitude. With AC and BC as sides, construct the parallelogram AEBC. Then the triangle ABC is equal to one-half the parallelogram AEBC. (A diagonal of a parallelogram divides it into two equal triangles.)

Since the area of the parallelogram is equal to the product of its base by its altitude, we have that the area of triangle ABC is equal to half the product of its base "b," by its altitude "a."

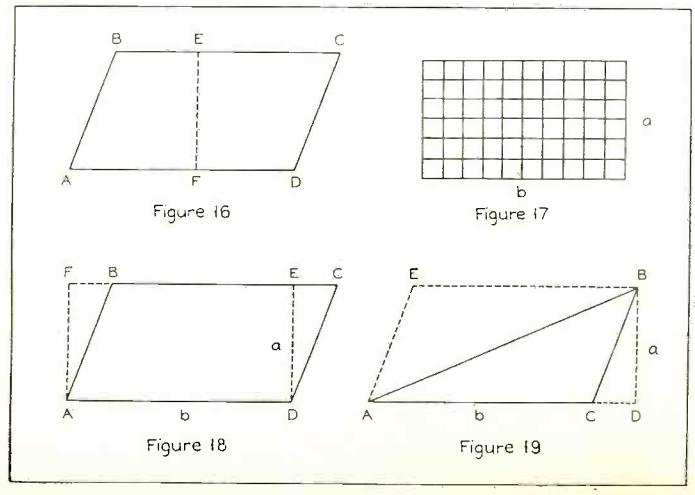


Figure 16 Figure 17 Figure 18 Figure 19

Applications to Radio

Let us investigate a few of the formulas which are applicable to radio designs and study the relations involved which are dependent upon factors where the areas are concerned. Radio engineers are constantly referring to electrical handbooks containing important formulas, and it is not expected that all of these be retained, or actively memorized, since engineering is so broad and so far-reaching that it is almost impossible to remember constantly all the formulas.

Although it is often

desirable to know and understand how the various formulas are derived, it is not absolutely necessary if the formula is well understood. A complete understanding of the formula is of course determined by reference to electrical theory and by reference to the fundamental mathematics involved.

Current Density

In designing any kind of coil for radio use, such as the primary coils for audio-frequency transformers, field coils for electromagnets in dynamic loud speakers, voice coils for moving-coil loud speakers, windings for power transformers, or secondary windings for output transformers, we have to consider, in addition to the resistance of the wire, the heating effects of the coil produced by the current. We think of the heat developed as being proportional to the watts dissipated in the coil, and this is dependent upon the product of the current squared and the resistance, or to I^2R.

Obviously, a small size wire will overheat if too much current is passed through it, and therefore a basis of design is established for a particular structure, which is accepted as a safe one for continuous operation. Let us consider that a copper wire will have a definite cross section of so many square inches, and by dividing the amperes of current through the wire by the square inches of cross section of the conductor, we will obtain a quotient which can be termed the current density of the conductor. Thus—

$$\text{Current density} = \frac{I}{\text{square inches}}$$

If the allowable value for the current density for a certain design of equipment is on the order of 1000, and the amount of current to be passed through the conductor is about 5 amperes, we have the formula:

$$\text{Square inches} = \frac{I}{\text{current density}}$$

and the necessary square inches of conductor must be equal to 5/1000 or equal to .005 square inches. We shall show later, in the study of the areas of circles, its equivalent area in square inches as compared to its area in circular mils.

Thus, in the design of radio apparatus, each equipment will be rated for its proper current density, dependent upon the conservativeness of the designer, its location in the equipment for proper ventilation, and the materials used.

Flux Density

In the design of any kind of a coil containing wire, the engineer is more or less interested in the amount of magnetic flux which this coil will take. If the amount of voltage across the coil is high, as would be the case across the primary of a power transformer, or the primary of some output transformers, the flux may reach values which may cause the coil to be inoperative. Let us consider a coil with an iron core, and with an applied voltage across its terminals. It can be shown that the following relation exists:

$$B = \frac{E \times 10^8}{4.44\, f\, N\, A}$$

where E = applied volts
f = frequency of supply
N = number of turns in the coil
A = cross section area of coil

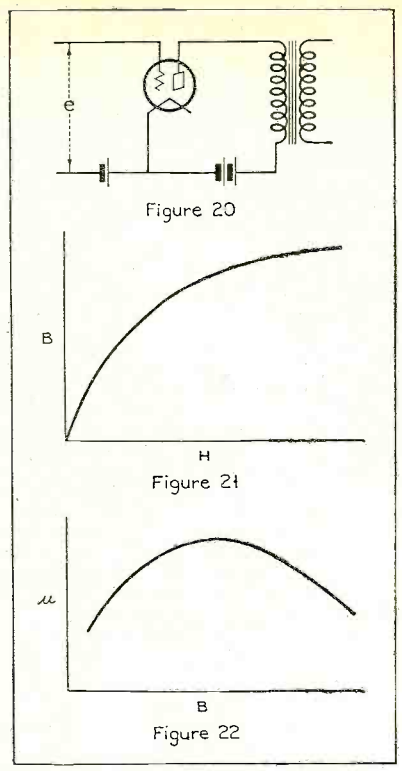


Figure 20
Figure 21
Figure 22

B = flux density of coil

Flux densities higher than 75,000 lines per square inch of area (A), at a frequency of 60 cycles, is considered to be detrimental to the heating of the iron.

Impedances of Coils

The radio engineer is interested in the impedance of the coils used in the plate circuits of the vacuum tubes employed in the radio- and audio-frequency stages of an amplifier. Let us consider the primary of an audio-frequency transformer connected in the plate circuit of a vacuum tube, as shown in Figure 20. The designer is interested in obtaining the maximum inductance at the lowest frequency, say 30 cycles, which he can get as economically as possible. The formula for the inductance of a coil with an iron core is determined by the following expression:

$$L = \frac{1.256\, N^2\, \mu\, A\, 10^{-8}}{l}$$

where L = inductance in henries
N = number of turns in the coil
A = cross sectional area of core in square centimeters
μ = permeability of the core
l = magnetic length of core in centimeters

An explanation of some of the constants used in this formula will be of interest here.

(1) *Centimeter:* A centimeter is simply a French unit of length, and one inch is equal to 2.54 centimeters. Therefore, one square inch will be equal to the square of 2.54 or 6.45 square centimeters.

(2) *Permeability* (μ): The conception of this variable (μ) need not be confusing, and a review of the fundamentals of magnetic theory will make this a little more clear. In the investigations of magnetic materials, so-called B/H curves are plotted as a result of electrical measurements in the laboratory which show the relation of the flux density (B) to the ampere turns (H) through the coil, as shown in Figure 21. Now, the permeability (μ) is taken simply as the ratio of B to H, and if this is plotted will be as indicated in Figure 22.

Therefore, by having the geometric dimensions of the core structure of the coil under consideration, and by having the B/H curves for the iron used, the inductance L of the coil can be computed. Since the impedance of the coil (Z) is practically equal to $2\pi fL$, we have the means of knowing whether our impedance is high enough for the frequency considered.

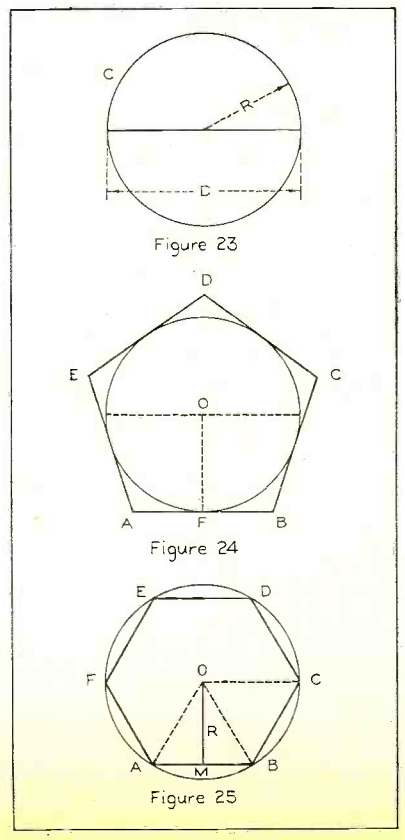


Figure 23
Figure 24
Figure 25

Area of a Circle

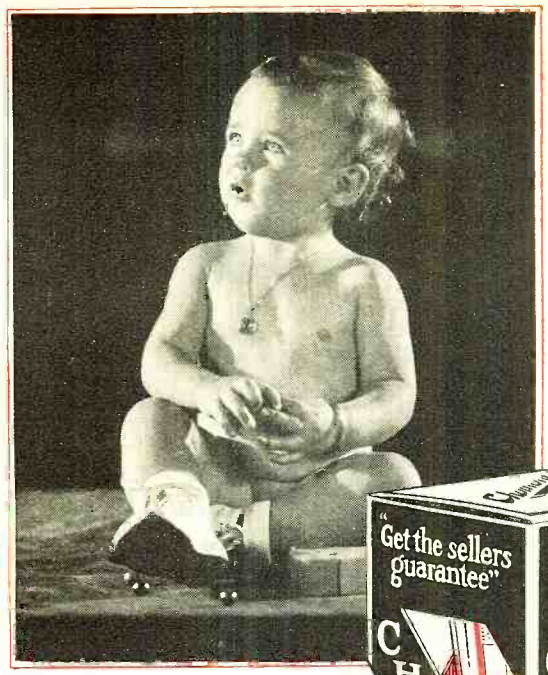
With reference to the area of circles, a review of a few definitions and theorems will be of interest at this time.

(1) A circle is a plane bounded by a curved line which is equally distant at every point from a point called the center.

(2) The bounding line of a circle is called the circumference.

(3) The ratio of the circumference of a circle to its diameter is represented by the Greek letter π. Thus, with reference to Figure 23, we have a circle with a circumference C, a diameter D and a radius R. The relation of the circumference to its diameter of any circle will always be a constant value equal to π, and the numerical value of this is to most practical purposes equal to 3.1416. Thus, we see that the circumference will be a little over three times the length of the diameter. Since the diameter D is equal to 2R, we also have:

$C = 2\pi R$ (*Continued on page* 94)



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1930
(January 15)

Champion
POWER PENTODE TUBE

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Pentodes mean MORE power when they bear the name CHAMPION.

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CHAMPION RADIO WORKS, INC.
DANVERS — Massachusetts

Tapping *the* Short Waves

condenser and grid leak may be omitted if desired, if the click which accompanies keying is not annoying. With many transformers, no "B" battery will be required, and the 22.5-volt posts may be shorted, as suggested tentatively by the dotted line. A 3-volt dry-cell tube should be used, such as the type -99. The "A" battery is conveniently two dry cells in series. Care should be taken to send slowly and distinctly. If possible, enlist the occasional services of an experienced operator to criticize your sending. It will be a most excellent idea to amplify the output of this simple code set, and record your transmission on a dictaphone or home recording device, along the lines suggested farther on for code recording. Listen to your own transmission. If you can transcribe it—it will pass.

Memorize the Sounds

In learning the code, it is said that it is desirable to memorize the sounds rather than think of the characters as dots and dashes. (It is over twenty years since the writer learned to copy, so I can't speak from experience.) The idea is sound from the psychology of mnemonics. Think of A as dit dah, rather than dot dash—the dit being said quickly.

Key work will have little or no effect on your receiving speed above ten words per minute. Nothing but copying will help here, and, unfortunately, there are very few stations transmitting at anywhere near this speed. It is discouraging to attempt copying speeds more than twenty per cent. faster than your reliable rate. Occasionally you will find commercial stations transmitting as slow as fifteen words a minute, repeating each word. Such stations afford excellent practice, but the necessity for such transmissions are few and far between.

Recording Important

Here the dictaphone and home recording arrangements, where variable record speeds are possible, are of genuine service. Clean-cut code signals may be recorded on these devices at high record speeds and decoded at a comfortable number of words per minute, with whatever repetitions as are necessary. The use of such arrangements is suggested in two of the illustrations. The note of the received signal should be pitched somewhat higher than for direct transcription, as this too will be lowered with the speed. It is possible, in this manner, to copy even high-speed automatic transmisison above forty words per minute, which is faster than even a good operator can copy direct.

After a certain amount of facility and speed are acquired, the press schedules between nine and midnight E.S.T. provide excellent practice. About the slowest press transmission (between eighteen and twenty words a minute) emanates from WPN, Garden City, N. Y., on 6515 kc.—46.05 meters. The "fist" is a little stiff, however, and it may bother the inexpert operator. For better though faster sending, KUP, San Francisco, on 6530 kc.

(*Continued from page 22*)

or 45.94 meters is excellent practice. The stock market quotations, with which press dispatches are generally concluded, are about the best training on numbers you will find.

After your speed increases, you will get to recognize certain groups of letters, many of them three-letter sequencies beginning with "Q." These are the international "Q signals" or abbreviations, a complete list of which is contained in "Commercial and Government Radio Stations of the United States," which may be obtained from the Government Printing Office in Washington, D. C., for fifteen cents.

It is a simple matter to become inoculated with the code bug. Any experimenter who has followed us to this point is in a fair way to being bitten, and the ultimate stage of infection is an unquenchable desire to own and operate one's own station—to join the ranks of the many thousands of amateur operators who hold distant records bettered by no commercial stations in the world.

The construction of an amateur transmitter is not difficult, and several simple transmitters can be purchased, completely assembled, for much less than the cost of a good receiver. Fundamentally, a transmitter is less complex than a receiving set. The construction, installation and operation of an excellent transmitter has been described in considerable detail by Don Bennett in the January, February, March and April, 1931, issues of RADIO NEWS. The existing amateur regulations are covered at length in the September, 1930, number.

Characteristic International First Letters of Amateur Calls

Abyssinia	ET
Afghanistan	YA
Alaska	K7
Algeria	CN
Argentina	LU
Australia	UO to VK
Belgium and colonies	ON
British Isles	G
Bolivia	CP
Brazil	PX
Bulgaria	CP
Canada	VE
Chile	CE
Costa Rica	TI
Cuba	CM
Curacao	PJ
Czecho-Slovakia	OK
Denmark	OZ
Dominica	HI
Dutch East Indies	PK
Ecuador	HC
Egypt	SU
Esthonia	ES
Finland	OH
France and colonies	F
French Indo-China	FI
Germany	D
Guatemala	TG
Haiti	HH
Hawaii	K6
Hedjaz	UH
Holland	PA, PB, PC
Honduras	HR
Hungary	HA
Iceland	TF
India	VO
Iraq	YI
Ireland	EI and GI
Italy and colonies	I
Japan	J
Jugo-Slavia	UN
Latvia	YL
Liberia	EL
Lithuania	RY
Luxembourg	UL
Mexico	X
Morocco	CM
Newfoundland	VO
New Zealand	ZL
Nicaragua	YN
Norway	LA
Panama	RX
Paraguay	ZP
Persia	RV
Peru	OA
Philippines	K1
Poland	SP
Porto Rico	K4
Portugal	CR and CT
Rhodesia	VQ
Rumania	CV
Russia	RA
Salvador	YS
Siam	HS
Spain	EAR
Sweden	SM
Switzerland	HB
Uruguay	CW
United States	W
Venezuela	YV

Licenses

It is of course essential that, before the experimenter can transmit, he possess both station and operator's licenses, procurable from the Radio Division of the United States Department of Commerce. It is illegal to transmit without such licenses, and the offense is a serious one.

Station licenses, which assign the call letters, are issued only to persons holding operators' licenses. To secure this it is necessary to pass a code and written examination in the presence of the radio inspector of your district. The radio inspector nearest to you is the correct office to which license application should be made, radio inspectors are located at the following addresses: Customs House, Boston, Mass.; Sub Treasury Building, New York City; Fort McHenry, Md.; Post Office Building, Atlanta, Ga.; Customs House, New Orleans, La.; Customs House, San Francisco, Calif.; Exchange Building, Seattle, Wash.; David Stott Building, Detroit, Mich.; Engineering Building, Chicago, Ill. There are several branch offices at which the examination can be taken, and in some instances a temporary license will be granted, upon evidence of proficiency, pending actual examination. Further information may be secured from the addresses listed above.

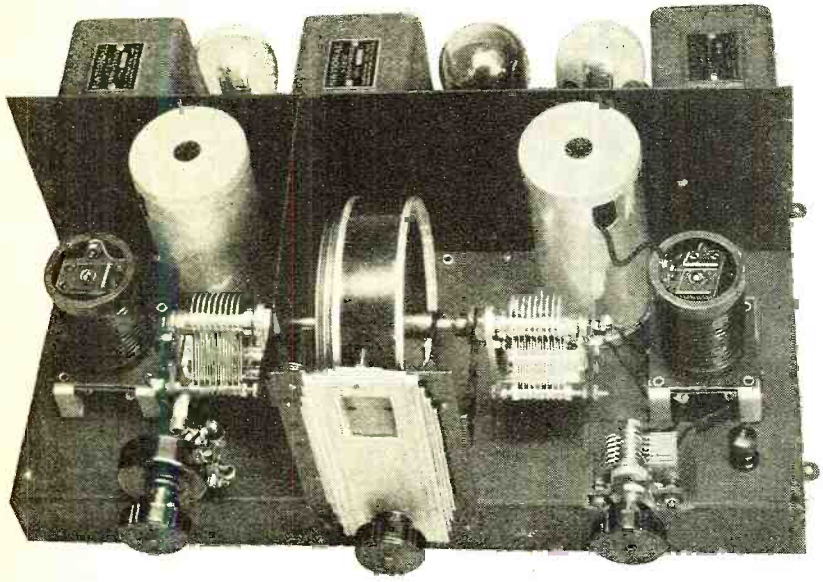
Code Examination

The code examination for a first-class amateur license is given at twelve words a minute, but the applicant is advised not to attempt the test unless he is sure of fifteen words per minute. The written

(*Continued on page 68*)

Now Still Further Improved!

The NATIONAL THRILL-BOX



Range 9—750 Meters

A special 245 push-pull model is now available for general short-wave broadcast reception.

For technical and amateur communication, the 227 push-pull model is recommended.

Now, NATIONAL CO. has made use of the remarkable UY 235 Variable Mu Screen Grid Tube, giving even better performance on the THRILL-BOX than ever before.

The short waves give a quality of daylight reception and a daylight distance that is amazing. Signals come in in midday from England so loud that they can be clearly heard all over a large house.

Lower Noise Level with THRILL-BOX

The circuit employed in the THRILL-BOX gives less background noise and a lower noise level than any other short wave circuit that we have tested in our Research Laboratory. There is less crackling, less hum, less interference with the reception of the broadcasts or the signals themselves.

270° Condensers Give Wider Separation of Stations

The special 270° Tuning Condenser employed in the NATIONAL THRILL-BOX spreads out the stations and the genuine Velvet Vernier Drive makes separate station logging easy and accurate.

Special Band-Spreading Coils

If still further spreading of the 20, 40 and 80-Meter Amateur Bands is desired, NATIONAL CO. has standard Band-Spreading Coils which give a spread of 50 dial divisions on these signals.

Genuine Single Control

The THRILL-BOX has TRUE SINGLE-KNOB TUNING. The tuning is done literally and actually with one knob only, not two or more knobs on one shaft. The stations always come in at exactly the same place on the dial.

Circuit Design for Maximum THRILL-BOX Performance

There are no band-changing switches on the THRILL-BOX or other additions to the R.F. circuit which are likely to reduce its efficiency and performance. Coil forms of R.F. transformers are made of R-39, the new low-loss coil material, developed by Radio Frequency Laboratories, available *only* in the THRILL-BOX. This is just another reason for the supremacy of the THRILL-BOX—every part, every component has been designed for the highest efficiency.

A New Special Broadcast Receiving Model Also Offered

We now announce a special broadcast receiving model of the THRILL-BOX, equipped with 245 tubes in Push-Pull for audio output. This gives very fine quality with large volume. For technical and amateur communication we recommend the Push-Pull 227 model. Write us for particulars and prices, using coupon below.

Humless Power Unit

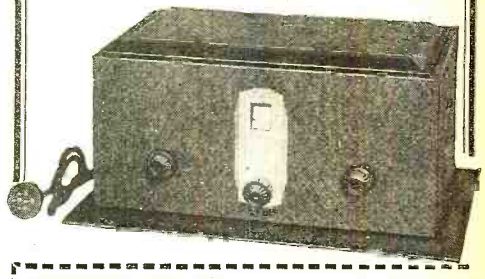
The power unit of the NATIONAL THRILL-BOX is specially designed for humless operation on the short waves. There is an electrostatic shield in the power transformer which isolates the secondary windings from disturbance and there is an over-size hum filter. Even the Rectifier Tube has a R.F. Filter which eliminates tunable hum. R. C. A. License.

NATIONAL THRILL-BOX SW5

Made by the Makers of the Famous Velvet Vernier Dials

Universal Use All Over World Proves THRILL-BOX Quality

The THRILL-BOX is built with NATIONAL Precision-Made Radio Products. NATIONAL Precision-Made Radio Products are used by: General Electric Co.; Westinghouse Electric & Mfg. Co.; R. C. A.; Tropical Radio (United Fruit Co.); Federal Tel. & Tel. Co.; American Tel. & Tel. Co.; Canadian Marconi; U. S. Naval Research Laboratories; U. S. Navy; Signal Corps, U. S. Army; Jenkins Television Corp.; Press Wireless, Inc.; De Forest Radio Co.; Wired Wireless, Inc.; U. S. Dept. of Commerce (Lighthouse Service); Pan-American Airways; Curtiss-Wright; Boeing Airplane Co.; Western Air Express; Roosevelt Field, Inc.; Southern Air Transport, and by thousands of leading Amateurs, Experimenters, Colleges, Universities, Schools and Research Laboratories the world over.



NATIONAL CO., INC.
61 Sherman St., Malden, Mass.

Gentlemen:

Check which

( ) Please send me complete information and prices on your New Improved THRILL-BOX, with 227 Push-Pull Output.

( ) Please send me complete information about the new Special Broadcast Receiving Model of the THRILL-BOX, with 245 Push-Pull Output.

( ) I enclose 50c (stamps or coin) for your 64-page Handbook of Short-Wave Radio, describing in full the latest and best short-wave receiving circuits, adapters, meters, etc.

Name.....

Address.....

Tapping the Short Waves

(*Continued from page 66*)

INTERNATIONAL COMMERCIAL CALL LETTER ASSIGNMENTS

CAA to CEZ, Chile
CFA to CKZ, Canada
CLA to CMZ, Cuba
CNA to CNZ, Morocco, Algeria
CPA to CPZ, Bolivia
CRA to CRZ, Colonies of Portugal
CSA to CUZ, Portugal
CVA to CVZ, Rumania
CWA to CXZ, Uruguay
CZA to CZZ, Monaco
DAA to DZZ, Germany
EAA to EHZ, Spain
EIA to EIZ, Ireland
ELA to ELZ, Liberia
ESA to ESZ, Esthonia
ETA to ETZ, Abyssinia
FAA to FZZ, France and colonies
GAA to GZZ, Great Britain
HAA to HAZ, Hungary
HBA to HBZ, Switzerland
HCA to HCZ, Ecuador
HHA to HHZ, Haiti
HIA to HIZ, Dominica
HJA to HKZ, Colombia
HRA to HRZ, Honduras
HSA to HSZ, Siam
IAA to IZZ, Italy and colonies
IAA to JZZ, Japan
KAA to KZZ, United States and colonies
LAA to LNZ, Norway
LOA to LVZ, Argentina
LZA to LZZ, Bulgaria
MAA to MZZ, Great Britain
NAA to NZZ, United States, mainly U. S. Navy
OAA to OBZ, Peru
OHA to OHZ, Finland
OKA to OKZ, Czecho-Slovakia
ONA to OTZ, Belgium and colonies
OUA to OZZ, Denmark
PAA to PIZ, Holland
PJA to PJZ, Curacoa
PKA to POZ, Dutch East Indies
PPA to PYZ, Brazil
PZA to PZZ, Surinam
RAA to RQZ, Russia
RVA to RVZ, Persia
RXA to RXZ, Panama
RYA to RYZ, Lithuania
SAA to SMZ, Sweden
SPA to SRZ, Poland
SUA to SUZ, Egypt
SVA to SZZ, Greece
TAA to TCZ, Turkey
TFA to TFZ, Iceland
TGA to TGZ, Guatemala
TIA to TIZ, Costa Rica
TSA to TSZ, Territory of the Saar Basin
UHA to UHZ, Hedjaz
UIA to UKZ, Dutch East Indies
ULA to ULZ, Luxembourg
UNA to UNZ, Jugo-Slavia
UOA to UOZ, Austria
VAA to VGZ, Canada
VHA to VMZ, Australia
VOA to VOZ, Newfoundland
VPA to VSZ, British colonies
VTA to VWZ, India
WAA to WZZ, United States
XAA to XFZ, Mexico
XGA to YUZ, China
YAA to YAZ, Afghanistan
YHA to YHZ, New Hebrides
YIA to YIZ, Iraq
YLA to YLZ, Latvia
YMA to YMZ, Danzig
YNA to YNZ, Nicaragua
YSA to YSZ, Salvador
YVA to YVZ, Venezuela
ZAA to ZAZ, Albania
ZKA to ZMZ, New Zealand
ZPA to ZPZ, Paraguay
ZSA to ZUZ, South African Union

examination covers the theory and operation of amateur transmitters and receivers, particularly in reference to tuning the former, and so adjusting the apparatus that it conforms with the national and international regulations. Questions are asked concerning radio law and the international abbreviations. The prospective amateur is advised to secure the government publications to which reference has already been made earlier in this article and to study their contents carefully.

All of which just about concludes the story of "Tapping the Short Waves." It remains for us merely to conclude with the international expression of cordiality and good luck—"73."

Latest Radio Patents

(*Continued from page 59*)

1,790,679. ACOUSTIC DIAPHRAGM AND MOUNTING. DON R. SEELY, Salt Lake City, Utah, assignor to The Utah Radio Products Company, Salt Lake City, Utah, a Corporation of Utah. Filed Aug. 20, 1928. Serial No. 300,748. 14 Claims.

1. An acoustic diaphragm formed of a sheet of wood which has been impregnated with a nitrocellulose solution.

1,787,813. TRICKLE-CHARGE SYSTEM. EDGAR W. BREISCH, Edgewood Park, Pa., assignor to Westinghouse Electric & Manufacuring Company, a Corporation of Pennsylvania. Filed Sept. 2, 1926. Serial No. 133,281. 8 Claims.

1. The combination with a storage battery, of a load circuit therefore, a charging circuit adapted to charge the battery at a relatively slow rate as compared to the rate of discharge demanded by said load circuit, and a snap switch so arranged as to connect said battery for either charging or discharging but never both charging and discharging and never neither charging nor discharging.

1,790,576. MODULATING SYSTEM. CHARLES A. CULVER, Northfield, Minn., assignor, by mesne assignments, to Federal Telegraph Company, a Corporation of California. Filed July 16, 1926. Serial No. 122,985. 3 Claims.

1. A modulation system comprising a plurality of electron tubes each having grid, filament and plate electrodes, input and output circuits interconnecting said electrodes

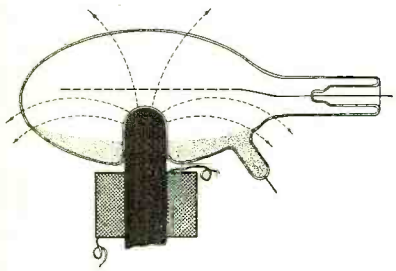
(*Continued on page 69*)

Latest Radio Patents

(*Continued from page* 68)

with the circuits of one of said electron tubes mutually coupled and connected with a source of potential for the generation of high frequency oscillations, a transformer having primary and secondary windings with the secondary winding thereof connected in circuit with said first mentioned electron tube, one of the terminals of said secondary winding being connected directly to the plate electrode of said first mentioned electron tube, a microphone circuit, a pair of said electron tubes being connected in balanced relationship and disposed between said microphone circuit and the primary winding of said transformer, whereby variable audio frequency currents may be impressed upon said first mentioned electron tube and superimposed upon the potential supplied by said source for controlling the amplitude of the high frequency currents generated in the circuits thereof, and means for controlling said source of potential independently of said variable audio frequency currents.

1,791,928. PHOTO-ELECTRIC CELL. AUGUST KAROLUS, Leipzig, and FRITZ SCHRÖTER, Berlin, Germany, assignors to Gesellschaft für Drahtlose Telegraphie m. b. H. Hallesches, Berlin, Germany, a Corporation of Germany. Filed Jan. 5, 1927, Serial No. 159,139, and in Germany Jan. 8, 1926. 2 Claims.



1. A photo cell comprising an air-tight envelope, a gas filling within said envelope, a photoelectric member, and an anode member therein, and magnetic means for changing the trajectories of the electronic stream flowing between the photoelectric element and the anode for increasing the number of electronic impacts in said gas.

1,790,646. RADIO SIGNALLING SYSTEM. ERNST F. W. ALEXANDERSON, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed May 9, 1925. Serial No. 29,210. 8 Claims.

1. An antenna comprising a radiating loop having its sides in a substantially horizontal plane, said horizontal sides having a length equal to at least a quarter of a wavelength of the radiated wave, whereby horizontally polarized waves are produced, and said antenna being mounted above the earth a distance equal to at least one eighth of a wavelength of the wave to be radiated, and means for supplying high frequency current to said loop.

1,792,937. WIRELESS-CONTROLLED AERIAL TORPEDO. ELMER A. SPERRY, Brooklyn, N. Y., assignor to The Sperry Gyroscope Company, Inc., a Corporation of New York. Filed Dec. 18, 1917, Serial No. 207,786. Renewed Feb. 23, 1928. 56 Claims.

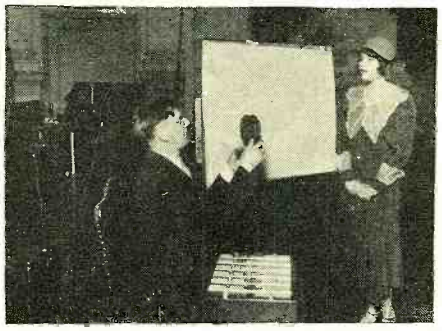
1. In combination, an aircraft, means for changing the direction of said aircraft after it has traveled a predetermined distance, and means controllable from a distance for starting the operation of said first-named means while the aircraft is in flight.

The Electrical Future of Music

(*Continued from page* 36)

gives, this multiplicity of the musical "elements" does not seem a serious fault with this chemical analogy. And the analogy does provide a very simple way of studying musical tones and thinking about them.

There remains, however, the important matter of the value or utility of different musical "compounds"; meaning by a musical compound merely any possible combination of the musical "elements."



Dr. William Braid White, acoustic engineer of the American Steel & Wire Company, testing the voice of Countess Olga Albani, radio singer, by pictures of the sound waves thrown on a screen

One musical compound, for example, is the tone of the A string of a violin, containing perhaps 95 per cent. of one "element" (the so-called fundamental) and smaller percentages of other "elements," representing the so-called harmonics or over-tones. Another and more complicated "musical compound" would be the mixed tone produced at any instant by a symphony orchestra; the composition of which in musical chemistry doubtless would include hundreds or even thousands of musical elements each indicated by the percentage in which that element is present in the total tone.

On this basis there would be no physical distinction between musical sounds and any other sounds. The noise of a passing street car, for example, would be represented by a frequency spectrogram and a "formula" in musical chemistry, precisely as one would represent the tone of an orchestra. Of course the two spectrograms and formulas would be different, but there would be nothing, in the physical analyses themselves, to distinguish between the noise and the music.

This distinction is one about which physicists and musicians argue interminably among themselves. About the only real distinction, it seems to me, is the conventional one that the "musical sound" is, in any country and any age, the sound which is pleasing to the majority of people. Country and age need to be considered because it is obvious that Chinese music, for example, has a very different "chemical composition" from Occidental music and yet proves highly pleasing to the Oriental ear. One of the great mysteries of "musical chemistry" at present is that of just which "compositions" of musical tones are pleasing and just which are unpleasing, and why.

In a sense this problem is like that of the synthetic chemist who has produced in his laboratory a thousand new chemical compounds. Some of these may be highly useful to mankind and to industry. Others will be disagreeable and harmful. Still others will be useless or inert. There is but one way for the synthetic chemist to decide which of his new compounds fall into the useful class. That is to try them. Similarly, it is probable, there will be but this one way of actual trial in which the synthetic musician can decide which of his tone compositions are pleasing to the average person. Furthermore, all this is likely to change.

Within the past twenty years we have seen the development, in the so-called "modern music," of tonal compositions which some people evidently regard as pleasing but which would have been regarded as highly uncomfortable by musicians a generation ago. It is no part of the duty of the musical engineer, however, to decide what the public wants. The public itself will express such preferences unmistakably.

It is the duty of the musical physicist, on the other hand, to provide the methods of analysis suitable for the new "musical chemistry," to accumulate as rapidly as possible these analyses on well known types of tone, just as chemists have accumulated chemical analyses on well known types of rock, and to provide, in addition, the synthetic machinery by which new musical "compounds" may be produced. This article would be expanded beyond any possibility of the Editor's patience were I to attempt to outline the thousands of analyses already made, indicating the different characteristics of the tones of different instruments or of tones from variable instruments like the human voice.

C. A. Johnson, of the E. E. Free Laboratories, with a special electro-magnetic pick-up used to take the tone from a single square inch of a piano sounding board

There is but one thing which perhaps requires attention. The invention of the piano had upon the art of music the most powerful effect of any event until the modern development of electrical music. This effect was the adoption of what is called the equi-tempered scale.

As I have explained above, the whole

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Electrical Future of Music

(*Continued from page 70*)

idea of harmonics, partials, overtones, and the like is based upon the way in which sound is produced by vibrating articles like strings. It was observed early in the study of musical sounds that combinations of tones produced by simple mathematical ratios of string vibrations are likely to be pleasing. For example, if a violin string vibrates as a whole and another precisely similar string vibrates in halves the two tones produced have what is called the octave relation. In "musical chemistry" this means that one of the "elements" has a vibration rate just twice that of the other "element." Similarly, the tones produced when strings vibrate in quarters, fifths and so on are usually more pleasing to the average ear, when these tones are blended together, than are the tones produced, for example, by two strings which vary only slightly in length and have no simple mathematical relation.

These observed facts of the relatively pleasing character of tones blended in simple mathematical ratios is the basis of all musical scales. It should be emphasized, however, that there is no fundamental basis for these scales. They do not exist in the music of birds. They are absent in Oriental music. We really have no reason to believe that the obsession of Occidental music with scale relationships is anything more than a convention and a habit.

An instrument like a violin, on which the player can produce any tone that he wishes; that is, any one of the thousands of "musical elements," may play in any scale that is desired. In other words, a set of mathematical relationships can be played upon A or G or any other tone. In general, these will be different for each tone on which one founds the mathematical relationship. When the piano was invented this was no longer true. Only a definite number of strings could be provided. These strings could not be retuned during the performance. Accordingly, there was invented the purely conventional equi-tempered scale used on the piano and well known to all musicians.

This scale is forced. That is, the different tones properly belonging in each of the different scales based on each of the individual fundamentals are forcibly consolidated into the arbitrary tones fixed by the tuning of the piano strings. It is usual for musicians to deplore this and to hail the greater purity of perfection of the tone from stringed instruments which can play perfectly in any scale without forcing the mathematical relationships into inexact forms. Admitting the facts, I am not so sure that the result is deplorable.

Since we still have almost no information concerning the tone "compounds" which are prevailingly pleasing or desirable, I do not see how we can be sure that the forced music of the equi-tempered scale is either better or worse, from the viewpoint of musical appreciation, than the supposedly more perfect music of instruments like the violin. Indeed the practical and sceptical physicist will go farther. How can we be sure that the

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The Electrical Future of Music

(*Continued from page* 71)

use of any scale is really more pleasing, convention being left aside, than is the scale-less music of the Orient?

We will be sure about this, there can be no doubt, when the synthetic musician has duplicated the achievements of his analogue the synthetic chemist. Synthetic music already has a long and respectable history. More than a generation ago musical tones were being produced by magnetic and electrical devices, put together into many combinations and tried out on experts or on the public. The great possibilities of synthetic music first appeared, however, with the perfection of the vacuum tube.

Four years ago Mr. C. A. Johnson in our laboratories constructed what I believe to have been the first "photo-electric organ"; an instrument in which tones of relative purity were produced by light pulses passing through holes in a rotating disc, entering a photo-electric cell and subjected, thereafter, to electric amplification. Numerous types of vacuum-tube organ have been built, making use of the ability of such tubes to oscillate at definite frequencies when in circuits of definite characteristic. The ability of such circuits to oscillate at variable frequencies depending upon variations in circuit capacity are utilized in the well known Theremin, invented by the distinguished Russian physicist of that name.

Only a few weeks ago before the New York Electrical Society in New York City, Dr. Alfred N. Goldsmith, Vice-President and General Engineer of the Radio Corporation of America, demonstrated still another variety of synthetic musical instrument, the electric carillon. In this instrument small iron or steel bars are struck mechanically with hammers and set thus into vibration. This vibration is picked up magnetically, amplified and played through loudspeakers. Thus there is produced an amplified equivalent of the musical "compound" produced by the vibration of the small metal bar. Tones resembling those of bells thus may be produced without having the bells.

Another method of producing amplified bell tones, worked out several years ago in our own laboratories, consists in producing relatively faint bell tones inside a sound-proof box; for example, by striking small vibrators like the chimes played in orchestras or like the familiar Japanese gongs. The sounds then are picked up by an ordinary microphone inside the sound-proof box, amplified and played over loudspeakers in the standard manner. From the standpoint of musical chemistry this consists in producing a small sample of the compound desired and then in magnifying the amount of this sample, as a synthetic chemist might do by increasing the productivity of his reactions.

Precisely similar methods have been used to produce other synthetic sounds not of musical character. Chains and bolts clanking against a small piece of iron were amplified, for example, to produce the sound of a war tank for theatrical purposes. The beat of a mechanical hammer against a small drum became the noise of an airplane motor. A ratchet turned against some wooden sticks, like the noise-making rattles used in night clubs, became the sound of a crash as an airplane collapsed against a house. It is evident that such methods can be extended almost without limit. The great thing which electrical and radio technique has to offer to the art of music and the science of sound is the possibility of producing any desired assortment or combination of the musical "elements" and of putting these together into any desired quantity or intensity of the resulting musical compound.

As Dr. Goldsmith said in his recent New York address, the electric music of the future will require not only this technique which the radio engineer already can provide but also new types of musical genius to appreciate, so far as may be possible, the public's likes and dislikes and to put together out of the enormously increased materials which electrical science now provides musical "compounds" which will give the public new pleasures and new thrills.

How to Build a Home Television Receiver

(*Continued from page* 40)

a colored pencil on the wiring diagrams shown in Figures 8, 9 and 10 as each connection is made. It is then easy to see which connections have been made and which remain to be made.

In wiring, it is a good plan to make all the connections which go to the ground (chassis) first. Then wire up the filament leads, being very careful to make the connections to the transformer terminals properly. The heavy wire should be used for the filament leads and the filament wires should be run in twisted pairs.

The ground connections to resistors R5, R7, R8, R10, R11, R13 and R14 are made easily by soldering one of the pigtail leads of each resistor to the metal mounting strip of the assembly.

In wiring the radio-frequency transformer units, all the wiring of the elements around the sockets should be made first and long leads should be provided for the leads which are to be brought out through the shields. These wires can then be run through the holes provided in the shields and the cylindrical portions of the shield can be fitted to the bases by means of the bayonet provisions made in the base and shields.

The balance of the wiring is so clearly shown on the wiring layouts, Figures 9 and 10, that it is not necessary to describe it in detail.

The builder should make every connection carefully to be sure that a good mechanical and electrical joint is made. Use a good grade of rosin-core solder and be careful to heat the connecting elements well before actually applying the solder. A little care taken in soldering will pay big dividends in freedom from the troubles which usually result from bad connections.

(*Continued on page* 87)

Public Address on Wheels

(*Continued from page* 48)

tery charger, phonograph turntable, microphones, and radio tuner.

The actual amplifier employed utilizes four stages of audio-frequency amplification and has an undistorted output of 50 watts. This is sufficient power to provide full sound coverage for the largest amphitheater.

An interesting incident in connection with the rebroadcast was the speed with which the sound truck was made ready for service. Charles Deane, engineer in charge, was told of the plan to rebroadcast signals from the blimp while eating lunch in a Newark restaurant at 1 o'clock. At 2:30 p.m. the truck was at Times Square (which is some thirty miles distant, partly through city traffic) with loud speaker mast erected and ready.

For those who would like to know more about the amplifier installed on the motor truck, the interior view which accompanies this article should be of interest.

As indicated, the amplifier consists of individual interchangeable panel sections of standard 19″ width which are mounted on 21″ channel-iron mounting racks. The racks extend from the floor of the truck to the roof and three are required for the complete apparatus.

The center rack contains a complete radio system which provides an output of 4.5 watts. The top panel is a regulation radio tuner and below this are the master-control and volume-indicating panels, the former permitting selection of four input sources and controlling volume in db. steps. Below the volume indicator is a shallow panel containing only one switch, and this permits of changing the amplifier from 4.5 to 50 watts undistorted output by bringing an additional power stage in the circuit. The two panels at the bottom of this rack are the three-stage, 4.5-watt, push-pull amplifier and the power supply.

The section on the extreme right has a special six-circuit microphone mixer-panel mounted at the top, and below this is a two-stage, low-level input amplifier which feeds into the master-control panel in the center section. The panel at the bottom of this rack is a push-pull amplifier and power supply with an output of 50 watts.

The section at the left of the picture contains the control equipment. The various panels mounted on this rack are for charging the storage batteries, compensating line voltages, changing from motor generator to an external power supply, regulating the output impedance of the amplifier so that the loud speakers operate at maximum efficiency, and for controlling current to the fields of the dynamic speakers and phonograph turntable. This section also contains a field telephone set for communicating with engineers working at a distance from the truck.

An interesting feature of the truck is the loud speaker mast, which stands 18′ high and supports six 6′ 6″ trumpets. When not in use this mast is folded and carried inside the truck body, but it takes less than one hour's time to erect the mast and install the loud speakers in position.

An Authoritative Forecast

(*Continued from page* 18)

Broadcasting Company and has constantly been improved. Its most important application is in the broadcasting of operas and other events in large auditoriums.

The directional microphone may be figuratively termed a "camera of sound" inasmuch as it can follow the musician or entertainer just as a camera or spotlight. Recently gunsights were added to the microphones to enable engineers to keep them accurately "aimed" at the artists. The directional microphone makes better balance control possible. It reduces excessive reverberation, thereby assisting towards better acoustical effects.

Radio Standardization

By J. H. Dellinger

Chief, Radio Section, Dept. of Commerce

THE radio industry is sufficiently mature to be interested in standardization. It is, in fact, beginning to benefit by standardization activities. Carefully prepared and extensive standards have been set up, for the manufacturers by the Radio Manufacturers Association, and for the engineers by the Institute of Radio Engineers.

Through the organs of publicity and through the committees of the several radio organizations, co-operation has become the order of the day. On a strictly technical or physical side, radio is benefited by a very satisfactory standardization situation. The important physical standard of radio is that of frequency. Happily, frequency standards of adequate accuracy for every purpose are available.

Without the degree of standardization made possible by these standards, interference conditions would make modern radio wholly impossible.

Two Loud Speakers for "Quality"

By Peter L. Jensen

Jensen Radio Manufacturing Company

THE use of two speakers, one large with good low-frequency response and one small with good highs, will probably be used in higher-priced consoles. The combined effect of two speakers gives a more pleasing effect which cannot be accounted for by merely improving the low and the high response of the system.

Apparently there is nothing on the horizon to challenge the supremacy of the electro-dynamic speaker. Any immediate improvement in speaker design affecting the radio industry will, therefore, be made in this type of reproducer.

The demand for still smaller speakers will only cease when the smaller size begins to affect the performance seriously. This point is about reached. Due to the greater compliance necessary in the moving system in order to reproduce frequencies below ninety cycles, no economy can be looked for by reducing the size of the cone further.

Tube Testers Help Customers

By Harold L. Oleson

Chief Engineer, Jewell Electrical Instrument Co.

A RETARDING influence in tube replacement sales is the scepticism with which the public regards the older tube testers that are difficult for the customer to read and understand. Modern food stores win public confidence by using indicating scales easily read by the customer as well as the salesman.

This important merchandising principle is readily adapted to tube mechandising equipment for radio dealers. Tube testers that indicate tube condition on large meters, easily read by the customer, have been developed. They prove the dealer's story convincingly and leave no room for doubt in the mind of the customer.

Once public confidence is established in dealer tube test methods and equipment, set owners will quickly get the habit of frequently bringing in their tubes for testing. Adequate tube testing equipment will enable the dealer to take advantage of this excellent source of revenue.

How the Radio Tube Grew Up

(*Continued from page* 23)

I succeeded in interesting one McCandless, a producer of miniature electric lights, located on Park Place, New York. McCandless' became the first vacuum tube plant. His men, skilled glassblowers that they were, made the early audions which were sold mainly to wireless experimenters for use as a detector. The audion was supplied with a wooden cabinet containing flashlight batteries for the "B" circuit, and with binding posts and switches for the necessary connections. According to one of our early advertisements: "The audion detector is operated by heated gases, employs a local battery and is complete with switches, batteries, rheostat and necessary connections. It is fully protected by U. S. Patents Nos. 879,532, 979,275 and others granted to Dr. Lee DeForest and held by the Radio Telephone Company. It is pronounced by experts to be the very best detector obtainable anywhere. Renewal audion bulbs may be secured, in exchange for old or broken ones, for $3.50 or $5.00 each. All tubes are tested before shipment, but the 'X' or $5.00 bulbs are tested for the maximum possible sensitiveness. With the audion you can easily increase your range from 50 to 100 per cent."

Our first audions made use of tantalum filaments. Usually a double-loop filament was employed, with three pigtail leads, so that one or the other loop might be used. When one loop or filament burned out, another was still available, thereby giving the short-enough life of those audions a double span, so to speak. The tubes were quite gassy. The plate voltage had to be delicately adjusted so as to be set at the most critical value. If increased beyond a given point, the tube would suddenly light with a purplish glow, and the signals would become garbled.

In time, the audion came into use for telephone purposes. It was in 1915 that the American Telephone & Telegraph Company, employing the DeForest amplifier, inaugurated the first transconti-

(*Continued on page* 75)

How the Radio Tube Grew Up

(*Continued from page 74*)

nental telephone services between New York and San Francisco. The same year that organization, using my "oscillions," or oscillating audions, made successful wireless telephone tests between Arlington, Va., and the Eiffel Tower in Paris, and again with Pearl Harbor, in Hawaii. So thoroughly convinced were wire and wireless men of the value of the audion or three-element vacuum tube that the device received no end of research and engineering development. In 1917 I entered into an agreement with the American Telephone & Telegraph Company, whereby that organization secured certain rights under the audion patents and whereby sufficient audions might be made available to the Army and Navy for radio communication during the World War. The telephone company, in turn, relicensed others to make and use the audion, so that today every reputable vacuum tube manufacturer is a relicensee under the DeForest audion patents.

Until the dawn of broadcasting, vacuum tubes were made by means of more or less laboratory equipment. The relatively small volume of production could be cared for by glassblowers, with a minimum of machinery. The existing lamp-making machinery was found ample, particularly since the tolerances for vacuum tubes were fairly wide. The prices asked for vacuum tubes were such that they could be made piecemeal and without much regard for cost.

But with the inauguration of broadcasting and the sudden demand for vacuum tubes by the public at large, the making of vacuum tubes became a real industry. No longer was it a question of supplying thousands of tubes. Rather, it was a matter of supplying millions of tubes to operate the sets in millions of homes. For the first year or two of broadcasting there existed a marked shortage of tubes. There were times when the list prices meant nothing as regards a maximum. Tubes often actually sold at a premium, because of the greater demand than supply.

By degrees, the radio tube industry geared itself to the demands. Automatic equipment was installed in the better plants. The skilled glassworker was replaced by the automatic machine, with its batteries of blue gas flames, its mechanical arms and fingers, and its constant merry-go-round operation for continuous production. Girl operators came into the industry, mounting and spot-welding the metal parts in place on the glass stem, and loading and unloading the automatic machines, followed by testing, inspection, wrapping and packaging. If one will glance at an early DeForest audion, with elements spaced ¼ inch or more apart, then at the first 201 tube of early broadcasting days, and again at the present –27 heater type a.c. tube, and the more complicated four-element tubes, one is immediately struck with the growing delicacy of vacuum tube construction. The greater accuracy of automatic machinery made possible closer tolerances and more accurate tubes.

The New Multi-Mu Tube

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distortion is caused by non-linear transmission characteristics of r.f. tubes. The signal in passing through the tube becomes distorted because of an increase in modulation of the signal. This distortion is most evident when a powerful signal is tuned in and when as a consequence the volume control of the –24 tubes is set so as to cause only a small plate current in the tube. It is particularly evident in the –24 type due to its sharp plate current cut-off.

Figure 2 shows the maximum input voltage at which the –24 and –35 tubes will operate and yet not allow the modulation to rise more than 20 per cent., which is a satisfactory condition. Figure 2 means just this: Using –24 tubes in a tuner and tuning in a powerful signal the maximum voltage which can be applied to the grid of the –24 tube without introducing distortion is .2 to .4 volt, whereas if –35 type tubes are used a larger voltage of from 4 to 10 volts may be applied without causing any greater distortion.

Thus the new tube can handle a signal without distortion at about 20 times the voltage permissible with the –24 tube. The significance of this in receiver design will be pointed out later in this article.

Cross-Talk

Cross-talk is commonly caused by the inter-modulation in the r.f. tubes between the signal to which the receiver is tuned and a strong interfering signal of different frequency.

The result is that both signals are heard at once. In order to diminish the unwanted signal it has been necessary to use one, two or three preselector circuits ahead of the first tube. These, however, provide very loose coupling between the antenna and the grid of the first r.f. tube and as a result the volume control governing the screen grid voltage on the –24 tubes must be advanced, resulting in a tube hiss.

The –35 tube, however, due to its inherent properties reduces cross-talk by a factor of several hundred times and this fact, together with its ability to handle powerful input signals without distortion makes possible better design in the tuner. Preselector circuits may be cut down to one as shown in Figure 3 without trouble from cross-talk, and the resultant better coupling makes it possible to get the same volume at a lower volume control setting than if two or more preselector circuits were used. Consequently less tube-hiss results.

This is no mere theoretical advantage. It is plainly evident in a receiver. The writer has a four stage r.f. tuner. Listening to out-of-town stations a tube-hiss was painfully apparent using –24 tubes. Changing the tuner over to –35 tubes with one preselector circuit the hiss was entirely gone and the selectivity unimpaired so far as cross-modulation was concerned. The four stage r.f. job has no more internal noise when tuned into a signal than a battery set would have. The explanation is that –35 tubes enable you to take the "load" off the tubes and throw it on the antenna where it belongs. The –35 tubes will hiss much the same as a –24 tube when turned up to full power. But by utilizing their properties and using fewer preselector circuits, the requisite volume is attained at a low tube amplification and without distortion.

Pursuing this line of thought, do not use a tiny antenna even though your set is powerful. Use as long a one as the normal selectivity of the receiver will stand. A small antenna nullifies the advantage of eliminating preselector circuits. The thing to keep in mind is that the stronger the signal that can be impressed on the grid of the first tube the less amplifying the tubes must do and so less tube-hiss results.

Adapting the Multi-mu Tube to Present Receivers

The multi-mu tube may be placed in almost any receiver using –24 tubes. As a matter of fact it may simply be placed in the –24 tube socket without a single change being made and in some cases it will work as well, and perhaps better, because less liable to cross-talk. The volume may be controlled by varying the screen grid voltage or by any of the other methods commonly used in receivers employing –24 tubes. However, these methods do not yield the full advantage of the tube for the tube-hiss will not be diminished.

The volume should be controlled by varying the C bias or control grid bias on the r.f. tubes between –3 and –40 to –50 volts. This means some work on the power pack or voltage supply device. In a power pack of conventional good design, as for example the Amertran, used by the writer, this means that the 2000 ohm C bias resistor which supplies C biases to the detector, r.f., and first audio tubes must be supplemented by a 3500 ohm (approximately) fixed resistor in series with it.

The basic idea is this: Where the voltage divider in a power pack is arranged as in Figure 4, with K or cathode at a point say 18 volts above the most negative point A, it must be changed to about 50 volts above point A. In theory you would move K up on the voltage divider. In practice you leave K where it is and insert at X a fixed resistor with a value of around 3500 ohms, thereby creating a potential difference of approximately 50 volts between K and B. Portion K B of the voltage divider becomes that part used to tap off C biases for the r.f detector and first audio and portion K C provides the plate and screen grid voltages for the tuner.

The volume control for a tuner may be a 20,000 ohm wire wound potentiometer of the straight line curve type (no taper) connected as shown in Figure 5.

Of course the extra 30 volts or so abstracted for use as a C bias means 30 volts taken away from the maximum voltage of the power pack but the effect is very small.

Referring back to the tuner for another point. When the r.f. tubes get their C

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Talking Movies for Schools

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In the early days of sound systems, various input and output impedances were used by different manufacturers and the result was a great deal of poor quality caused by attempting to work a 4000-ohm pick-up into 500-ohm input transformers and similar mismatching. Nowadays manufacturers are standardizing more or less on certain impedances and are prepared to furnish units with whatever terminal impedance is required.

Suitable matching transformers are available from a number of transformer manufacturers, so there should be no problem of matching impedance values. For example, in the above equipment the output impedance of the universal head amplifier is regularly 4000 ohms. The Ward Leonard attenuator and the input of the Amertran 25A amplifiers each have a terminal impedance of 500 ohms. Accordingly it is necessary to replace the output transformer, T2, in Figure 2, with one having a secondary impedance of 500 ohms. A good unit to use for this substitution is to parallel feed the Amertran 993 transformer with the Amertran 3842 choke. The impedance of the pick-up should, of course, be 500 ohms, since it works into the same fader by means of a throw-over switch. If the one supplied with the turntable is of the high-impedance type it should be replaced with a theatre pick-up of 500 ohms of a type similar to the Presto Projectionist.

The same rules of matching apply in the output circuit. The output transformers of many amplifiers designed for sound pictures, such as the one specified, are fitted with a 500-ohm winding for the auditorium speakers and a 15-ohm winding for the booth monitor. In this case a matching transformer must be used to couple into the speakers behind the screen. This must have a secondary of 30 ohms for two dynamic reproducers in series or about 7 ohms if they are connected in parallel. The Amertran type 3377 is suitable for this unit, since it provides taps so that an adjustment can be made for the exact impedance of the speakers.

Some engineers attempt to correct for deficiencies in the frequency response of the system by deliberate mismatching. It is better practice to do this correcting by means of a variable tone control as shown in Figure 1. Some sort of tone control is very desirable if not essential in a sound motion picture system because of the variation in the recording on the film. This is particularly true of reproduction of speech, since it doesn't take much distortion to render it unintelligible. The amount of adjustment necessary will vary with the room and with the size of the audience.

For the smaller lecture halls one loud speaker is sufficient for the volume required. When only one is used, it is probably better to select a horn type, because of its projection qualities. There is some advantage in having two or even more speakers so that the angle of each may be adjusted to distribute an equal volume of sound to all parts of the room. The horns or cones should be placed directly back of a good sound screen so as to give the illusion that the sound is coming from the picture. The frequency-transmission characteristic of the screen is as important as any other link in the system. Much of the unintelligible speech heard on some systems is the result of an attempt to project sound through a heavy, closely woven screen which is not transvocent.

There are various miscellaneous points on the installation which contribute to the final result. All input and output lines should be twisted and shielded. They should be kept far enough apart to prevent oscillation due to feedback. The tubes selected for use in the head amplifier should be as non-microphonic as pos-

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New Multi-Mu Tube

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bias through a common resistor as they do here, there is sometimes a pronounced tendency for oscillation to occur, even though the grid circuits of the r.f. and detector tubes are apparently well filtered as in Figure 6.

Using this method, a high gain 3 stage r.f. tuner was found to be quite unstable. The author then arranged a double filter circuit which entirely eliminated the trouble when applied to the grid circuits. Figure 7 illustrates this. C1 and R1 are inside the shielding and C2 and R2 are outside and the wire joining R1 and R2 is as short as possible, under 2 inches. This is simply doubly filtering each lead.

It was found essential to treat the grid circuit leads thus and it is desirable in a fine job to do the same to the screen grid and the plate leads. Space is generally at a premium so the 1094 series of Aerovox resistors and the small Aerovox condensers were found very convenient for this use. Values of R1 and R2 are 75,000 ohms for grid leads, as shown, and 10,000 ohms for screen-grid leads and for plate leads.

When using −35 tubes bear in mind that the plate current drain is higher than with the −24 type and that when volume is controlled by varying the control grid bias the plate current will vary considerably. This results in variation of the supply voltage, the amount of this variation depending upon the regulation characteristics of the power pack. In adjusting the plate voltage, therefore, a good plan is to measure this voltage with the volume control all the way up, and again with it all the way down, then adjust the voltage, strike a good working average, which will not permit excessive voltage with the volume control down or too little with the volume control turned up full.

The writer has designed a four stage r.f. tuner which seems to be all that can be desired—sensitive, selective and dead quiet. If you do not get results right away, just keep at it because the fault will be in you and not in the tube.

The Chemist's Role in Radio

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next door to strictly chemistry. In the development of audio transformers, it has been necessary to develop alloys of desirable magnetic characteristics. From common grades of iron, in laminated form, radio manufacturers have gone to silicon iron, nickel iron, and other alloys, some of them quite costly, in quest of desirable characteristics so as to provide true tone response over the entire musical frequency scale. Certain patent considerations, particularly covering nickel steel, have caused some transformer manufacturers to search and search for suitable alloys that might circumvent the patents. A remarkable opportunity has been offered to the metallurgist in this field.

Even in the familiar dynamic loud speaker, metallurgy plays an important part. The grade of iron used for the core of the electromagnet is most important, for it determines just how much magnetic flux shall be obtained from a given bulk of iron, and this bulk, in turn, determines just how efficient the loud speaker shall be. The less the bulk for a given flux density, the better the loud speaker.

The Chemist and Vacuum Tubes

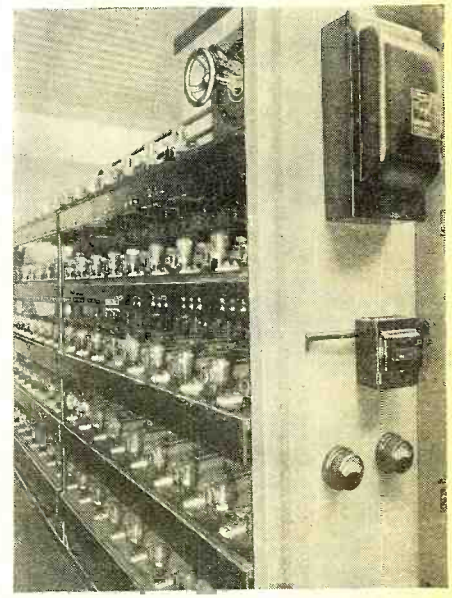
Consider the vacuum tube. To the layman, it is simply a piece of wire called the filament, which is heated by means of current; a lattice member, called the grid, which handles the control energy; a cylinder, called the plate, which handles the output energy; and a glass envelope to provide a means of placing these elements in a good vacuum. Simple enough. Yet there is a world of chemistry involved in the vacuum tube—a sad truth which vacuum tube manufacturers have learned.

First of all, there is the filament. The trend today is decidedly towards the oxide-coated filament, and away from the tungsten and thoriated tungsten types, thereby multiplying the chemical problems just about a thousand times. Special alloys are being sought for the wire, and, in many instances, found by chemists specializing in vacuum tube problems. Nickel, heretofore used mainly for filament, is being abandoned, because of its chemical interaction with the carbonates used as the coating. In fact, it was a chemist who first told vacuum tube manufacturers why certain low-current types "went west" after a few hours of use.

Oxide-coated filaments require many things. First, there must be the wire, chemically immune to the carbonates even at high temperature. The wire must offer the necessary high electrical resistance, so as to be economical in operation. The best wires are those with a cold resistance several times that of nickel, and with the resistance rising rapidly as they warm up, so as to provide some measure of automatic current regulation. The wire must not stretch unduly when heated, to sag and "short" with the near-by grid. A high melting point is necessary, for the carbonates require about 750 deg. C. to provide the necessary emission.

And then there is the oxide coating, usually made up of strontium and barium carbonates, prepared with utmost care and then applied to the wire by means of successive dippings and bakings in a continuous operation, and by means of an air brush in the case of the a.c. heater cathodes. Utmost precautions are taken to guard against impurities in the oxide coating. The larger vacuum tube manufacturers maintain chemical laboratories just for wire and cathode coating, in charge of trained chemists.

The greatest obstacle encountered in the production of good vacuum tubes is gas. Utmost precautions must be taken to be sure that all the gas is removed from the tube before sealing. To this end the pumping is carried out as far as possible within the economic time limit, followed by the flashing of a chemical or "getter" to clean up the remaining gases. The metal parts are frequently baked in a hydrogen atmosphere, so as to remove



The tubes shown in this corner of the RCA Technical and Test Department are burned to complete exhaustion on these life racks

oxygen in the pores of the metal. Even so, with nickel for the support wires, plate and grid, there is considerable imbedded gas which is certain to be exuded when the tube is in use, resulting in gassy tubes. For this reason, molybdenum or "molly" plates are frequently used, also molybdenum wire for supports and grid. However, this metal is far more expensive than nickel, and introduces a serious increase in cost in a field that is highly competitive. For this cause the nickel parts continue in general use, although there are many opportunities for the research chemist by way of better metals or alloys or platings.

All in all, the vacuum tube field is essentially one for the skilled chemist.

The Chemistry of Rectifiers

Several years ago, prior to the introduction of the perfected a.c. tubes, the urgent need of the radio art was satisfac-

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The Chemist's Role in Radio

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tory rectifiers for converting alternating current into direct current, both at high voltages for the plate requirements, and at low voltage for filament requirements.

In the high-voltage field, the Raytheon or gaseous rectifier scored the preliminary success, back in 1925, when it was introduced as the result of the work of C. C. Smith, then of the Harvard faculty,

Ageing racks in a vacuum tube plant. The filament or cathode must be thoroughly seasoned, so that emission is up to standard and stabilized

and Dr. Bush of the M. I. T. staff. Making use of ionized helium as the one-way conducting medium, the Raytheon tube paved the way for socket-power operation. At first only the plate and grid requirements were supplied, but later came more powerful rectifiers capable of supplying the filament requirements of vacuum tubes wired in series for high-voltage, low-current operation.

About two years ago, the chemical rectifier in cartridge form, making use of sulphuric acid, nickel steel and silver, appeared, for the purpose of charging storage batteries and, in connection with a suitable filter system, supplying the filament requirements of tubes wired in the usual parallel manner. These rectifiers, however, were not a success, because the chemistry involved was not fully understood. And so the sulphuric acid rectifier came to an inglorious end, with serious losses to manufacturer, jobber, dealer and public. The idea originally came from France, where Henri André, a noted French radio worker, spent great care in producing just the right kind of cartridges. All in all, the rectifier of this type was a mean problem in electro-chemistry.

Other forms of rectifiers have been introduced from time to time in radio, notably the tantalum rectifier employed as a trickle charger for storage batteries, the "A" eliminator, the dry-disk or copper-oxide rectifier, the Tungar or argon gas bulb, and finally the filament rectifier now in common use. All have presented certain chemical problems.

There are no end of attractive problems awaiting the electro-chemist in the field of radio. There are opportunities for very delicate electro-plating of insulators, whereby to form shielding of very small bulk. There are interesting possibilities by way of plated wires for oxide-coated filaments. There are marvelous opportunities in chemical cells and rectifier couples. Even the old thermo-couple idea is a possibility for the farmer's radio in isolated spots far from electric light service, when operated by the heat of an oil burner. True, attempts have been made in the past to produce thermo-couples, electrically heated, for supplying the requirements of radio sets from the electric light socket. In the presence of perfected a.c. tubes, these attempts have appeared foolish. However the a.c. sets by no means answer the problems of the rural home, and there is a wonderful opportunity awaiting the electro-chemist who can develop a satisfactory thermo-couple operated by an oil burner.

Chemistry in Condensers

Formerly, a condenser was considered simply two conducting plates, such as tinfoil, separated by a non-conductor or dielectric, such as glass or paper. There was little chemistry in condensers. Today, however, the picture is changed by the growing condenser requirements of radio.

Most of the high-voltage, moderate capacity condensers for the filter and by-pass circuits are made with paper dielectric. Winding machines serve to roll the two ribbons of tinfoil or other metal foil with the intervening paper separation. The paper dielectric consists of a plurality of thicknesses of paper, or so many "papers," such as a two-paper, three-paper, six-paper, twelve-paper condenser and so on.

There is a vast amount of chemistry involved in these devices. For instance, the chemist must check up on all the materials entering into the construction of a condenser, otherwise the condenser is liable to break down, rendering an expensive radio set inoperative. Chemists have worked out simple tests for locating metal particles imbedded in the paper, and thereby constituting a potential weak spot. The paper is treated with chemicals, whereupon the metal particles, even if invisible to the eye, appeared as discolorations of considerable diameter. Since an absolutely pure paper is impossible in commercial production, a maximum of spots per foot is set as the standard.

The impregnating compound must be carefully developed for satisfactory melting point, insulating qualities, mechanical properties, and chemical inertness. The rolled condenser sections are placed in vacuum kettles, and, after being pumped out, the liquid insulating compound is introduced in the kettles. Under the vacuum existing, the compound penetrates not only into every fold and interstice of the compressed paper section, but also into the very fibre structure of the paper,

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Talking Movies for Schools

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sible. Sometimes it is necessary to replace a half-inch rubber pad under each foot of the projector, particularly if the floor is not free from vibration. Where the service requirements are heavy and continuous it is desirable to have a reserve amplifier ready to take the load in case of temporary failure of the main amplifier. This emergency amplifier need not be as rugged as the main unit, but should have an equally good frequency response and the same power output. Since the drain on the storage batteries is heavy, it is essential to have the charging circuit arranged so that these batteries can be charged daily. A complete reserve battery unit is necessary to prevent delays due to discharged batteries.

If a film library is to be built up and kept on hand it will be necessary to build a special fire-proof ventilated film vault for this purpose. Specifications for this vault may be obtained from the National Board of Fire Underwriters. A total of 6000 feet may be kept in the booth at any one time.

The operator in charge of the equipment should be thoroughly competent to both operate and maintain his equipment. Even de luxe equipment will not give satisfactory results unless handled properly and carefully maintained. The operator should also have a license, which can be obtained by applying to the local city authorities.

When the equipment is installed and in perfect operating condition, the overall frequency response should be checked. The electric part of the system can be checked with an audio oscillator in the same fashion that any audio system is calibrated. Constant frequency films are available for checking the overall response. With a perfect frequency response some difficulty may still be experienced due to improper sound distribution or too much reverberation in the auditorium. The former can be corrected by changing the angle of the speakers and the latter by proper acoustical amendment in the auditorium. If the reverberation is so great as to interfere with the intelligibility of speech *when the audience is in the room*, and when the volume is at the proper level, it will be necessary to provide a remedy in the form of sound-absorbing material applied to a part of the walls or ceiling. In this connection it should be borne in mind when making tests in an empty auditorium that the presence of an audience will reduce reverberation and echo to a considerable degree.

The following are the main units of equipment required for an installation consisting of one projector equipped for sound-on-film and sound-on-disc:

1—*Equipment:* 1 Simplex projector, Model A, with Peerless lamp house fitted with a carbon arc. *Manufacturer:* International Projection Corporation, New York.

2—*Equipment:* 1 sound head with head amplifier and accessory apparatus for attaching to projector, Universal Model A. *Manufacturer:* Universal Sound Systems, Inc., Philadelphia.

3—*Equipment:* 1 synchronous turntable, 33 1/3 r.p.m., with pick-up and accessories for attaching to projector. *Manufacturer:* Universal Sound Systems, Inc., Philadelphia.

4—*Equipment:* 1 main amplifier with about 70 db. gain and 10 watts undistorted output, Amertran 25A. *Manufacturer:* Amertran Sales Co., New York.

5—*Equipment:* 1 fader, Ward Leonard 8803 or similar model. *Manufacturer:* Ward Leonard Elec. Co., Yonkers, N. Y.

6—*Equipment:* 2 dynamic reproducers for auditorium, cone type. Best auditorium dynamic horn type. *Manufacturer:* Best Manufacturing Co., N. Y. C. Racon horn with Racon giant unit. *Manufacturer:* Racon Electric Co., New York City.

7—*Equipment:* 1 monitor speaker smaller in size but similar in quality to the auditorium speakers.

8—*Equipment:* 1 sound screen about 6′ x 8′.

9—*Equipment:* 2 sets 160 ampere-hour storage batteries for head amplifier filament supply and exciter lamp.

10—*Equipment:* 2 sets of heavy-duty "B" batteries for head amplifier plate supply and photo-cell.

11—*Equipment:* 1 motor generator, d.c. to a.c., 1 k.v.a. capacity. Esco FB3 or FB4, with starter and voltage control. *Manufacturer:* Electric Specialty Co., Stamford, Conn.

12—*Equipment:* 1 battery charger.

13—*Equipment:* 1 film rewinding equipment.

14—*Equipment:* 1 film splicer.

15—*Equipment:* 1 tachometer for checking film speed.

16—*Equipment:* 1 tone control.

17—*Equipment:* 1 Diehl ¼ h.p. single-phase synchronous motor.

If the installation is to include two machines, items number 1, 2, 3, 9 and 10 will have to be furnished in duplicate, and an auxiliary fader dial should be placed in front of the second machine and connected by an extension shaft and crown gears to the fader proper, so that the volume may be regulated from either machine.

Chemists' Rôle in Radio

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thereby providing thorough impregnation,

Then there are the liquid or semi-dry low-voltage, high-capacity condensers. These make use of the fact that aluminum oxide will pass current freely in one direction whereas it offers high resistance to currents of a reversed polarity. A great deal of chemistry is involved in these wet or semi-wet "A" condensers, and only when a chemist is on the job is it possible to obtain a satisfactory product. The radio engineers must concede the place of honor to the chemists in this field.

One might go on and on with the work of the chemist in the radio field, but a sufficient number of instances have been cited to prove that the chemist is an essential factor in successful radio design and production.

More Power to the Midgets

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Overall dimensions—
Length ..... 5⅝"
Diameter ..... 2 3/16"
Base C
Bulb S-17

The pentode tube offers advantages in circuit design because of its greater voltage amplification with high power output, providing certain precautions are observed in design of the speaker load. When operated at a plate and screen voltage of 250 volts and a control grid voltage of 16.5 volts to the center tap of the filament the maximum power output of 2.5 watts can be obtained with a signal input of 15.25 volts peak or 10.8 volts RMS. This is of advantage when additional sensitivity is required with a minimum of amplifier stages. Also, when operating the power output tube directly from the detector through resistance coupling, it is possible to use lower voltages on the detector to obtain satisfactory output when tuned to low percentage modulation signals.

Figure 3 shows graphically a typical relation of power output, total harmonic distortion in per cent. of the fundamental, and the distribution of the harmonic distortion components with respect to load resistance. These data were obtained by measurement at a plate and screen voltage of 250 volts, control grid bias of 16.5 volts to center tap of the filament, and a signal input of 10.8 volts RMS. These curves point out the load circuit limitations which must be considered in the design of the output transformer and its associated circuits. Between load resistance values of 6000 to 8000 ohms the power output is fairly constant, increasing only .2 watt. The total harmonic distortion goes through a minimum over this range and does not exceed 6.4 per cent.

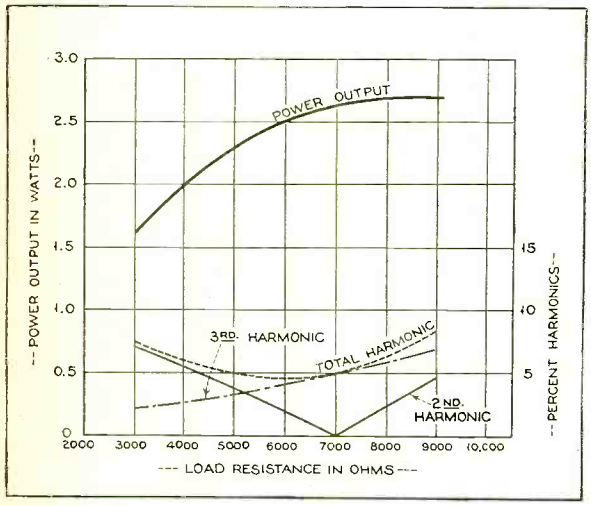

Figure 3. Graphic presentation showing relationship between power output and harmonic distortion at various load resistance values

Therefore it is desirable to keep the output load approximately between these limits over the frequency range desired to obtain satisfactory power output and freedom from distortion. If the transformer impedance falls appreciably below 6000 ohms at the low frequencies, insufficient power will be obtained at these frequencies. On the other hand, if the impedance rises rapidly at the higher frequencies the distortion will also rise rapidly.

The power amplifier pentode offers considerable advantage in circuit design when high gain with comparatively high power output at moderate "B" voltages and current is desired. Improved circuit design and changing conditions make possible the satisfactory application of the power amplifier pentode.

A Vacuum Tube Voltmeter

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A potentiometer and battery of 90 volts were connected to a voltmeter. The voltage was made 57, and applied to the plate of the tube. The plate current was noted. Then the resistor was substituted for the potentiometer and voltmeter, and the clip on the resistor was set so that the plate meter read as before. The same kind of operation was carried out in adjusting the grid bias.

The easiest way to calibrate the vacuum-tube voltmeter is by means of a standard a.c. voltmeter which has a range of from .1 to 25 volts. If a good meter with this range is not handy, a standard resistance box may be used. If the total voltage across the resistance box is known, then using the box as a potentiometer or voltage divider, we can obtain enough different voltages to plot the calibration curve.

In calibrating our meter, the resistor R2 is set to maximum. With the grid bias at 6 volts, and 57 volts on the plate, a plate current of several microamperes

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Stepping Out for World-Wide Reception

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afternoon hours, signing off at about six o'clock E. S. T. Mexico, Honduras and South America were received during our evening hours.

None of the stations on the other side of the world was tuned in, for the simple reason that the difference in time is such that they go on the air long after good little Americans have gone to bed. Australian and New Zealand stations do not start to come in, for instance, until about 1 a.m. E. S. T. and are best along about three or four o'clock in the morning. Circumstances would not permit our tests to be continued after midnight. However, this fact did not worry us any, because, judging from the quality and volume of reception obtained from European and South American stations, there was no question in our minds regarding the ability of the Scott receiver to bring in these other stations.

It so happens that a friend of mine in Chicago has listened in rather extensively on short-wave stations with the same model receiver, so we wired him for a brief log of foreign stations he had heard. His telegraphed reply is reproduced elsewhere in this article. This provides evidence of the reception possible with this receiver operating in Chicago and indicates that our reception in New York was not in any way unusual for this particular outfit.

It would be well, at this point, to provide a little more information on the equipment and methods employed in making the phonograph records of foreign reception. The Presto home recorder contains complete equipment for recording and for playing back records, lacking only the audio amplifier and loud speaker, which may be those of any modern receiver. It is connected to the receiver by means of two leads to the "phonograph" connections of the receiver, providing the receiver boasts this modern feature, as does the receiver under discussion. Otherwise there is an adaptor which is plugged into the detector socket of the receiver. There are also two other adaptors which are inserted in the sockets of the output tubes of the receiver. With this outfit records may be made either of radio programs tuned in on the receiver or of music or voice picked up by the microphone which comes with the home recording equipment.

After the necessary adapter connections have been made to the receiver, the switch provided on the home recorder provides for the various uses of the equipment. Simply by setting this switch on the "radio" point the radio receiver functions in the usual manner. By throwing the switch to the "radio recording" position the recording equipment is thrown into operation and the radio programs may be put on records. Throwing to the "microphone" position, records may be of one's own voice speaking into the microphone. Another switch setting provides for playing back any phonograph record, either home-made or commercial. During all of these operations the loud speaker is left in the circuit, and whether recording or playing back, everything is audible.

The record discs employed with this recorder are the Remsen discs of smooth metal. The recorder employs a metal stylus in recording and this cuts its own groove. A fiber needle is used in playing back the records, with the result that the records last indefinitely.

The Scott receiver was described in some detail in the June issue, so there is no need here for repeating the description. That issue also told the story of the reception tests made on the broadcast wavelengths. A few words here regarding the operation of the receiver on the short waves will complete the story.

To put the receiver into operation on the short waves involves plugging in the proper pair of short-wave coils for the desired wavelength range and clipping two short-wave leads on to the control grid terminals of the first r.f. and detector tubes. These operations require only a few seconds. For short-wave ranges above 38 meters the process is even more simple, because it is necessary to change the clip on only one tube.

On the wavelengths below 38 meters, where one would expect the tuning to become more and more critical, it actually is extremely simple, due to the fact that the oscillator dial becomes the major tuning control and the other dial functions more as a vernier than as an actual tuning control. This convenience results from the fact that there is some interaction between the tuned input circuit and the oscillator tuning. When a station is tuned in on the oscillator dial it may be tuned out by varying the input tuning control, but likewise a station can be tuned in on the oscillator dial even though the input tuning control is several degrees off its setting.

In tuning the receiver it is convenient to set both dials alike for the approximate wavelength desired and then, leaving the oscillator dial alone, moving the left-hand dial a few degrees up or down until the desired station is heard. This sounds simple and actually is just as simple as it sounds if the "short-wave station finder" provided with the receiver is employed. This novel device, which appears in one of the illustrations, shows at a glance the dial setting for any given wavelength in the short-wave band. Thus, if one desires to tune in the Chelmsford station mentioned above, the scale on the station finder is revolved until the wavelength of 25.5 appears in the window. The arrow on the edge of the station finder then points to the proper dial setting. In checking up on the station finder, I have found it surprisingly accurate. It indicates the proper dial setting for Chelmsford and other foreign stations within the fraction of one degree.

It might be said here that this short-wave station finder eliminates one of the greatest complications involved for the novice in short-wave reception. Normally, with a short-wave receiver, one has to learn through hours of patient experi-

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Radio News Technical Information Service

The Technical Information Service has been carried on for many years by the technical staff of RADIO NEWS. Its primary purpose is to give helpful information to those readers who run across technical problems in their work or hobby which they are not able to solve without assistance. The service has grown to such large proportions that it is now advisable to outline and regulate activities so that information desired may come to our readers accurately, adequately and promptly.

Long, rambling letters containing requests that are vague or on a subject that is unanswerable take up so large a portion of the staff's working time that legitimate questions may pile up in such quantities as to cause a delay that seriously hinders the promptness of reply. To eliminate this waste of time and the period of waiting, that sometimes occurs to our readers as a consequence, the following list of simple rules *must* be observed in making requests for information. Readers will help themselves by abiding by these rules.

Preparation of Requests

1. Limit each request for information to a single subject.
2. In a request for information, include any data that will aid us in assisting in answering. If the request relates to apparatus described in RADIO NEWS, state the issue, page number, title of article and the name of the device or apparatus.
3. Write only on one side of your paper.
4. Pin the coupon to your request.

The service is directed specifically at the problems of the radio serviceman, engineer, mechanic, experimenter, set builder, student and amateur, but is open to all classes of readers as well.

All questions from subscribers to RADIO NEWS will be answered free of charge, provided they comply with the regulations here set forth. Non-subscribers to RADIO NEWS will be charged a nominal fee of $1.00 for this service. All questions will be answered by mail and not through the editorial columns of the magazine, or by telephone. When possible, requests for information will be answered by referring to articles in past issues of the magazine that contain the desired information. For this reason it is advisable to keep RADIO NEWS as a radio reference.

Complete information about sets described in other publications cannot be given, although readers will be referred to other sources of information whenever possible. The staff cannot undertake to design special circuits, receivers. equipment or installations. The staff cannot service receivers or test any radio apparatus. Wiring diagrams of commercial receivers cannot be supplied, but where we have published them in RADIO NEWS, a reference will be given to past issues. Comparisons between various kinds of receivers or manufactured apparatus cannot be made.

Only those requests will be given consideration that are accompanied by the current month's coupon below, accurately filled out.

JULY, 1931
Technical Information Coupon
RADIO NEWS Laboratory
381 Fourth Avenue
New York City, New York
Gentlemen:

Kindly supply me with complete information on the attached question:

☐ I am a regular subscriber to RADIO NEWS and I understand this information will be sent me free of charge.

☐ I am not yet a subscriber to RADIO NEWS and enclose $1.00 to cover costs of the service.

☐ I wish to become a subscriber to RADIO NEWS and enclose $2.50 to receive the magazine regularly for one year, and to receive this valuable technical information service free of charge.

Name .....

Address .....

Stepping Out for World-Wide Reception

(*Continued from page 82*)

ence where a given wavelength may be found on the dials. It is almost unbelievable that such a simple device as this station finder can simplify this process to the extent that it does.

This receiver has no critical requirements so far as antenna length is concerned for short-wave reception. Any antenna which will give good results on the broadcast band will be suitable for the short-waves as well. For those who desire the very best results on the short-waves an antenna 150 feet or more in length may be used because when the short-wave coils are plugged in the antenna is switched over from the long wave antenna terminal of the receiver to the short-wave terminal which cuts out the tuned input circuit to the first r.f. tube and replaces it with a choke or untuned circuit.

There seems to be little more to tell about the short-wave operation of this receiver except to add that while it is what we might almost class as a scientific instrument, nevertheless it is well within the ability of the absolute novice to operate. The use of the two tuning dials instead of one may *seem* at first to be a step backward from our modern one-dial receivers, but actually this provides one means of obtaining maximum efficiency and little loss in simplicity of operation because the two dials tune almost exactly equal. Likewise it would be possible to take care of the changes required to shift from broadcast waves to short-wave waves by means of switches. but this would introduce the necessity for additional leads which might have a tendency to reduce efficiency.

New Pentode Variable-Mu Superheterodyne

(*Continued from page* 43)

are placed directly behind the power transformer housing. The i.f. and second detector tubes are individually shielded in cases pierced to assure adequate ventilation and the grid leads to the i.f. tubes are individually shielded up to the point where they enter the tube shields. The filter condensers, consisting of three 4 m.f.d. semi-self-healing dry electrolytic condensers are contained in the small can directly behind the tuning dial. Two cords project from the rear of the chassis—one, the power cord and the other a 4-lead speaker connection cord.

Only three controls are visible on the front of the receiver—the left one being the tone control, the center one the control for the vernier tuning dial, and the right one the combined on-off switch and volume control. No other controls are either necessary or desirable. The chassis dimensions are 19½ inches long, 10½ inches deep, and 8 inches high, over all.

When the chassis is mounted in a cabinet, it is essential that it be cushioned from any vibration set up by the loud speaker. Otherwise, due to the excessive selectivity of the receiver, distortion of tone might result at high volume. This is taken care of by strips of sponge rubber placed under the mounting flanges at each end of the chassis.

Figure 2 shows the bottom view of the receiver and indicates a very pleasing simplicity considering the performance of the set. In the upper right hand corner is seen the oscillator low frequency trimmer condenser C4, accessible through the hole in the right end of the chassis. Directly to its left is the -27 oscillator socket with the three bias resistors R9, R10, and R11 visible above it, and likewise the by-pass condenser C13. It will be noted that a portion of the oscillator plate current is bled through the bias resistor for the first detector in order to secure a desirable and constant order of value of bias for this tube—more so than would be obtained in this particular position with pure automatic bias on the first detector. The r.f. choke L4 is seen between the ends of the shielding cans for the first r.f. and detector coils L1 and L2, these coils being essentially similar to the oscillator coil which is housed in the gang-condenser-oscillator shield on the top of the chassis. The on-off switch SW, and volume control RS, together with the resistance R4, are seen to the right of the tuning dial, while the tone control R2 is at the left of the dial. The power transformer T6, on top of the chassis, has its terminal lugs projecting through the slots visible at the left of the chassis and to its right, the filter choke shown as L5 in the circuit diagram. Bias resistance R12 and by-pass C15 for the pentode power tubes are seen just to the left of the tone control. The transformer visible near the speaker cord outlet is the push-pull audio transformer T4. The balance of the placement parts hardly needs description.

It will be noticed from an examination of the circuit diagram that the plate current of the second detector tube is brought through the resistance R1 and is isolated from the primary of the audio transformer by C11, the combination of R1, C11 and the primary T4 making up the Clough system of tuned audio amplification and being in a large measure responsible for the very excellent base response of the receiver, and particularly the slight hump between 50 and 100 cycles in the curve of Figure 6.

The tone control circuit consists of rheostat R2 and condenser C12, the rheostat being of 500,000 ohms resistance and C12 being of .025 mfd. capacity. By-pass condenser C9 is a combination of two .5 and one 1 mfd. units is seen directly behind the tuning dial at the rear of the chassis. The balance of the resistors and condensers are for bias, by-pass, and bleeder purposes and are located where most convenient in the assembly. The second detector r.f. plate choke L6, is not visible. On this point readers of previous articles will recall that the second detector r.f. plate choke was not only undesirable, but could not be included in the circuit without serious fourth harmonic i.f. feed-back and consequently, "blooping," at 70 kc. the i.f. frequency being 175 kc. This, however, is not true in the present design where the shielding of the r.f. and oscillator circuit is considerably better, and the choke here serves a desirable stabilizing purpose in view of the higher gain of the receiver as compared to the previous 724 model.

There is little point in going into the specific design features of the individual parts of the receiver, since they are all covered in articles by the writer in the last October, November, December, and January issues of RADIO NEWS. Suffice it to say that the r.f. transformer coupling the first r.f. tube and the first detector has both capacitative and inductive coupling between primary and secondary in order to provide a substantially flat gain curve from one end of the broadcast band to the other. The i.f. transformers are all dually tuned to 175 kc., the first transformer having a small copper shielding ring between primary and secondary to provide looser coupling and a consequently higher order of selectivity than is desirable in the second and third i.f. transformers. The oscillator circuit employs a tuned tank circuit for frequency determination in order to eliminate variations due to oscillator tube variations, or differences in oscillator tubes. This tank circuit employs the customary three padding condensers in addition to the tuning section of the gang condenser, the small trimmer on the gang condenser itself being the 1400 kc. trimmer, and the larger condenser, C4, on the right end of the chassis, being the low frequency, or 600 kc. trimmer. The oscillator is coupled to the first detector by a small coupling coil in the latter's cathode lead, since inductive coupling as employed in the 724 receiver is not possible with the individually shielded coils of the 726 receiver.

The filter circuit utilizes one choke coil, LS, and the speaker field together with three 4 mfd. dry electrolytic condensers C14, and in addition, the filtration pro-

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Merchandising Radio Service

(*Continued from page* 60)

"Our list of prospective dealers is prepared by writing to the local newspapers in all towns within 100 miles of Sioux City requesting their advertising rates and the names of all the radio dealers in their territory. We also plan advertising in each small-town newspaper to acquaint the people throughout the territory with our service and the name of our local representative. Write-ups in these papers are also available with a surprisingly small amount of advertising.

"With each circular letter sent to these dealers we also enclose an application blank. When this blank is filled out and returned to us, the dealer's credit rating and business methods are investigated, and, if satisfactory, they are entered on our preferential list of dealers and receive our regular wholesale discount. We then send them our dealer's kit, which contains shipping tags, repair tags, shipping stickers, and an authorized service agent showcard.

Selling the Small Town

"Our service in this division is just starting and the need of service in most of the small towns is surprising. The dealers are often sceptical, because they have been gyped in service work by some itinerant radio expert.

"When we receive a set from our territory dealers to be repaired, and we replace a transformer or some other part, the replacement was really necessary and the dealer is charged exactly for what was done and nothing more. If all service stations would adopt this policy, and guarantee their work, it would not be difficult to obtain service work from a steadily increasing number of dealers.

Advantages of Centralized Service

"Good radio service starts when the set is installed, not when it goes bad. In order for a set to function satisfactorily, the aerial, ground, balancing condensers, and line voltage should be checked carefully. Another important fact that our installation men remember when installing a set for a dealer is—that particular set is the greatest set in the world, they either have one at home, or, if they had the money, they would buy nothing else! Remarks of this nature instil confidence in the customer's mind. Believing us to be an exclusive service organization, we are considered disinterested parties in the actual sale.

"When a dealer handles his own service, it is a safe estimate to say that 25 per cent. of his time will be consumed in service conversations and in details pertaining to operating the service branch of his business. Experience has shown that in a great majority of cases the dealer actually loses money on his service operations. Thus it follows that the dealer is contributing 25 per cent. of his time to jobs that, in the final washout, are not profitable. The small, part-time dealer finds that the total annual volume does not warrant the dealer's maintaining even one serviceman.

"Our experience with local dealers indicates that the service expense ranges from 5 per cent. to 8 per cent. This does not include 25 per cent. of his own time and the time of the other employees used in service efforts. Taking the minimum of 5 per cent. on an average sale of $175, then $8.75 represents the service cost. We deliver, install and guarantee good popular makes of radios for a period of 90 days for $4.50 or slightly over 2½ per cent. on a $175 sale—a saving of $4.27 to the dealer plus the fact that he may devote his entire efforts to sales. We include the delivery, because if we did not handle this phase of the operation the dealer would still be required to maintain a truck and driver, and his natural reaction would be that his driver could just as well be his serviceman.

"If the customer needs an aerial, we install this at a charge from $6.50 to $15 to the customer, the dealer receiving the regular wholesale percentage discount. If the set is not sold and must be returned, we return it and charge $1.50 for the delivery, installation inspection, and return the set.

Tube Replacements

"About the first question most dealers ask us when we present our proposition is: 'Who sells the replacement tubes?' When he is told that we do, he immediately feels that he is losing money because he is relinquishing this service. However, a bit of thought in the right direction will generally clear up this misapprehension. According to our investigations, an average of about two tubes per year are replaced in a radio set. We assume that the dealer would sell these tubes to his customers, which is a doubtful presumption. With the average list price of $2 as the value of replacement tubes, this means that the dealer would lose $1.20 on each tube or $2.40 for the two. However, he has already made a saving of $4.25 plus the fact that he has his time free to devote to sales. Also, the dealer does not always sell his customer the replacement tubes. Our dealers still sell tubes from their stores, and we do not hesitate to state that the majority of the tubes sold by any dealer are sold over the counter.

"Where a dealer employs our service on a $4.50 basis, he escapes the necessity of removing the chassis and bringing it to our service station. We handle all service on sets for a period of 90 days after sale. Following this guarantee period, we service the dealer's customers at a nominal rate that is uniform and free from the old racket of overcharging. Also, when this customer is in the market for a new radio, the only firm that learns of the fact from us is the firm that turned over the call. This is a rule that we stress, for if we were to play favorite with any particular dealer, we could not expect to survive.

"Another imagined objection to centralized service stimulates the following

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Merchandising Radio Service

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question: 'What about the sets I have sold in the past, and on which I must render service?' The answer, of course, is that we shall be glad to handle this service on a mutually profitable plan that allows the dealer a given percentage of the total bill to his customers. Working on this basis, the dealer makes a clear profit by simply turning the call over to us. We are enabled to handle all extra work in this manner by virtue of the fact that we have a volume of business exclusively service. For the same reason we are able to employ a better class of servicemen, and to keep them occupied during the working hours of the day. This is something that the dealer, in most cases, has been unable to do, because he does not have sufficient work at all times for his service crew.

"We also have some dealers who cannot be convinced that the 90-day guarantee system is profitable. In such instances we handle all service work with him on the same basis that we handle the extra service for our guarantee dealers.

"In summary, our service station in making the delivery, installation and maintenance charge of $4.50 is working on a very close margin but has the following good points:

"First—We secure new customers who at the end of the guarantee period will be required to pay list prices for parts and service.

"Second—Installations mean the sale of antennas that we would not get otherwise.

"We believe that this system will increase our volume of business steadily. It is our duty to treat our customers fairly, to work very closely and honestly with our dealers so as to maintain, at all times, his good will and confidence."

Which leaves nothing to comment aside from an emphatic editorial "Q. E. D."

Twelve Years of Radio Progress

(*Continued from page 25*)

other stations opened during the summer of 1922, the radio rage spread throughout the entire country.

Since that time radio has become the most universal of all forms of entertainment. It stretches from churches to night clubs, with interludes on the theatrical and concert stages, schools, lecture platforms, sports events. Incidentally, most of the techniques which we accept as a matter of course were once tremendously sensational. For example, the first church broadcast, which came from the Calvary Episcopal Church, was hailed as a "daring experiment" when it made its début on January 2, 1921, over KDKA. Controversies as to whether or not it bordered upon the sacrilegious raged, but the program was enthusiastically hailed and became a regular feature.

In 1921 remote control was inaugurated on a far larger scale than this. The same station broadcast the Johnny Dundee-Johnny Ray fight on April 11; on May 9 the first program to originate on the stage of a theatre; on August 4-6, the Davis Cup matches; and on August 5, a play-by-play account of a ball game. WJZ presented a World's Series game shortly after it opened, and KYW's first program was a broadcast of the Chicago Civic

A group picture of the orchestra and artists on an NBC commercial hour

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Home Television Receiver

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Type –24 a.c. screen-grid tubes, VT1, VT2 and VT3, should be inserted in sockets S1, S2 and S3 and the tube shields slipped in place over them and fitted to their bases. The cap terminals from the radio-frequency transformers should then be fitted over the top terminals of the tubes.

The –27 type tubes, VT4 and VT5, should be placed in sockets S4 and S5.

A type –45 power tube, VT6, should be placed in socket S6 and a type BH rectifier, RT, should be placed in socket S8.

Complete instructions regarding the adjustment and operation of both the receiver and televisor will be given in the next and concluding article of this series which will appear in the August issue.

List of Parts Required

N1 Baird No. 51 chassis with 8 sockets (S1, S2, S3, S4, S5, S6, S7 and S8), 3 coil shield bases (CS1, CS2 and CS3), 3-post binding post strip (GND., SHORT ANT. and LONG ANT.) and 2 Aerovox type 260 condensers (C10 and C13) mounted on the chassis.
1 Baird No. 76 front panel.
1 Baird No. 75 dial and escutcheon plate.
1 Baird No. 61, 3-gang variable condenser (C1, C2, C3), fitted with two trimmer condensers (C5, C6).
1 Baird No. 71, 9-plate midget condenser (C4).
1 Baird No. 72, 14-plate midget condenser (C7).
3 Aerovox type 1465 (Baird No. 54) .0001 mfd. mica condensers (C8, C11, C17).
2 Aerovox type 1450 (Baird No. 56) .02 mfd. mica condensers (C9, C12).
2 Aerovox type 260 .25 mfd. condensers (furnished already mounted on chassis) (C10, C13).
3 Aerovox type 15-8 (Baird type 62) dry electrolytic condensers (C14, C15, C16).
1 Aerovox special condenser block (Baird No. 59) (C24, C25, C26, C27).
1 Aerovox type 260 (Baird No. 66) 3-condenser strip (C28, C29, C30).
1 Aerovox special (Baird No. 73) buffer condenser block (C31, C32).
1 Baird No. 64 double choke unit (CH1, CH2).
3 Baird No. 60 r.f. chokes (CH3, CH4, CH5).
1 Baird No. 80 dial light assembly (DL).
2 Baird No. 53, 1-megohm pigtail resistors (R1, R2).
2 Baird No. 77, 400-ohm grid resistors (R3, R4).
2 Baird No. 57 jacks (J1, J2).
1 Baird No. 70 combination potentiometer and a.c. switch (P and SW2).
1 Standard 2-prong a.c. plug (P1).
1 Baird No. 65 gang resistor. This unit should be mounted so that the large-size resistor at one end is at R14. (R5, R6, R7, R8, R9, R10, R11, R12, R13, R14.)
6 5-prong sockets (already mounted on chassis) (S1, S2, S3, S4, S5, S7).
2 4-prong sockets (already mounted on chassis) (S6, S8).
3 Baird No. 52, 4-prong sockets (S9, S10, S11).
1 Baird No. 68, 2-terminal toggle switch (SW1).
1 Baird No. 79, 3-terminal switch (SW3).
1 Baird No. 69, 2-pin jack speaker terminal unit (SPEAKER).
1 Baird No. 63 power transformer (T).
3 Baird tube shields (TS1, TS2, TS3).
3 Baird coil shields (CS1, CS2, CS3).
1 Baird No. 74 voltage divider (VD).
3 Baird No. 55 control grid clips.
4 Baird No. 67 knobs.
1 Baird No. 78 wire kit.
1 Baird hardware kit.
1 Baird set of octocoils.
1 suitable cabinet.

All in a Day's Work

(*Continued from page 62*)

.00025 mfd. condenser when the dial is rotated, increasing the wavelength of the first tuned r.f. circuit. Sandpapering this contact, and also the metal contact on the drum dial, and applying a little vaseline, effects a satisfactory cure. However, if the make-and-break contact occurs directly on the frequency of a carrier wave, an annoying click will be heard. This can be eliminated by shifting the dial slightly so that the contact is made on one side of the signal."

New Pentode Variable-Mu Superheterodyne

(*Continued from page 84*)

vided by the bucking coil in the speaker voice coil circuit and the additional by-pass condensers in the receiver circuit. The hum level is so low as not to be noticeable with the ear close to the speaker when the receiver is in operation. Volume is controlled by potentiometer R5 in the bleeder circuit which adjusts the control grid bias of the r.f. and first and second i.f. tubes. A minimum value of bias is assured by the fixed resistor R4.

The loud speaker is of a special 10½ inch Jensen electro dynamic type—a special design for the high frequency compensation necessary to secure the over-all response curves described. It is the only type of loud speaker which may be satisfactorily employed with this receiver in order to obtain the full benefits of its excellent tone quality. The loud speaker is connected to the receiver by means of a four-lead cable projecting from the set chassis and having four lugs for attachment under terminal screws on the loud speaker terminal strip.

In a forthcoming article, a variation of this receiver, adapted to operate from 15-650 meters, all entirely self-contained and without plug-in coils, will be described.

Twelve Years of Radio Progress

(*Continued from page 86*)

Opera Company, direct from the stage of the Opera House.

However, it was not until Jack Dempsey fought Georges Carpentier in Jersey City on July 2, 1921, that a real ringside blow-by-blow description was broadcast. At this time, Major J. Andrew White was at the ringside with a telephone. He phoned the word picture of the battle to J. O. Smith at Hoboken, who repeated it into a microphone, sending it out over the station operated for experimental wireless dispatching by the D., L. and W. Railroad.

Two years later the first broadcast from a moving train was made on the Easter Special coming down from Cornell. Despite the passage of the train over bridges and through the tunnels, the 150-meter wave was well received by the listening amateurs. The broadcast was a description of the countryside, as it flashed by, interrupted by occasional musical selections by the glee club. Its announcer was the writer of this article.

It was to the amateurs largely that the progress of broadcasting is due, but the poor amateur seldom got a break from the authorities who regulate activities. In the earliest days when 360 meters was the only wave on which regular broadcasting stations operated, one could tune down below 200 meters and hear the hams putting on amateur talent and shows of their own. There were phonograph records, little dramas and musical entertainment, much of which was really quite noteworthy. Then the Department of Commerce relegated them to the short waves and, banning entertainment, limited the scope of their efforts to code and voice. They bowed to the decree with the time-honored philosophy of the pioneer and pushed on to explore the new realms open to them, and which they knew were to be taken from them as soon as they definitely established their usability.

Tremendous interest in radio was aroused by the international tests conducted in 1923 under the auspices of the American Radio Relay League, Paul Godley supervising. Godley went to Androsan, Scotland, and listened in on the experimental transmissions of such eminent American amateurs as Major Armstrong of regenerative, superregenerative and superheterodyne fame; Johnny Grinan, Dick Richardson, the Princeton boy who had one of the few operator's licenses during the war; J. O. Smith, the first amateur to instal continuous wave in place of spark; Ralph Waldo Emerson Decker, and a host of others. To these men and the sensational work which they did is due a great amount of credit for the popularization of radio. Most of them are still trail-blazing on the short waves, and are taking a lively interest in television.

A photograph of the staff of "old WEAF," then located at 195 Broadway. Among them are Leslie Joy (extreme left), Graham McNamee (second from left), Phillips Carlin (second from right) and G. W. Johnstone (extreme right). They all now hold executive positions with the National Broadcasting Company. Kathleen Stewart, the favorite pianist of radio listeners for many years, is shown at the extreme right

At first an interesting laboratory experiment, radio had by this time been recognized as an advertising as well as an entertainment medium. Manufacturers of nationally advertised products made use of its facilities to push their products, and in order to secure listeners for their spoken advertisements, surrounded their appeals with attractive programs. Competition between sponsors, each endeavoring to offer the most attractive broadcast, resulted in huge sums of money being spent for talent.

In order to get the utmost value out of each dollar spent on the artists, a given program was sent out over two or more stations instead of only one.

At the same time the use of higher

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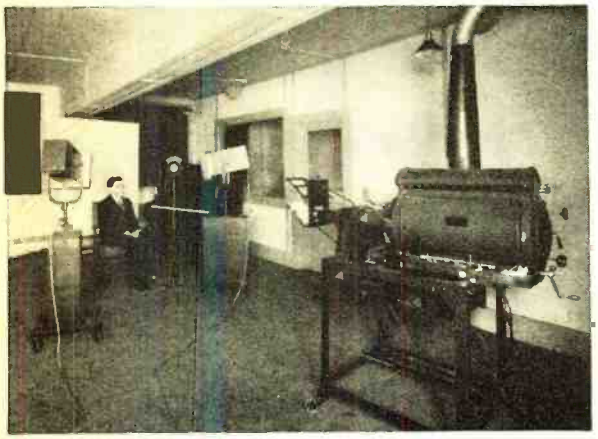
New York Looks-In

(*Continued from page* 31)

the performer faces a sweeping beam of light which scans or analyzes the image to be transmitted. The beam sweeps the subject in sixty parallel, horizontal lines, one following another from top to bottom, then starting at the top again at the rate of twenty complete pictures or frames per second. The reflected light from the image is picked up by a battery of photo-electric or light-sensitive cells, sometimes referred to as "electric eyes," which translate the varying amount of light into corresponding electric terms. Amplified millions of times, the electrical impulses are impressed on the television transmitter which propagates corresponding signals.

The scanning mechanism comprises a powerful arc light, a scanning disc, three lenses mounted on a turret for ready interchangeability, and a stand which may be moved vertically, horizontally or tilted to follow the performer. The operator can direct the scanning beam by means of lenses picking up a close-up, a half-length or full length of the performer or performers.



Studio of television station W2XCD, Passaic, N. J. In foreground is the light source with lenses and scanning disc. Microphone and photo-electric cells are in background. Sound is broadcast on 1604 kc.; sight on 2050 kc.

Translated into terms of receiving, since at any given instant the subject is illuminated by a single spot of light the reflection from which is picked up by means of the photo-electric cells and subsequently transmitted, while at the receiving end a single dot of corresponding light value appears before the looker-in, it is essential that both dots be exactly at the same point with respect to the entire image. This function is called synchronization, a term which requires more detailed explanation. Where a common alternating-current power station is available the receiving and transmitting scanners are kept in perfect step by means of synchronous motors electrically "geared" together. Where different alternating-current power systems are employed, there are other methods of maintaining the essential synchronism, including a synchronizing feature included in the television signal.

The change from the former forty-eight line, fifteen pictures per second scanning to the present sixty-line, twenty pictures per second scanning systems of W2XCR and other television stations, provides not only greater pictorial detail but also reduces "flicker" to a negligible minimum. The improvement approximates 40 per cent.

While this new station, in the heart of the greatest metropolitan center in the world, is an entirely new venture for television, it does not contain any new and startling development in the art of transmitting vision by radio. The major principles involved in the apparatus utilized are fundamentally those which have been used in other Jenkins stations throughout the country. However the new station does contain all of the latest available refinements of equipment.

While the DeForest station W2XCD in Passaic is experimenting with various technical devices and improving transmission, the Jenkins station W2XCR in New York will attack the problem more from the program end, developing a form of presentation best suited to the maximum entertainment value, using always the finest equipment. To put it differently, W2XCD will use *program material* as a means of testing equipment and results, while W2XCR will use the *equipment* to test program material and presentation technique.

Of course, in any finished whole, equipment and program must compliment each other to the full. And so they shall. But in these early stages of the art, experimentation is the golden rule. Fortunately the Passaic and New York stations see fit to cooperate, to their mutual benefit and that of television as a whole, by each experimenting in its own field. Since the engineering staff and facilities are located in Passaic, W2XCD is in the better position to devise and improve equipment, while the proximity of W2XCR to the entertainment center of the nation, Times Square, permits the testing, by that station, of all forms of talent and the formulation of the principles of television presentation that may well be followed in years to come.

When television broadcasts were first inaugurated from the Jenkins Station W3XK in Washington, D. C., I firmly believed that just as sound broadcasting developed first as an experiment in which radio amateurs took part, so would radio-vision develop best in the hands of amateurs rather than behind the closed doors of the research laboratory.

(*Continued on page* 90)

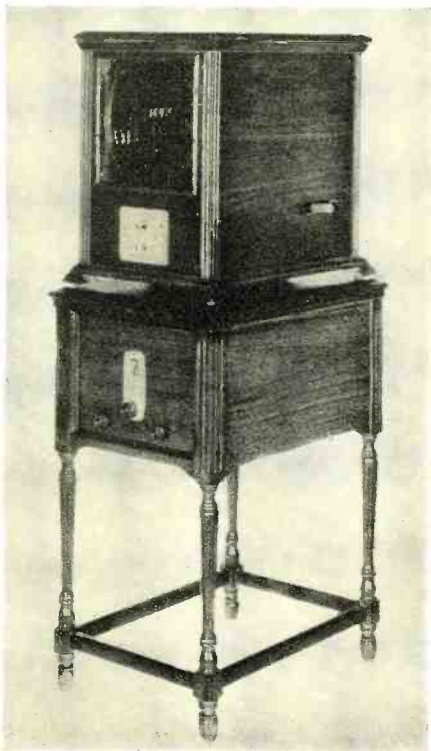
New York Looks-In

(*Continued from page* 89)

When the Washington station was opened radio amateurs all over the country were invited to build experimental radio-vision receivers and tune in the signals.

Since those pioneering days a tremendous transition has taken place. Today, television has reached the stage where it is possible for the layman to obtain apparatus and derive considerable enjoyment from television programs.

While television is still far from perfect, reception has been reduced to its simplest stages, considering our present knowledge of the science. While we eagerly look for new developments and inventions in the not too distant future, changes will probably take the form of continual improvements rather than radical novelties.



Close-up front view of Jenkins televisor

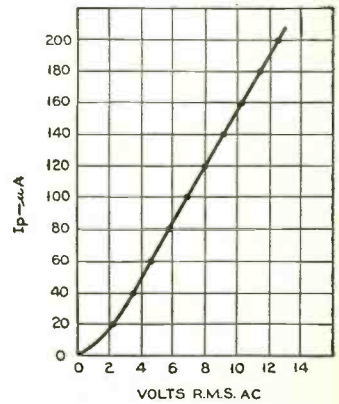
It is in the interest of accelerating the development of television and placing it on an entertainment basis that the Jenkins Television Corporation and the De-Forest Radio Company have taken up the broadcasting of television. W3XK is continuing to serve a large portion of the country as the original station. The De-Forest Company is continuing its transmissions from station W2XCD at Passaic. Station W2XCR, the new New York transmitter, will be developed along the lines of supplying visual entertainment in the metropolitan area. The best of talent is being secured.

The day has arrived, I believe, when television has passed beyond the laboratory stage and has reached the point of understandability and utility for the average radio listener. With television now being widely accepted throughout the eastern part of the country, perfect vision by radio is soon bound to be the outcome.

Vacuum Tube Voltmeter

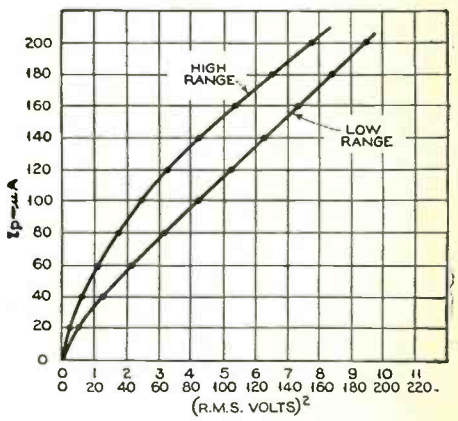
(*Continued from page* 81)

will show on the plate meter. By adjusting R1, this reading may be made some exact value, say 25 microamperes. The reset knob then returns our plate meter to zero, and we are ready to calibrate. In using the meter again, we merely go through this procedure. This means that the values of plate and grid voltages will always be correct if the plate meter reads 25 microamperes under the above conditions, regardless of the voltage of the B battery.



High-range calibration curve

The purpose of the condensers, which are 1 microfarad each, is to by-pass the alternating current. If this is done, the calibration will be independent of the frequency up to a frequency at which the internal capacities of the tube become important.



Wave form error curves

It might be mentioned here, that both ranges may be increased some by shunting the plate meter with a resistance, but this cannot be carried very far if the grid is to draw no current. By increasing the reflexing resistor R4, the high range may also be extended some, but, here again we are limited by the flow of grid current. It must be remembered that the plate voltage drops as R4 is increased, and that the lower the plate voltage is, the easier it is for grid current to flow. In this V. T. voltmeter, no grid current flowed on the low range

(*Continued on page* 91)

Twelve Years of Radio Progress

(*Continued from page* 88)

power began to be considered, but it was not until New Year's night of 1926 that the first superpower station went on the air. This was WJZ, and the man responsible for its use of high power was David Sarnoff. The use of superpower has been of tremendous importance in the popularization of radio. It has made reception far better by improving the signal-to-static ratio, and consequently superpower is being adopted by all the big stations which can get permission to use it.

Broadcasting Chaos

That brings to mind the time when the authority of the Department of Commerce failed and chaos resulted. This was in 1925, when stations abandoned the appointed waves and time to which they had been assigned and used their own judgment as to what bands, powers and hours they would utilize for their broadcasts. Inasmuch as all wanted waves toward the upper end of the broadcast spectrum, wanted to be on the air full time, and wanted to use as much power as they could push through their antennas, the chief result was a howling heterodyne which marred nearly every program. To overcome this evil the Federal Radio Commission was formed.

Ever since it was found that there were more stations which desired to broadcast than there were channels to accommodate them, some means of straightening out the difficulty has been sought. Limitation of power and of time on the air has been used as the most practical means for eliminating cross-talk and heterodyning, but how effective it really is is realized by every listener who has a sensitive set and whose reception of locals is marred by the signals of DX stations.

For years experiments have been conducted with the idea of synchronizing stations so that two or more will be enabled to operate on the same channel, using adequate power. Until last year no great success was made along these lines, but now WEAF synchronizes with WTIC, and WJZ with WBAL very successfully.

Even as broadcasting has grown, so have vacuum tubes developed and circuits improved, and along with the betterment of receiver design the improvement of transmitters has kept pace.

Set Building

In 1924 set building was perhaps at its height. A survey conducted among the licensed amateurs of America revealed that it was apparently the custom to build a set, use it for about three weeks and tear it apart to use the parts for another one.

It was in this year that one of the most popular circuits made its début. This was the three-circuit tuning, a simple regenerative set with an aperiodic primary. Shortly thereafter it was superseded by the neutrodyne and other forms of tuned-radio-frequency receivers, which retained their popularity until the advent of the –24 type tube. This tube, known as the "screen-grid tube," and the modern power tubes were radio's next big step as far as reception was concerned. Also the perfection of various types of a.c. tubes, which enable the listener to do away with all batteries, simply plugging in on the electric light lines, were developments which made the batteryless set possible.

During this entire period, C. Francis Jenkins and a new army of experimenters had begun work on telephoto (still) and television (moving) pictures. Various means of producing the former include the use of a radio controlled airbush, an air jet providing heat to a thermo-sensitive paper, a light beam on a photo-sensitive paper, an ink bar, a stylus working through carbon and similar devices. All these have been used commercially to greater or lesser extent.

Television

Television, too, has been receiving particular attention of late years. Thus far the majority of the experimenters have concentrated their efforts on apparatus in which a scanning disc and glow tube are used. Other experimenters have discarded the scanning disc and used the cathode-ray tube instead. But even though television is a branch of radio, it is a subject far too large to be included in the scope of this article, and so we must leave the other wonderful developments to be written at a later date.

A Vacuum Tube Voltmeter

(*Continued from page* 90)

scale. On the high range scale about 2 microamperes were in the grid circuit when the applied a.c. voltage was 13 volts.

In order to investigate the wave-form error of this particular V. T. voltmeter, the plate current was plotted against the square of the applied a.c. voltage. If this curve is a straight line, we will expect the reading of the voltmeter to be free from wave-form error.[1] The low range curve gives a straight line from about 20 microamperes on up, so we can feel that the voltmeter is free from error due to wave-form over most of its scale. In the case of the high range or reflex type, the curve is not straight until we have reached about 100 microamperes, or one-half scale.

[1] See Terry, "Advanced Laboratory Practice in Electricity and Magnetism."

The Values Employed

R1	50,000 ohm variable resistor
R2	50,000 ohm variable resistor
R3	15 ohm rheostat
R4	50,000 ohm fixed resistor
r1, r2, r3	wire wound resistor of about 60,000 ohms
A	0–200 microammeter
V	0–8 volts voltmeter

INDEX TO ADVERTISERS

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, Of RADIO NEWS, published Monthly at Jamaica, New York, for April 1, 1931.

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

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Laurence M. Cockaday, who, having been duly sworn according to law, deposes and says that he is the Editor of the RADIO NEWS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Radio-Science Publications, Inc., 381 Fourth Avenue, New York City.

Editor, Laurence M. Cockaday, 381 Fourth Avenue, New York City.

Managing Editor, None. Business Managers, None.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Radio-Science Publications, Inc., 381 Fourth Avenue, New York City.

B. A. Mackinnon, 225 Varick Street, New York City.

H. K. Fly, 225 Varick Street, New York City.

R. B. Asmus, 551 Fifth Avenue, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

LAURENCE M. COCKADAY, Editor.

Sworn to and subscribed before me this 27th day of March, 1931. (Seal) Joseph H. Kraus.
(My commission expires March 30, 1931.)

In Science and Invention for July

Twenty Thousand Leagues Under the Sea Today—Lieutenant-Commander H. A. Gosnell, U.S.N.R., gives a fascinating comparison of Jules Verne's prophecy of the submarine and the Nautilus as it is today.

Amazing Camels of the Plant Kingdom—Can Plants Think? Perhaps they can, you will conclude after reading this article by Forman T. McClean, of the N. Y. Botanical Gardens.

The Romance of Glass — A tour through the Corning Glass Works, explaining the various processes in the manufacture of Glass, by A. Dinsdale.

The House of Tomorrow—An interview with Samuel G. Hibben, of the Westinghouse Lamp Company, on how you will live in the future. By Mary Jacobs.

Are You Getting Enough Sleep?—Dr. Frederic Damrau presents several cures for insomnia.

Spectacular Harmless Fireworks—How to make your own for the Fourth!

Preparing Your Outboard Boat for Racing—What you can do to make your outboarding enjoyable this summer.

Several How to Make Its, including: A Poker Chip Dragon, New Tools You Can Easily Make, Building a Model Glider, How to Preserve Butterflies and Moths, A Fill-in Book and Magazine Case, Ornamental Furniture from Discarded Spools; Electrical Principles from Easily Performed Experiments.

The Professional Touch in Home Recording

(*Continued from page 27*)

found that excellent results are obtainable through the use of the new Electrad Loftin-White A-250 amplifier. This amplifier is a direct-coupled two-stage unit, with a −24 type screen-grid tube in the first stage and a −50 type tube in the output stage. It utilizes a single −81 half-wave rectifier tube. The power consumption of this amplifier is 85 watts and its rated maximum undistorted output is 4.6 watts. The rated gain at 1000 cycles is 55 decibels.

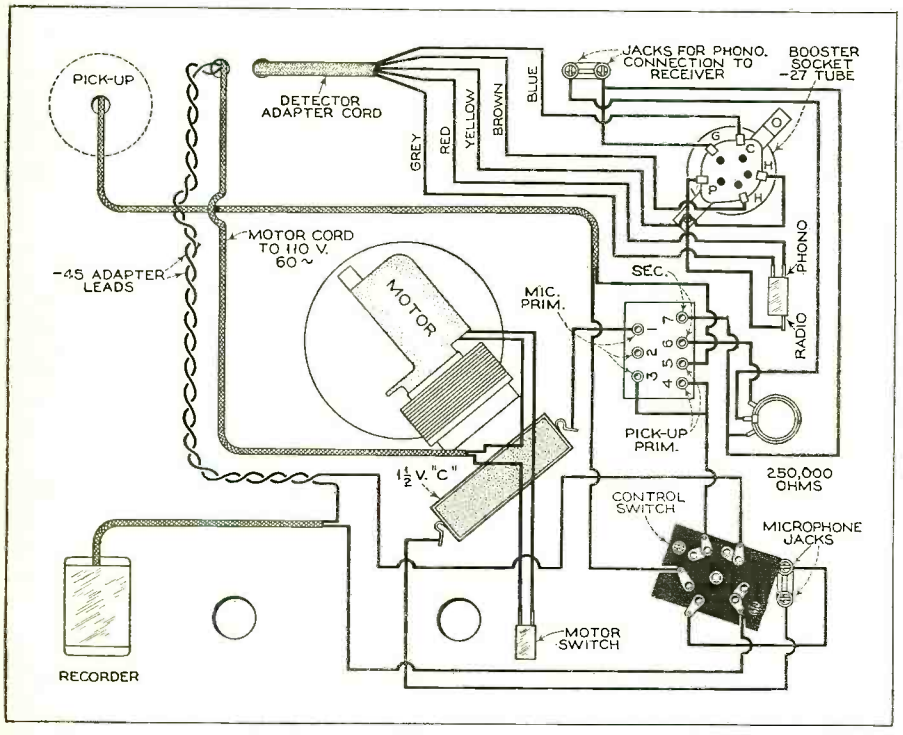
Where economy is of the utmost importance, the Electrad A-245 amplifier can be substituted for the A-250. Although the quality of the recordings in this case will not be quite so high, nevertheless, worth-while results are possible. On the other hand, in cases where price is not a consideration, but where the very highest quality of recording must be obtained, it is suggested that the Electrad model C-250 be used. This is a two-stage Loftin-White amplifier, using a −24 tube in the first stage and two −50 type tubes in push-pull in the output stage. The rated maximum undistorted output of this amplifier is 10.35 watts. For average recording requirements, the A-250 amplifier will give complete satisfaction.

The schematic diagram shown in Figure 2 illustrates the hook-up employed by the writer with highly satisfactory results. An actual photograph of this apparatus is also shown.

In designing the above recording system the selection of the record maker and of the amplifier naturally constituted the most important considerations. However, choice of the matching transformers and of the output choke also has a decided bearing on the attainment of the desired results. It was necessary to obtain matching transformers of the highest quality and proper impedance values. The phonograph motor used was found to be especially well adapted to home recording because of its power and uniform speed.

The utilization of a high-quality speaker is just as important as the use of a high-grade amplifier, record maker, matching transformers, pick-up, etc. In the final analysis, the speaker is even more important, since a poor speaker will spoil the reproduction of the finest recordings.

Even where price is a vital consideration, quality should not be sacrificed. In such cases it is suggested that a Wright-DeCoster model 217 Jr. dynamic reproducer be substituted for the model 207. The writer was able to obtain very good results with this speaker and this substitution is recommended to those who wish to meet a certain price, without seriously impairing the quality of the results.



Complete circuit of portable home recorder shown on page 26

The operation of the apparatus shown in Figures 1 and 2 is as follows: The closed-circuit jack (2) at the "mike" control box is provided for the purpose of plugging in a milliammeter to check the current through the microphone. Microphone current is adjusted with the potentiometer (3) in accordance with the microphone manufacturer's specifications.

After all the components are connected as shown in the diagram, the A-250 amplifier is connected to the 110-volt, 60-cycle source. The phonograph motor is also plugged into a similar 110-volt outlet. With the amplifier switch "on," switches (8) and (17) are thrown to the "up" position and the microphone is tested. Switch (17) is then thrown to the "down" position, the phonograph motor is

(*Continued on page 95*)

Junior Radio Guild

(*Continued from page 64*)

(4) A regular polygon is a polygon which is both equilateral and equiangular. With reference to Figure 24, let ABCDE be a regular polygon with a circle inscribed within it. The radius OF of the inscribed circle is called the apothem of the polygon.

(5) The perimeter of the polygon is equal to the sum of its sides.

Proposition Theorem

The area of a regular polygon is equal to half the product of its apothem by its perimeter.

This theorem is important for the proper understanding of the area of a circle. With reference to Figure 25, let P represent the perimeter and R the apothem of the polygon. Now, a circle can be circumscribed about the polygon which will have radii OA, OB, OC, etc., and therefore the polygon is divided into as many triangles as it has sides.

The area of each triangle is equal to ½R times the base (the area of a triangle is equal to half the product of its base by its altitude).

Therefore, the area of all the triangles, which is equal to the area of the polygon, is equal to ½R multiplied by the sum of all the bases, which is equal to the perimeter P. We have, then, the area of a regular polygon is equal to half the product of its apothem by its perimeter.

Proposition Theorem

The area of a circle is equal to half the product of its radius by its circumference.

It is of interest to note the similarity of this proposition to the previous one. With reference to Figure 24, let C represent the circumference and R the radius of the circle. Let a polygon be circumscribed about the circle, and we know that:

Area of the polygon = ½R × P (the area of a regular polygon is equal to half the product of its apothem by its perimeter).

Let us conceive the polygon to be circumscribed about the circle which will have the number of sides indefinitely increased. We see, then, that the perimeter will approach the circumference of the circle, the area of the polygon will approach the area of a circle, and ½R × P will approach ½R × C.

Thus, since the area of a regular polygon is always equal to ½R × P and a regular polygon with infinite sides can approach the circumference of a circle as a limit, we have:

Area of the circle = ½R × C

We have, then, the area of a circle is equal to half the product of its radius by its circumference.

Backstage in Broadcasting

(*Continued from page 57*)

the lower floors was necessary. The network's rapid growth and enlarged personnel demanded so much additional space that some departments have already been

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The Professional Touch in Home Recording

(*Continued from page 93*)

started, the recording head is put into position on the spiral feed, so that the cutting needle touches the disc and the recording is started by talking into the microphone.

For radio recording, switch (8) is left open and the input terminals of the amplifier (A) and (B) are connected to the secondary wiring of the first audio transformer in the radio receiver. The (A) connection should be made at the grid terminal, marked "G." In order to play back the records, switch (17) is thrown to the "up" position and switch (8) is thrown down. The recording head is taken off the feed mechanism, the pick-up is placed on the record, and the phonograph motor is started.

New Principle Incorporated

The microphone used incorporates an entirely new principle, namely, that of transverse current flow. The current is forced across the face of the instrument by locating two carbon electrodes near the opposite edges of the diaphragm. Between these electrodes there is a shallow channel, filled with special microphone granules and held in place by a thin treated silk membrane, which acts as a diaphragm. When sound impinges upon the diaphragm the adjacent granules are disturbed. This changes their resistance and hence modulates the direct current flowing through the column. In this manner greatly improved tonal reproduction is attained, without agitating the carbon electrodes, which are used only to make a quiet, constant electrical contact with the granules. This new improvement reduces background noises and eliminates "packing."

All microphones should be handled carefully and it is suggested that the "mike" be held vertically while recording, for best results. It is necessary to do a little experimenting before the true potentialities of the recording apparatus can be realized. An ordinary conversational tone of voice is recommended for recording, with the microphone held directly before the mouth, at a distance of from one to three inches, depending upon the strength and penetrating qualities of the voice. Microphone hiss may be eliminated in many cases by turning the side of the "mike" towards the speaker. For piano recording, the microphone should be placed near the back of the keyboard and at the center, but it should not touch the piano. Distances up to 15 inches are permissible for the recording of vocal selections. In recording instrumental music it is best to experiment with the microphone placement, until the best distances and positions are found. If trouble is experienced with a microphone howl, this may be due to the fact that the speaker stood directly in front of the equipment while recording. Radio recordings will be improved by adjusting the radio receiver volume control for maximum undistorted signal strength. If the receiver is equipped with a tone control, this should be set for the maximum high frequencies.

Complete List of Parts
(Shown in Figure 2)

1—One-button Amplion microphone, 500 ohms
2—Closed-circuit jack*
3—500-ohm Electrad potentiometer*
4—Dry cells to energize microphone*
5—Filament switch*
6—Amertran matching transformer, type 5752†
7—Electrad royalty potentiometer, 0-500,000 ohms
8—Double-pole, double-throw switch
9—Amertran pick-up matching transformer, type 406-A
10—Electrad L-pad, type LS-2000
11—Pacent master phonovox pick-up—2000 ohms
12—Electrad Loftin-White amplifier—type A-250
13—Amerchoke, type 101
14—Flechtheim condenser, 2 mfd., 1000 volts, type HS-200
15—Wright-DeCoster dynamic reproducer, type 207
16—Output transformer on speaker
17—Double-pole, double-throw switch
18—Presto home recorder 4200-ohm impedance head with feed mechanism
19—Pacent electrovox phonograph motor and turntable
20—Phonograph motor switch

*Items indicated thus are included in the Electrad control box.

†*Note:* Where a two-button, 500-ohm microphone is used, Amertran type 547-A matching transformer should be substituted. A 200-ohm, two-button microphone will require the Amertran type 923-A matching transformer.

A Tool Kit

(*Continued from page 61*)

Yankee ratchet screwdriver—No. 15—4-inch blade.

Spudger.

This last item, the "spudger," is a tool much used by telephone men for cleaning dirt, chunks of insulation and solder between the "punchings" on terminal blocks. It can also be used for the mechanical testing of soldered connections and for many other purposes. A spudger can be made from a piece of ¼-inch round or square fibre rod about six inches long by sharpening one end to an edge and pointing the other end. It is used as a pick. Small sheets of emery paper, sandpaper and crocus cloth should be added to the kit. A supply of one of each of the different size fuses used in the installation will also prove useful.

If the engineer is working mainly on Western Electric sound equipment and is occasionally called upon to string and clean light valves, he will find the following additional tools to be indispensable:

4½-inch jeweler's tweezers—No. 18.
1¼-inch screwdriver—Valley "Pet."
⅛-inch camel's hair brush.

Backstage in Broadcasting

(*Continued from page* 94)

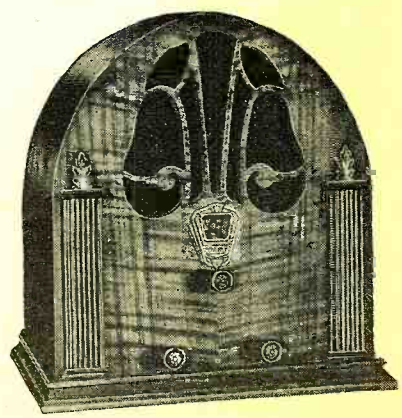
transferred to larger quarters as many as three and four times. Expansion is so speedy and transfers so frequent that it is quite essential to consult the directory board in the main corridor to ascertain whether or not the department you are seeking is still on the same floor as upon your previous visit.

THE return to the air of Norman Sweetser on the occasion of Rudy Vallee's recent personal appearance tour brought about numerous queries as to where the veteran N. B. C. announcer had been for the past year. Although he was not on the air, Sweetser occupied an important executive network assignment to which he returned at the conclusion of the Vallee tour. Sweetser has been manager of the Times Square studio of the N. B. C. since its inception in the Spring of 1930. It is from this site that the Collier's, Camel, Clicquot Club and General Electric Hours are regularly heard. The site was previously known as the Frolic Theatre and is located in the heart of New York's amusement center. The auditorium accommodates 600 visitors and there has rarely been an empty seat during the presentation of any program behind the huge glass curtain separating the onlookers from the stage-studio.

What's New at the Trade Show

(*Continued from page* 56)

one -80 type rectifier tube. It is equipped with a dynamic speaker and the receiver



chassis is made of cadmium-plated steel. The cabinet is finished in figured walnut, measuring 17 inches high by 16½ inches wide by 10¾ inches deep.

Maker—Wholesale Radio Service Co., Inc., 38 Vesey St., New York City.

BE SURE THAT IT DOES !

Supreme Oscillator Model 70, Less Tube and Batteries, Dealers' Net Price, F.O.B. Greenwood Miss. **$49.75**

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3. The only perfectly shielded Oscillator with adaptability for external 110-volt D.C. or A.C. (of any frequency) power supply, as well as for use with its self-contained batteries.
4. The only commercial Oscillator which may be operated with or without modulation for the beat-note adjustments recommended by some radio manufacturers.
5. The only popular priced Oscillator provided with a vernier-movement tuning dial for fine adjustments.
6. The only commercial Oscillator built into a cast aluminum housing, with an aluminum panel covered with bakelite, so that the complete Oscillator can be removed from the carrying case when desired.
7. Completely controlled output.
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9. The only popularly priced commercial Oscillator accompanied with an *attenuated* output meter, combined with an accurately calibrated high-range ohmmeter.

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BURY past mistakes with the past season. In selecting your equipment for new season's opportunities *BE SURE!* Look at the panels to the right—to the left. Check, *Double-Check* the answer to the question, "Does the instrument you intend to buy offer these advantages?" And let the obvious superiority and foresighted engineering design of Supreme Instruments lead you to an investment that is producing daily dividends for knowing servicemen throughout the radio world. The "Money-back" Guarantee below will uphold your own good judgment and the Supreme tradition, "Supreme by Comparison."

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MODEL 90 PIONEER OF PENTODE ANALYSES

FIRST to provide all PENTODE TESTS AND ANALYSES, Model 90 enters the new season unchallenged for versatility to every radio service development. The instrument adopted and recommended by the engineers of RCA Institutes, who say—"The best mechanical equipment ever designed. Permit us to congratulate you on the superior design and construction." Could more absolute assurance be desired than this recommendation from the world's foremost engineering institution and the money-back guarantee below?

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THE famous Supreme Model 400-B Diagnometer needs no introduction to the service world. The new Pentode Series N-4 is now ready for shipment. Write today for information.

Does the Analyzer you intend to buy offer all these advantages in PENTODE ANALYSES?

In addition to all regular analytical tests, the Model 90 provides—

1. Power pentode analyses without special Pentode adapters which have exposed high potential terminals.
2. Measurements of power pentode space charge grid potentials.
3. Measurements of power pentode space charge grid currents.
4. Measurements of power pentode plate currents.
5. Measurements of power pentode plate potentials.
6. Measurements of power pentode control grid potentials.
7. Measurements of power pentode filament potentials.
8. Screen grid analyses without radio circuit oscillations.
9. Six (6) ranges for A.C. potential measurements up to 900 volts with "1,000-ohms - per - volt" meter sensitivity.

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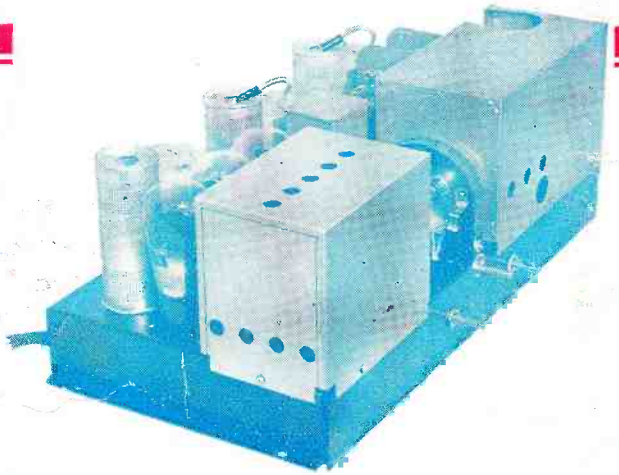
SM

New 726 Superhet with *Four* Vario-Mu's and *Two* Pentodes in Push-Pull



Since last September thousands of superheterodynes have left the Silver-Marshall Laboratories to go into the homes of radio experts from coast to coast. Production on the S-M 724 had to be doubled to keep up with the demand caused by the receivers themselves. Hundreds of letters were received enclosing three and four page logs and praising the sets' performance.

The Laboratories were proud of that receiver and are even more pleased to present the new S-M 726. It is a nine-tube superhet embodying *four* Vario-Mu '51 tubes and *two* audio Pentodes in push-pull. Just imagine *that* set! It surpasses the best, having even better selectivity and sensitivity than the 724, plus all the advantages of the new tubes. For the first time *real* tone is possible on a "performer." Superhet noises have been remarkably reduced. The local-distance switch is no longer necessary. It is non-radiating—the coils are all shielded. Tone control has been incorporated. In short, it is impossible to build a single-control nine-tube super with built-in power unit that will outdo it at any price! Its price is 'way down.

Read this list of features: *Four* Vario-Mu tubes; *two* Pentodes in push-pull with twice the power and four times the sensitivity of '45's; these six tubes with two '27's and one '80 give reception equal to *thirteen* ordinary tubes in a superhet circuit; completely variable tone control; non-radiating oscillator with shielded tubes, condensers, and doubly shielded coil.

The 726 is offered only with speaker, as it was necessary to specially design a dynamic that would take its output and respond adequately to the highs that are made possible by the Pentodes.

Send the coupon for prices and complete technical data.

Write for *New* General Parts Catalog

SILVER-MARSHALL, Inc. Dept. R-N 1
6405 W. 65th Street, Chicago, U. S. A.

Please send me full details on the S-M 726 (enclosed you will find 2c).

Please send me FREE your new General Parts Catalog.

Name .....

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The new Catalog gives detailed data on a complete new line of chassis, kits, amplifiers, replacement parts, etc. Everything from an All-Wave Super without plug-in coils, to a new line of transformers.

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