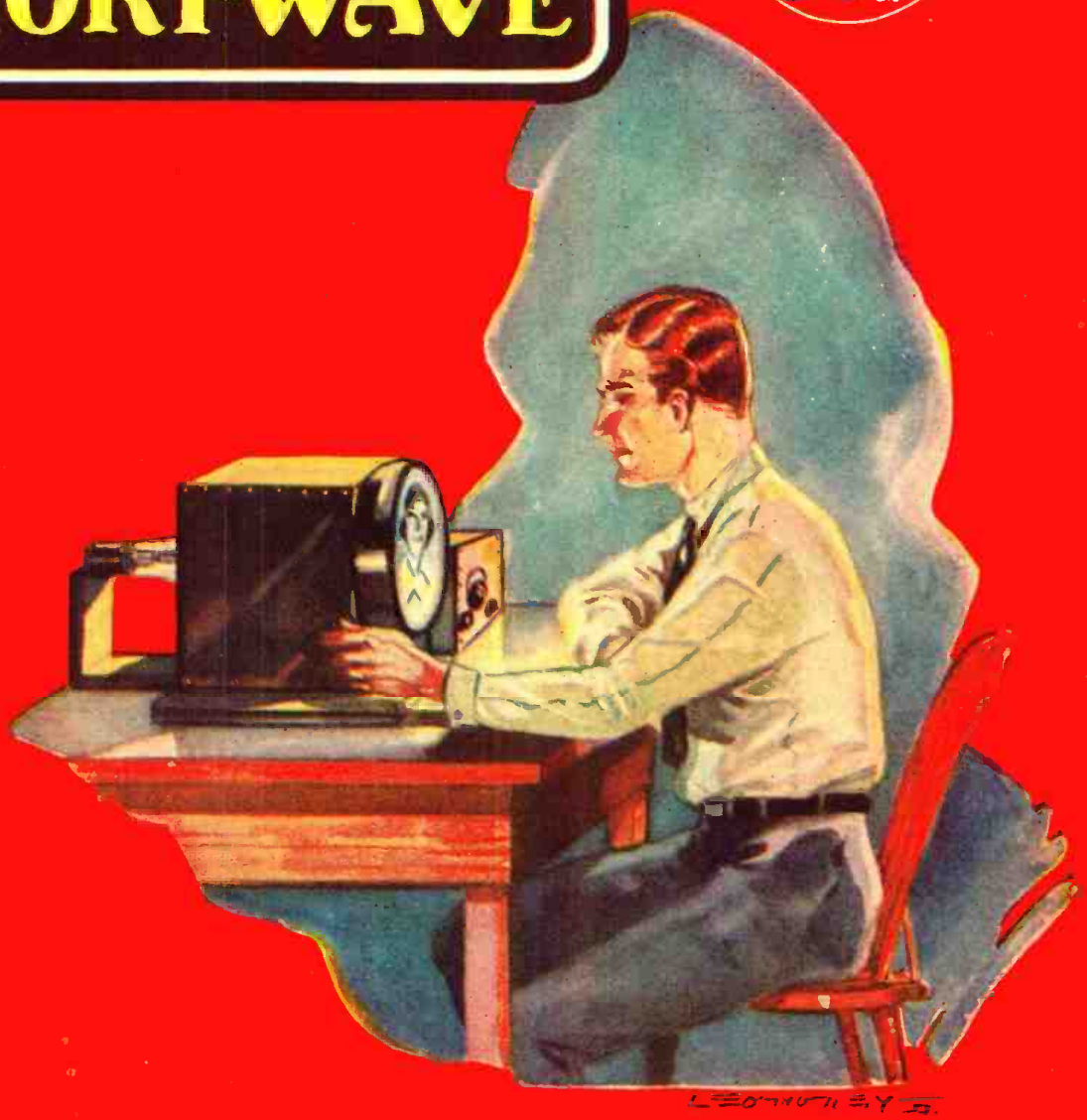
SHORT-WAVE TIME SCHEDULE

RADIO NEWS and The SHORT-WAVE

NOVEMBER
25 Cents

NRA MEMBER U.S.

Newest Cathode-Ray Tubes for TELEVISION



A Publication Devoted to Progress and Development in Radio

Short Waves
DX Reception
Amateur Activity
Experimental Research

Service Work
Engineering
Electronics
Industrial Application

Television
Set Building
Broadcasting
Electrical Measurement

READRITE EQUIPMENT APPROVED BY PROFESSION ...

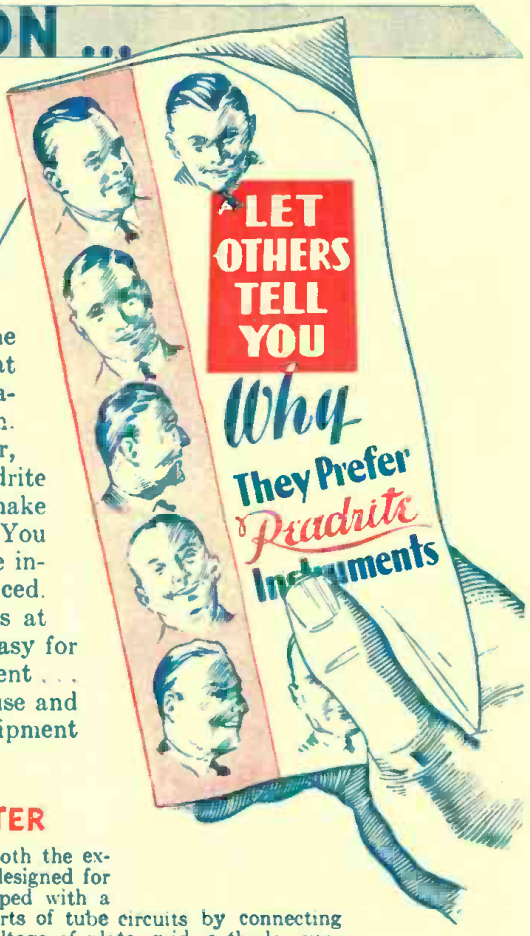
because of Greater Flexibility ... Economy ... and Ruggedness —!

No. 710
READRITE TESTER

No. 550
READRITE
OSCILLATOR

No. 410
TUBE TESTER

NOW is the time to cash in on the widespread public interest that is being aroused by the sensational Radio Prosperity Campaign. And you, as a Radio Service Engineer, can cash in best by using the Readrite testers shown here. They will make money for you and save you money! You can afford to standardize on Readrite instruments. They are popularly priced. They enable you to make more calls at less cost per call . . . they make it easy for you to meet every servicing requirement . . . they withstand the hardest kind of use and abuse . . . they insure that your equipment dollar stretches much farther.



No. 710 READRITE TESTER

This all-purpose tester fills every need of both the expert service man and the beginner. It is designed for the testing of new and old radios. Equipped with a practical selector switch for checking all parts of tube circuits by connecting to the set sockets. Selection for testing voltage of plate, grid, cathode, suppressor grid and screen grid is quickly and accurately done. Plate current, filament volts, line and power supply volts, resistance and continuity are measured. Battery is used for continuity testing of transformers, chokes, etc. Handles most advanced circuits and newest tubes.

The No. 711 Readrite Tester is the same as the No. 710 except that it is equipped with the new Triplett D'Arsonval Volt-ohmmeter, which has 1000 ohms per volt resistance. The readings are 0-15-60-300-600---0 to 300,000 ohms. Ohmmeter reading is secured with the 4½ volt battery, which is furnished.

Here's Proof of READRITE Leadership.

Write for your copy TODAY!

No. 550 READRITE OSCILLATOR

This signal generator furnishes a modulated signal of constant frequency for the alignment of all modern radios. It is used to align r. f. transformers, check oscillator stage, compare gain in tubes and determine the sensitivity of a receiver.

No. 410 TUBE TESTER

Used for checking new and old tubes in receiving sets. Simply designed, compactly constructed, this tester is ideal for both outside work and for counter use. A push button provides two-plate current readings for determining the conductance and worth of a tube. For those wanting a longer-scale instrument, the Model 416 Tester, with a Triplett D'Arsonval Flush Mounted Meter is offered. This instrument does not have illuminated dial, but in other respects is the same as the No. 410.

YOUR JOBBER CAN SUPPLY YOU

See him today, or send the coupon for descriptive catalog.

NRA
WE DO OUR PART

TIE IN WITH THE NEW PROSPERITY CAMPAIGN

SEND COUPON FOR QUICK FACTS !

READRITE METER WORKS,
80 College Ave.,
Bluffton, Ohio

Gentlemen:
Send me catalog on Readrite Instrument No. ( )
as well as folder giving proofs of Readrite Leadership.

Name .....

Street Address .....

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

READRITE METER WORKS

80 College Ave, Bluffton, Ohio

The Hand that Rules the World

THE hand that turns this knob is ruler of the world's wealth of entertainment. A twirl of this SCOTT dial commands the music of dance bands from London or Paris—direct. It brings symphonic concerts from Germany or opera from Rome—direct. It decrees that Spanish tangos, South American rhumbas, or the wild laugh of the Australian kookaburra bird be heard with natural fidelity of tone in the quiet comfort of your home as far as 10,000 miles distant.

This is the hand that tunes a SCOTT ALL-WAVE Deluxe Radio Receiver! For this mighty radio gives any hand command of the most startling power ever built into a receiver. Power that is derived from the conscientious craftsmanship of trained technicians who build this instrument to most precise standards in one of the finest-equipped radio engineering laboratories in the country. So fine is this receiver that its advanced 12-tube circuit is positively guaranteed to give consistent reception of stations 10,000 miles or more away, to cover the entire range of wave bands from 15 to 550 meters, to serve without breakage or failure of any part (excepting tubes) for a period of five years, and to fully satisfy you on a 30-day free trial, or your money will be refunded.

But that alone is not enough to make this truly "The World's Finest Receiver." There are other all-wave receivers capable of reception of foreign stations. The greatest point of superiority in a SCOTT ALL-WAVE Deluxe is the *quality* of its reception. It has smooth sureness of tone that makes the listener feel perfection . . . and laboratory tests prove the justness of this feeling by scientific demonstration that SCOTT ALL-WAVE Deluxe reproduction varies from actuality in a degree so fine as to be undetectable by the human ear.

It is this quality of superb tone that makes the SCOTT ALL-WAVE Deluxe as valuable for hearing broadcasts from stations nearer home as for reaching out thousands of miles for foreign stations. Its superior selectivity enlivens your dials with dozens of stations that cannot be received by less able radios.

If you are tired of ordinary radio reception restricting you to a limited number of domestic stations . . . if you thrill to the thought of hearing the delightful programs direct from foreign lands . . . if you would like to listen-in to exciting police calls from all over the U. S. A., hear airplanes talking to their landing fields while aloft, or eavesdrop on wireless telephony amateurs . . . if you love music and crave to have it reproduced with all the richness of actuality . . . you *need* a SCOTT ALL-WAVE Deluxe . . . and you will delight in ruling the new and more pleasurable world of entertainment it represents.

Every claim of SCOTT superiority is supportable by proofs. Send the coupon for them NOW!

E. H. SCOTT RADIO LABORATORIES, INC.
4450 Ravenswood Ave. *Department N-113* **Chicago, Ill.**

NRA WE DO OUR PART

SCOTT 15-550 METER ALL-WAVE *Deluxe* RADIO

Satisfaction
As Expressed by Scott Owners

From every state in the U. S. A., and 91 foreign countries, has come to us the expression of satisfaction and pleasure experienced by SCOTT owners in the operation of their receivers. There is not room here to reproduce even a small representative number of those enthusiastic comments. But here are two that are typical of the way in which this receiver is appreciated in every part of the world.

Enjoyable Reception in Bad Location

Perhaps you recall that you warned me that I was in a bad location. Well, even in this location I have tuned in England, Spain, France, Germany, Italy, Venezuela, Colombia, Canada and of course, a number of the U.S. short wave stations. When I say tuned in, I mean with enough volume and clarity to sit back and enjoy the program.

I have had a number of sets but I believe that the Scott is the finest Radio that I have ever owned.

L. C. Miller,
Atlanta, Ga.

His First Testimonial Letter

I have never had much faith in these enthusiastic letters that manufacturers receive from owners of their products and which they show to prospective buyers. And yet, here I am writing just such a letter, my first I assure you. I take off my hat to you. Your radio is without doubt the finest I have ever handled. For 12 years I have made practically every new circuit myself and have owned most of the nationally known sets. None of them have even been in the Deluxe class. All stations come in just the same. Your fading device is perfect. The tone is so far ahead of everything else that I am planning to build my Scott into my new home.

Mr. K. G. Pfeiffer,
Piggott, Arkansas

SEND THIS COUPON
For All Details and Proofs!

E. H. Scott Radio Laboratories, Inc.
4450 Ravenswood Ave., Dept. N113 Chicago, Ill.

Send me at once, without obligation, all particulars regarding the SCOTT ALL-WAVE *Deluxe*, including performance PROOFS and technical data.

Name.....

Address.....

Town..... State.....

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RADIO NEWS

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CONTENTS

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RADIO CALL BOOK SECTION

DEPARTMENTS

Published Monthly by **Teck Publications, Inc.,** *Washington and South Avenues, Dunellen, N. J.*

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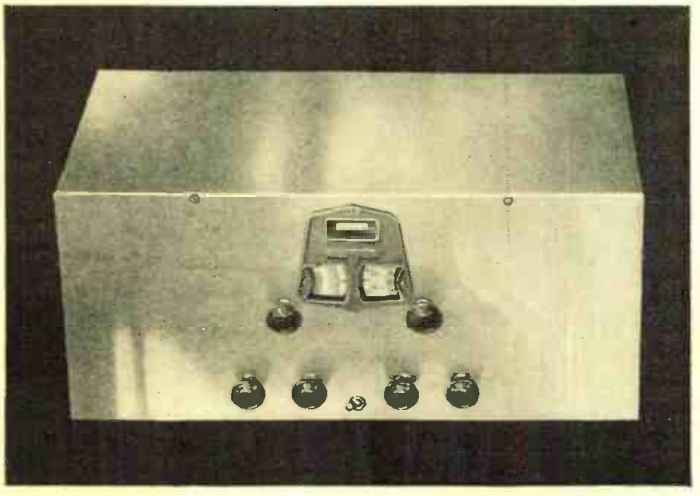
25c a Copy, $2.50 a year, $3.00 in Canada, $3.50 in Foreign Countries. Subscribers are notified that change of address must reach us five weeks in advance of the next day of issue.

McMurdo Silver now presents

MASTERPIECE II

Designed especially for Admiral Byrd,



from specifications developed in collaboration with the research and engineering departments of Harvard and *another great eastern University.

Admiral Richard E. Byrd, U.S.N., asked Dr. McCaleb of Harvard University which radio receiver would be best for his next Antarctic expedition.

In substance, Dr. McCaleb replied, "McMurdo Silver's Masterpiece, with certain additions."

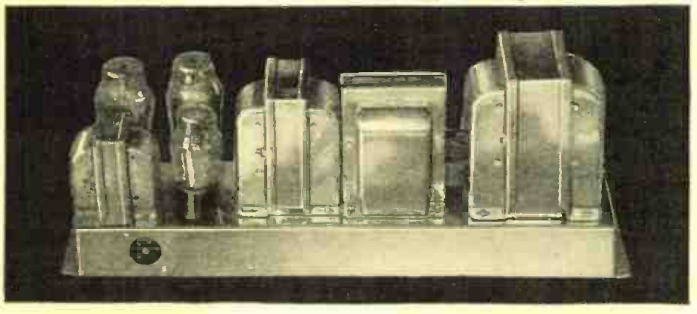
Immediately, the engineering department of Harvard made certain suggestions to Mr. Silver, as did the engineering research department of another great eastern university, to produce, for Admiral Byrd, the greatest, most complete, most thoroughly able all-wave radio receiver the world has ever seen. Masterpiece II is the result.

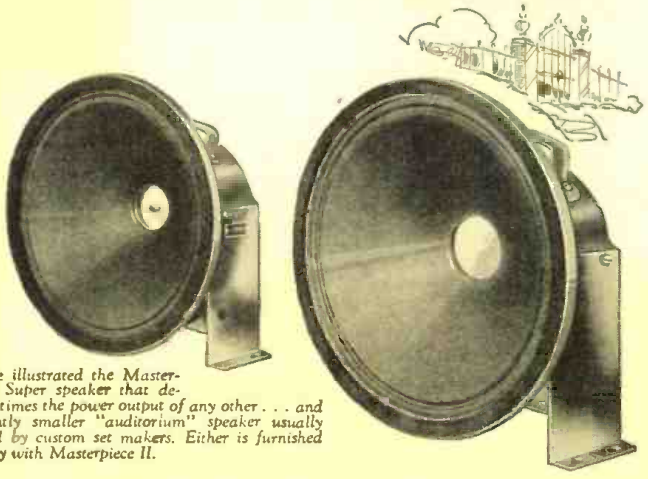
The specifications of Masterpiece II, as you can readily see, promise a quality and extent of performance often dreamed of, but never seriously considered as either probable or possible of attainment. Yet, Masterpiece II actually meets them, to the letter, and its performance, very conclusively asserts the fact that an entirely new era of transoceanic radio reception has been born.

Duplicates of Masterpiece II . . . *exact* duplicates of the very receiver that is going into the Antarctic with Admiral Byrd, are now available.

A completely descriptive, fully illustrated book will gladly be sent upon receipt of the coupon below.

*Name on request. Neither this university nor Harvard has a commercial interest in McMurdo Silver, Inc.





Here are illustrated the Masterpiece II Super speaker that develops 4 times the power output of any other . . . and the slightly smaller "auditorium" speaker usually furnished by custom set makers. Either is furnished optionally with Masterpiece II.

BRIEF SPECIFICATIONS

Wave length Range 10 to 570 meters or 520 to 30,000 kc. Four position wave change switch.

(External unit extends range from 700 to 2000 meters.)

Tuned R. F. stage on both Broadcast and entire Short Wave range yet single dial tunes the receiver. Greatly improves signal-noise ratio on 12,000 mile reception.

Band-spread tuning on short waves. Makes short wave tuning actually easier than broadcast tuning.

3 air-tuned intermediate stages. Most accurate intermediate amplification ever developed.

Sensitivity better than ¼ microvolt absolute average.

Interstation noise suppressor adjustable to exact location requirement.

Automatic volume control holds all stations 20 microvolts and up at constant volume to the ear.

Selectivity absolute 9 Kc. for Europe, better than U. S. needs (21 Kc. wide 10,000 times down).

Fidelity perfect over 30 to 4,000 cycle audio range.

Undistorted power output, 15 watts.

Automatic and manual tone controls.

Special impregnation for tropical climates.

Built-in beat oscillator for easy finding of S.W. and weak broadcast stations.

Chromium plated steel shielding case eliminates need for cabinet.

10 day trial in your home. Open-and-shut guarantee. Money back instantly if *you* are not absolutely satisfied—no questions asked.

McMurdo Silver, Inc., 1733 Belmont Ave., Chicago, U.S.A.
Send me full technical information on Masterpiece II.

Name.....

Street.....

Town.....State.....

McMURDO SILVER, Inc.

1733 BELMONT AVENUE - - - CHICAGO, U. S. A.

I'll Train You Quickly for RADIO'S

LEARN AT HOME

Get into this Field with a Future

MY BOOK, "Rich Rewards in Radio," gives you full information on the opportunities in Radio and explains how I train beginners at home to become Radio Experts and how I train experienced service men for better Radio jobs—better pay. It's free. Clip and mail the coupon NOW. Radio's amazing growth has made thousands of fine jobs which pay $40, $60, $75 a week. Many of these jobs lead to higher salaries.

Radio—the Field with a Future

Once or twice in a man's lifetime a new invention starts a new business. You have seen how the men and young men who got into the automobile, motion picture, and other industries when they were started had the first chance at the big jobs—the $5,000, $6,000 and $7,500 a year jobs. Radio offers the same chance that made men rich in those businesses. It has already made many men independent and will make many more wealthy in the future. You will be kicking yourself if you pass up this once-in-a-lifetime opportunity for financial independence.

Many Radio Experts make $40, $60, $75 a Week

In the short space of a few years, 300,000 Radio jobs have been created, and thousands more will be made by its future development. Men with the right training—the kind of training I will give you in the N. R. I. Course—have stepped into Radio at 2 and 3 times their former salaries. Experienced service men as well as beginners praise N. R. I. training for what it has done for them.

Many make $5, $10, $15 a week extra in spare time almost at once

My Course is world-famous as the one "that pays for itself." The day you enroll I send you material, which you should master quickly, for doing 28 Radio jobs common in most every neighborhood. Throughout your Course I will show you how to do other repair and service jobs on the side for extra money. I will not only show you how to do the jobs, but how to get them. I'll give you the plans and ideas that have made $200 to $1,000 a year for N. R. I. men in their spare time. G. W. Page, 110 Raleigh Apts., Nashville, Tenn., wrote me: "I made $935 in my spare time while taking your Course." My book, "Rich Rewards in Radio," gives many letters from students who earned four, five, and six times their tuition fee before they graduated.

Get ready for jobs like these

Broadcasting stations use engineers, operators, station managers, and pay up to $5,000 a year. Radio manufacturers employ testers, inspectors, foremen, engineers, service

Broadcasting Stations employ trained men continually for jobs paying up to $5,000 a year.

Television—the coming field of many great opportunities—is covered by my course.

HERE'S PROOF

$400.00 Each Month

"I spent fifteen years as traveling salesman and was making good money but could see the opportunities in Radio. Believe me, I am not sorry. I have made more than $400 each month and it really was your course that brought me to this."—J. G. Dahlstead, Radio Sta. KYA, San Francisco, Cal.

Radio Service Man Doubles Salary

"I spent 15 years building and repairing Radios, but felt I could refresh my memory and learn about developments I had overlooked. Upon completion, I was appointed Service Manager of Parks & Hull, and was immediately repaid for the cost and time spent in study. I give the N.R.I. full credit for my success in the Radio Field. It immediately increased my earnings 100%."—J. E. McLaurine, 1511 Guilford Avenue, Baltimore, Maryland.

$500 a Year Extra in Spare Time

"Although only doing spare time Radio work, I averaged about $500 extra a year in addition to my regular income. My example and that of hundreds of other N.R.I. graduates should convince any skeptical person of the superiority of N.R.I. training."—Edward H. Fawcett, Slough Road, Ladner, B. C., Canada.

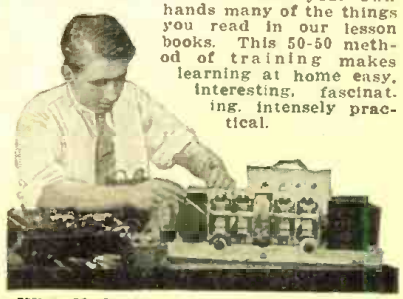
$50 to $75 a Week

"I am in the radio service business for myself, where it is possible for me to make $50 to $75 a week. Service work has increased because people, who in normal times would buy a new Radio, now are contented to have the old one 'pepped up'."—Bernard Costa, 150 Franklin St., Brooklyn, N. Y.

You Get Practical Experience

··I Will Give You Special Radio Equipment Without Extra Charge

My Course is not all theory. I'll show you how to use my special Radio equipment for conducting experiments and building circuits which illustrate important principles used in such well-known sets as Westinghouse, General Electric, Philco, R. C. A., Victor, Majestic, and others. You work out with your own hands many of the things you read in our lesson books. This 50-50 method of training makes learning at home easy, interesting, fascinating, intensely practical.



With N. R. I. equipment you learn to build and thoroughly understand set testing equipment—you can use N. R. I. equipment in your spare-time service work for extra money.

Act! MAIL COUPON Today - - - Get The Facts About

GOOD Spare Time and Full Time Jobs TO MAKE MORE MONEY

Many Make $40, $60, $75 a Week

28 MONEY MAKING HINTS FREE

Mail the coupon. I'll send you one copy of my valuable 56-page reference book "28 Tested Methods for Making Extra Money." I'll do it to prove that my training is easy to understand and use—that it is practical—that it is full of money making information right from the start. This book shows you how to do 28 Radio jobs common in every neighborhood—tells you how to get these jobs. Hundreds of my students have made $5, $10, $15 a week in spare time while learning. Prove to yourself that you can do it, too. Mail coupon.

Spare time set servicing pays many N.R.I. men $5, $10, $15 a week extra. Full time men make as much as $40, $60, $75 a week.

Loud Speaking and Public Address Equipment is another growing Radio field—it offers many money-making opportunities to trained men.

Radio factories employ testers, inspectors, foremen, engineers, service-men, for jobs paying up to $7,500 a year.

men, buyers, and managers for jobs paying up to $6,000 a year. Radio dealers and jobbers (there are over 35,000) employ service men, salesmen, buyers, managers and pay up to $100 a week. Radio operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. There are hundreds of opportunities for you to have a spare time or full time Radio business of your own—to be your own boss. I'll show you how to start your own business with practically no capital—how to do it on money made in spare time while learning. My book tells you of other opportunities. Be sure to get it at once. Just clip and mail the coupon.

You can learn at home in your spare time to be a Radio Expert

Hold your job. There is no need for you to leave home. I will train you quickly and inexpensively during your spare time. You don't have to be a high school or college graduate. My Course is written in a clear, interesting style that most anyone can grasp. I give you practical experience under my 50-50 method of training—one-half from lesson books and one-half from practical experiments with equipment given without extra charge. This unique and unequalled method has been called one of the greatest developments in correspondence Radio training. N. R. I. pioneered and developed it. It makes learning at home easy, fascinating, practical.

Television, Short Wave, Public Address Systems Included

There's opportunity for you in Radio. Its future is certain. Television, short wave, public address systems, police Radio, automobile Radio, aircraft Radio—in every branch, developments and improvements are taking place. Here is a real future for thousands and thousands of men who really know Radio—men with N. R. I. training. Get the training that opens the road to good pay and success.

Your Money Back if you are Not Satisfied

I will give you an agreement in writing, legal and binding upon this Institute, to refund every penny of your money upon completing my Course if you are not satisfied with my Lessons and Instruction Service. The resources of the National Radio Institute, Pioneer and World's Largest Home-Study Radio School, stand behind this agreement.

Find out what Radio offers you Get my book AT ONCE

One copy of my valuable 64-page book, "Rich Rewards in Radio," is free to any ambitious fellow over 15 years old. It has started hundreds of men and young men on the road to better jobs and a bright future. It has shown hundreds of men who were in blind alley jobs, how to get into easier, more fascinating, better paying work. It tells you what my graduates are doing and making, what Radio jobs pay, how you can quickly and easily fit yourself to be a Radio Expert. The Coupon will bring you a copy free. Send it at once. Your request does not obligate you in any way. ACT NOW.

J. E. Smith, President
Dept. 3MR
NATIONAL RADIO INSTITUTE
Washington, D. C.

NRA WE DO OUR PART

I have doubled and tripled the salaries of many. Find out about this tested way to BIGGER PAY

Get a Job with a Future

FILL OUT AND MAIL THIS COUPON TODAY

J. E. SMITH, President
National Radio Institute, Dept. 3MR
Washington, D. C.

Dear Mr. Smith: I want to take advantage of your Special FREE Offer. Send me your reference book "28 Tested Methods for Making Extra Money" and your book "Rich Rewards in Radio," which explains Radio's Opportunities for bigger pay and your method of training men at home in spare time. I understand this request does not obligate me. (Please print plainly.)

Name..... Age.....

Address.....

City..... State..... IJS-1

The Famous Course That Pays For Itself

The Editor—to You

THE principles of operation laid down by the National Industrial Recovery Administration form a foundation upon which the radio industry will find a footing for pulling itself out of the mire into which years of *progressively unreasoning selfishness* has caused it to slip. These principles, if adhered to strictly by manufacturers, jobbers, dealers, servicemen and the public themselves individually, will result in a business situation where radio equipment can be manufactured honestly at a decent profit, where the trade can exist on a self-sustaining basis without resorting to price cutting or other "gyp" methods and where the ultimate consumer is no longer lured to part with his money simply on a price basis for the purchase of goods that do not embody the best technical improvements of the science.

* * *

The "unreasoning selfishness" I speak about has led, among manufacturers, to the policy of overproduction of radio merchandise to sell at a price lower than their competitor's even if such a policy leads to cutting down on engineering, sales and advertising budgets. This, in many cases, has resulted in a large financial loss for the manufacturer, a slackening of sales due to elimination or cutting down of advertising to an inadequate basis and a complete demoralization of sales forces. It has thrown workers in the radio industry out of employment all along the line and its ultimate result is industrial suicide! And cut-throat competition in the retail trade has been doing its best to hasten the demise!

* * *

And now the NRA comes along pointing out with a steady finger, the *path of reason*, to make radio successful along with all other industries and to set its feet on the bedrock of *reasonable* principles of manufacture, sale and purchase. It tells the manufacturer to make real apparatus that will give the public the real benefits of this wonderful science that can do so much more to add to social safety, education and entertainment. One of the things holding up television is the feeling of despondency that does not allow for the necessary research in pushing the already good scientific start made in this field. The NRA tells manufacturers to include in the price of their goods a sufficient amount for paying living wages and for advertising their goods honestly and adequately. It tells manufacturers to play fair with their consumers, their employees and themselves.

* * *

AND it tells the dealer to handle only those products which are manufactured along such lines; it tells them to sell these products at a fair price without resorting to unfair methods in making sales; it also insists that salesmen get a living wage.

* * *

THE NRA tells the radio-minded public to buy only those products manufactured and sold under these reasonable standards. It therefore becomes the duty of every purchaser to be sure that the radio apparatus they buy is manufactured and sold so that the workers who produce and sell them will be able to make an adequate living and so that the industry will be able to continue on a respectable basis. No one really wishes to purchase goods manufactured by a failing concern or through sales agencies that use disreputable methods.

* * *

IF the radio industry as a whole, the manufacturing forces, sales forces, advertising forces and the consumer, will *insist on these reasonable principles*, everyone will be benefited and still greater advances will be made in this science. We believe that everyone will give their wholehearted approval and co-operation to the NRA both in spirit and in deed. Everyone *must* cooperate!

* * *

RADIO NEWS whole-heartedly endorses these principles and has already signified such endorsement by signing the publishers' code, the provisions of which are being carried out fully. Our readers can co-operate with us by telling their friends and acquaintances about RADIO NEWS and the service it has always rendered to all classes of radio readers.

* * *

KENNETH HARKNESS, the well-known designer of American radio apparatus, is now in England and writes us that radio in that country is picking up. The industry is establishing itself on a firmer basis. The photograph reproduced on this page shows the great radio show recently held in Olympia Hall, in London. Many new developments were features of this show.

* * *

COMING over the Editor's desk this month are a number of letters from our readers with suggestions and words of appreciation; excerpts of which follow:

* * *

"SOME two or three years ago the policy and make up of your journal did not altogether suit the average Australian listener and reader but I can certainly assure you now that your present policy finds widespread satisfaction in this part of the globe. Considering the high price we now pay for the magazine (65c in your currency) and that *we buy it*, is sufficient cause for a good deal of pride and achievement on your part. I feel in duty bound to enclose these few words of thanks and perhaps encouragement for all the good radio fare provided in your splendid magazine."—Ivan R. Hodder, Eromanga, Grenorchy, Vic., Australia.

* * *

"I WISH to express my appreciation of the RADIO NEWS which I have now taken for six months. While I consider the Wireless World the best weekly from the point of view of an English book, there is not a monthly magazine on the market that anywhere approaches RADIO NEWS for value, technical information and articles of general interest to the radio minded. There is not a shilling's worth of interesting information to be had anywhere that equals RADIO NEWS."—J. H. Slater, Bradford, England.

* * *

"I SURE appreciate the contents of RADIO NEWS, they help immensely. As an experimenter and serviceman I realize I could not do without RADIO NEWS' help."—H. L. Taylor, Galt, Can.

* * *

"I READ everything that I can get my hands on that has anything about radio in it and I can honestly say that RADIO NEWS is far ahead of any magazine that I have read. There are but two things that could make it suit me better and that is put in more diagrams and service data for servicemen. The second thing is I believe RADIO NEWS should really be printed twice a month instead of once a month."—Frank C. Mannon, Maxwell, Nebraska.

* * *

"I HAVE been reading the 'NEWS' for more than two years. Every month I find something I need in it and just keep on getting it. But now your DX numbers, oh boy, am I glad I am getting it."—E. A. Hering, Harrisburg, Va.

* * *

"BEING a commercial radio operator and regular reader of RADIO NEWS, I am very pleased to know that attention is being paid to the commercial Op in your magazine. Your QRD column, devoted to the commercial Op, is very interesting."—Karl Scheiern, Edmore, Mich.

Hugo Gernsback

. . . say these 30 Leading Radio Manufacturers . . to their 40,000 DISTRIBUTORS and DEALERS throughout United States and Canada

AMERICAN BOSCH
AMERICAN TELEVISION
ARCTURUS TUBES
BALKEIT • BRUNSWICK
CAPEHART
CLOUGH-BRENGLE CO.
CROSLEY • CLARION
DAYRAD • DeFOREST
ECHOPHONE
FADA • GREBE • HOWARD
HAMMERLUND
KENNEDY • KOLSTER • LYRIC
MAJESTIC • PHILCO
SANGAMO ELECTRIC
SENTINEL • SHELDON
SILVER-MARSHALL
STEWART RADIO
STEWART-WARNER
STROMBERG-CARLSON
UNIVERSAL MICROPHONE
ZENITH

●

The need for men, PROPERLY trained, is one of the Radio Industry's major problems, today.

In fact, the very future of the Radio Industry is dependent on the industry having available, at all times, an adequate supply of PROPERLY trained men to install and service—not only the present-day highly complicated Radio and Electronic equipment—but the still more complicated equipment that will be brought out by the Industry, from time to time.

The above 30 manufacturers realize this. They know that under such circumstances, no ordinary Radio Training is going to give them the type of "trained" man they want. Only a Training that is right-up-to-the-minute, and properly prepared, highly practical, and properly supervised, will answer their purpose.

Radio and Television Institute home-training has successfully met their every test. That's why these manufacturers recommend R. T. I. Training, not only to their own men, everywhere—but to all men who want to get somewhere in Radio.

* *This message approved by the above thirty Radio Manufacturers.*

LEARN RADIO FROM REAL RADIO ENGINEERS

HERE THEY ARE:
Dr. C. M. Blackburn, Chief Radio Engineer, Grigsby-Grunow Company (Majestic),
Kendall Clough, Chief Engineer Clough-Brengle Co. (Radio Engineers and Manufacturers)
Karl Hassel, Chief Engineer, Zenith Radio Corporation,
Homer Hogan, Gen. Manager, Radio Station KYW, Chicago,
R. MacGregor, Service Manager and Sales Engineer, Transformer Corporation of America (Clarion),
H. C. Tittle, Chief Radio Engr., Stewart-Warner Corporation,
F. D. Whitten, Service Manager, Chicago Plant, Philco Radio and Television Corporation,
—and R.T.I. Staff.

LET THESE ENGINEERS RIGHT FROM THE HEART OF THE BIG RADIO INDUSTRY *Train You at Home for*

GOOD PAY RADIO WORK

To the man who wants to make $35 to $75 a week and more—*Here's a Message for You!*

"The great Radio Industry, today—more than ever before—is on the lookout for PROPERLY trained men to fill its more responsible jobs. These are the better-paying jobs in Radio . . . jobs which give steady work at good pay, as a starter; and an early advancement to still better-paying jobs, as a future."

HERE, THEN, IS REAL OPPORTUNITY

But to qualify for these better-paying jobs, men must be PROPERLY "trained"—they must know the theory of Radio, as well as the practical side, and be able to teach other men some of the things they know.

The Radio Industry, itself, has no time to train these men. That's why the Radio & Television Institute, of Chicago, is doing the job.

You'll be trained at home — in your spare time—easily and quickly, and at a cost of only a few cents a day. And as you are taught to "earn as you learn"—R. T. I. Training need cost you nothing.

R.T.I. TRAINING IS "SHOP TRAINING" FOR THE HOME

It comes to you right from the Radio Industry—right out of the factories where Radio sets and other vacuum-tube devices are made. It was planned and prepared for you by big radio engineers IN these factories, most of whom are the Chief Engineers of these great Radio plants. And NOW these same engineers are actually supervising R. T. I. Training. Which means that trained the R.T.I. way, you'll be trained as the Radio Industry wants you trained — just as the Radio Industry, itself, would train you if it was doing the job.

You learn by doing, of course, because that's the Shop Way of teaching. But you also learn the theory of Radio — without which you can't hope to go far, or make much money, in this great industry.

ELECTRONICS—SOUND PICTURES P. A. SYSTEMS—PHOTO CELLS—TELEVISION—all included

Radio service is just the starting point in R.T.I. Training. From there we take you up through the very latest developments in Radio, and then on into the new and larger field of Electronics—Sound Pictures, Public Address Systems, Photo Cells, and Television. This feature alone makes R. T. I. the outstanding home training in Radio.

YOU GET "QUICK RESULTS"

C. E. Head, 431 Third St., Alexandria, La., Says: *"Made my first money 11 days after starting your training—cleared $14.25."*

Frank E. Klemann, Lisle, Ill., writes: *"Doubled my pay in less than six months."*

Harry L. Stark, Ft. Wayne, Ind., writes: *"Now making three times as much money as I was making when I started your training."*

So, if you want to get out of a small pay, no-future job, and into good pay, big-future work — get *into Radio*. But let these big engineers direct your training.

MAIL COUPON FOR FREE BOOK

Let me tell you more about this amazingly easy Shop-Type home-training, and more about the wonderful opportunities for the R. T. I. TRAINED man in this—the world's fastest growing industry. Everything is fully explained in my big, new booklet . . . "RADIO'S FUTURE, AND YOURS." Send today for your copy. The book is free.

Ray D. Smith, President,
Radio and Television Institute, Chicago

Ray D. Smith, President,
RADIO and TELEVISION INSTITUTE, (R.T.I.),
2130 Lawrence Ave., Dept. 48, Chicago, Ill.
Without obligation of any kind please send me a copy of "Radio's Future and Yours." I am interested in your home training and the opportunities you say exist in the great field of Radio for the R.T.I. Trained man.

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To Supplement Rather Than Supplant the Teacher

Radio is bound to have a growing part in American education both for the schoolboy and the grown-up. Part of its application will be in the school and another part in the home. But to say that radio will supplant the teacher, having all teaching done by a central bureau over the radio, is not held a part of its future. The individual and personal touch must be maintained and radio already finds its greatest utility in augmenting the teacher's work in special fields

Radio News

VOLUME XV November, 1933 NUMBER 5

RADIO
AND ITS PRESENT RELATION TO
EDUCATION

Just how far has radio gone as an educational aid in the United States? And what are its future potentialities? These and other questions, relating to education, are the subject of this article by—

Samuel Kaufman

EVER since popular radio broadcasting came into existence, educators throughout the United States have pondered much over the topic of "educational broadcasting." Many intelligent minds—some of the greatest in the world—have tried to discover an ideal method of presenting educational programs through the medium of the ether. Some systems that have been tried have proven better than others, but no plan for radio education has been, as yet, successful enough to be acclaimed by any majority of educational and broadcasting groups. It is true that there has been a decided lack of harmony between educators and broadcasters. Just whose fault it is cannot be ascertained. But, apparently, the greatest rift is confined to the ranks of the educators themselves.

Some educators believe that a certain portion of the American broadcast band should be allocated to educational institutions for the purposes of educational broadcasting alone. This plan immediately raises a hue and cry from other educational quarters to the effect that the method has already been tried and proven unsuccessful.

Many educators agree that any station presenting educational programs, excluding others of a general entertainment type, is doomed to failure. In this instance it is claimed that failure will be measured in loss of listeners.

Networks and individual stations throughout the country have often expressed their willingness to allot time to educational groups and institutions for worthy educational broadcasts. Many of these offers have been accepted. The National Broadcasting Company, the Columbia

EDUCATORS TO THE PUBLIC

At left, Dr. Herman N. Bundesen, Chicago Health Commissioner, an ardent radio lecturer. Center, Ernest Hutchinson, Dean of the Juillard Graduate School, often heard on the Columbia chain. Right, Burton Holmes, famous traveler and lecturer, heard over the National Broadcasting networks. These are three famous educators in every sense of the word

FROM THE BROADCASTING STUDIO—

Dr. Walter Damrosch, Dean of American musical conductors, broadcasts to an estimated audience of more than 6,500,000 listeners in his Musical Appreciation Hours

Broadcasting System and scores of individual stations are now presenting educational programs. In numerous instances the time on the air and studio facilities are donated to the educators who themselves supply the program material. In other cases, the networks and stations conceive and present their own educational programs.

Though everyone is prone to agree that both the educators and the broadcasters are sincere in their efforts, it can readily be seen that many points of a controversial nature are bound to arise under any of the systems that are in use today.

Some of the Present Activities

Educators frequently berate broadcasters for not giving them enough time on the air; when the time is secured, the educators may declare that the allotted hours are not satisfactory and the the broadcasters save the more select periods for the commercial sponsors who pay for the time. It is on this last point that the educators themselves often disagree. Some favor daytime hours, while others are anxious to secure evening hours.

For programs conceived for classroom reception, the daytime hours are, of course, the only hours to use, while the evening hours are best suited for adult educational programs.

All educators seem to agree that educational broadcasts cannot *supplant* the school teacher in any way. They aver that the broadcasts can efficiently *supplement* the school teachers' efforts. The possibilities for radio education seem to lie in rural districts which lack the personnel and facilities of the big city school boards.

The Columbia Broadcasting System's "American School of the Air" has presented regularly scheduled educational programs, designed for classroom reception, for four successive seasons. The National Broadcasting Company's "Musical Appreciation Hours," directed by Dr. Walter Damrosch, the network's music counsel, have won wide acclaim from educators and students during the last few seasons. Localized educational series, such as those presented by the "Ohio School of the Air," have proven effective. Adults have not been neglected. The National Advisory Council on Radio in Education, financed by John D. Rockefeller, Jr., the Carnegie Corporation of New York, Mrs. C. Cary Rumsey, and the American Political Science Association, has presented numerous series of educational broadcasts over the NBC and CBS.

The CBS "American School of the Air" features such topics as history, geography, literature, music, science and current events. The programs have been made entertaining as well as educational. Textbooks and outlines have been supplied to teachers. These outlines have been arranged by grades and suggestions are given for visual classroom aids.

At the start of the past "semester" of the "American School of the Air," William S. Paley, president of the CBS, asserted that the programs were designed to stimulate enterprise and individual initiative on the part of pupils, to supplement the work of classroom teachers, to vitalize instruction and to enrich the curriculum of our schools.

Diversified Appeal

Dr. Damrosch's NBC series of "Musical Appreciation Hours" is also carefully arranged for successful classroom reception. The series is arranged by grades and teacher's manuals are printed and distributed by the network.

Although many network and individual station educational broadcasts are designed for classroom reception, the programs are also received in homes, institutions, playgrounds and other points where they may prove beneficial. The advantage of radio education is that it is not confined to the walls of a school. Every radio loudspeaker in the country is, in effect, a master instructor bringing knowledge to listeners.

In addition to broadcasts *into* schoolrooms, there are many educational radio programs that come *out of* the institutions of learning. In an experimental manner, some institutions have, from time to time, sponsored broadcast lectures and have given actual scholastic credits to radio listeners over wide areas who formed huge radio "classes."

Many schools throughout the country have been equipped with radio receivers to receive the numerous educational programs on the air. Some large schools are equipped with centralized receiving sets which route the programs to all rooms of the buildings. Some schools have separate radio receivers in classrooms. In other instances, school auditoriums are radio-equipped.

The National Advisory Council on Radio in Education has presented several series on timely topics that have been of especial interest to adults. These programs, covering many topics of psychology and economics, brought to the microphone numerous distinguished speakers.

It was at the third annual assembly of the National Advisory Council in New York that eminent educators and broadcasters recently discussed the aspects of educational broadcasting. The many existing problems were discussed and some solutions were offered.

One of the highlights of the (*Continued on page 312*)

—INTO THE COLLEGE

Air programs carry educational material into this class at Columbia University, where teachers are the students and where music is listened to rather than just simply being taught

COLLEGE COURSES THAT SPECIALIZE IN

Teaching Broadcasting

Many hundreds of RADIO NEWS *readers request information regarding college instructions in the various lines of broadcasting. In this short article a specialist gives the result of a United States Government survey in this field*

By Cline M. Koon*

LESS than one American college or university out of fifty is offering courses in radio broadcasting and program building at the present time, according to replies to an inquiry sent out recently by the United States Office of Education. Approximately one college out of every twenty reports it gives some instruction in broadcasting in other college courses, or to voluntary groups of students. Courses in music, public speaking, dramatics, English, research, and advertising are most commonly mentioned as including units in radio production and evaluation.

Oglethorpe University, Georgia, has established a school of radio broadcasting and grants a degree to students who complete the course. Western Reserve University at Cleveland, Ohio, offers several courses in radio singing, speaking and play production. The University of Denver, Colorado, presents courses in broadcasting methods, continuity writing, and principles of broadcasting. Kansas State College of Agriculture and Applied Science at Manhattan, Kansas, the University of Southern California at Los Angeles, and the Municipal University of Omaha, Nebraska, each offers two courses in radio speaking and program building. The following colleges and universities each report one course in radio broadcasting:

Bob Jones College, Lynn Haven, Florida.
Chicago Musical College, Illinois.
Cincinnati College of Music, Ohio.
Georgetown University, Washington, D. C.
Kansas City-Horner Conservatory, Kansas City, Mo.
New York University, New York City.
Pasadena Junior College, Pasadena, California.
State University of Iowa, Iowa City, Iowa.
Syracuse University, New York.
University of Akron, Ohio.
University of South Dakota, Vermilion, South Dakota.
University of Wisconsin, Madison, Wisconsin.

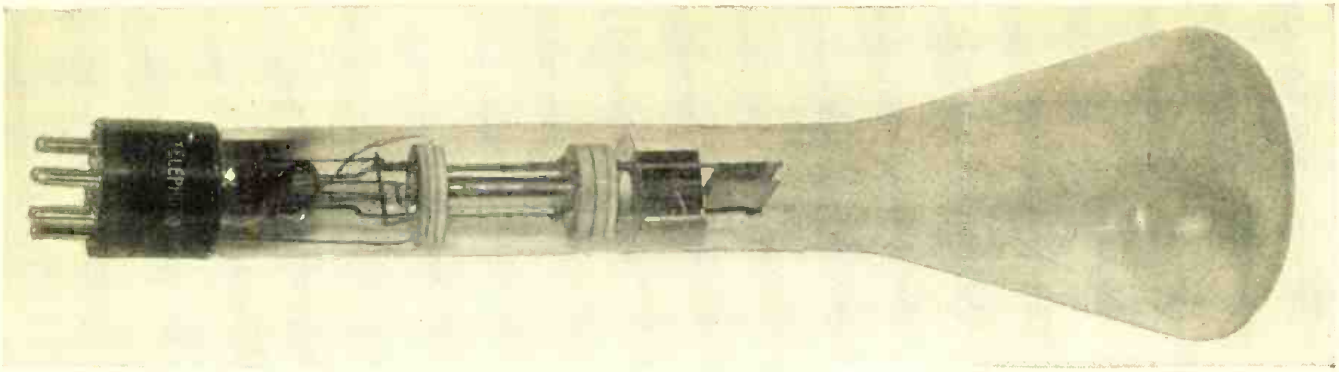
*Senior specialist in Education by Radio, U. S. Office of Education, Department of the Interior.

The topics considered in the courses on broadcasting include: voice training, diction, microphone technique, radio writing, announcing, speaking, singing, acting, directing, program building, analyses of listener reactions. The laboratory work includes practice in radio writing, voice tests, program building, coaching and broadcasting by qualified students. House-to-house interviews to determine what the listener expects is included in one course. The following description of a course in radio speaking will serve to illustrate the nature of the work usually done in radio broadcasting courses:

Radio Speaking

This course is taught four times during the year. It is a general course in the field of radio. Included in it is a study of (and then microphone practice of) announcing, advertising, public speaking, acting, program building, continuity writing; voice training and interpretation, education, and the writing, or cutting and adapting of radio drama. Regular school year.

College courses in broadcasting are being planned to meet the rather widespread demand for instruction in broadcasting and program building. Many college students are interested in entering broadcasting occupations. Multitudes of other people, both old and young, are potential broadcasters since they may be on the air occasionally. Teachers also want to acquaint themselves with the technique of broadcasting that they in turn may give their pupils instruction in this new field. If the broadcasting classes actually prepare and present programs over the air, it appears that the students derive the additional benefit of the intensive effort required to build the broadcasts, and that the college derives the benefit of stronger public relations. Thus it appears that the colleges which are offering courses in radio broadcasting or treating broadcasting in other courses are utilizing the rather general interest in the subject to vitalize instruction and extend the services of the institution.



The How and Why of

CATHODE RAY TUBES

For Television and Other Uses

This series of articles will fill a long-felt need for practical construction data on cathode ray equipment. Complete details for making a cathode ray oscilloscope and television equipment will be given and the manifold applications of this equipment discussed

By John M. Hollywood and Marshall P. Wilder

CATHODE ray tubes are essentially devices indicating by means of the movement of a spot of light on a screen, the value of a voltage or current applied to the proper terminals. Unlike the usual meter, the only moving part is a beam of electrons, which has such little inertia that there is practically no time lag between application of a voltage and the movement of the spot of light. The power consumed in moving the beam is practically negligible. The cathode ray tube may also be used as an ammeter by causing the unknown current to flow through coils, and applying the resulting magnetic field to the cathode ray tube; the power required to move the spot of light will then be of about the same value as that required by the ordinary ammeter, but unlike the ordinary instrument, a change in the flow of current will be indicated instantaneously by the movement of the spot. These characteristic features have made cathode ray tubes exceedingly useful for many purposes, and now that relatively inexpensive tubes which give very good performance are commercially available, the next few years will probably see an increasing use of this instrument by all persons interested in electrical measurements.

The electrode structure of the first cathode ray tubes was similar to that illustrated in Figure 1. In these tubes, the electrons were attracted from the cathode to the anode, which was pierced by a small hole. Some of the electrons, now moving with high velocity, would pass through this hole and impinge upon the glass wall (screen) of the tube, where a fluorescent light was produced. It was found that the electrons moved in straight lines unless deflected by a magnetic or electric field.

Until recently, in almost all cathode ray tubes the electron beam was focused to a spot on the screen by introducing a small amount of an inert gas into the tube. Heavy positive ions would be formed and collect along the beam, neutralizing the space charge of the electrons and condensing the beam into a thin line. This method had many objections. To focus the spot, the gas pressure had to be regulated by varying the cathode temperature; and as the tube became older some of the gas would become absorbed so that the cathode temperature had to be raised to dangerous limits, shortening its life. Positive ion bombardment of the cathode also cut short its life.

When deflecting plates were inserted in the tube, to which a voltage could be connected so that the electron beam would be sent in proportion to the voltage, the ionized gas would cause leakage currents to flow between the plates so that the instrument could not be

Cathode Tubes in Television

THE radio public has been hearing and reading much about the wonders of the cathode ray tube, and particularly of its recent application to television experiments which have been going on behind the locked doors of some of the world's leading laboratories. But there has been almost a total lack of authentic and practical information on the cathode ray tubes themselves; and a complete lack of any kind of constructional data on television, laboratory or other apparatus employing these tubes. RADIO NEWS therefore takes pleasure in presenting this series of articles. This first concerns itself primarily with the theory and design of the tube. Subsequent articles will provide detailed data to enable the builder to construct cathode ray equipment at home, including television receivers capable of reproducing images with a degree of fidelity and definition never before possible with home-made apparatus.

—The Editors.

THE EARLIEST TYPE OF CATHODE RAY TUBE

This type of tube provided a beam focused on the screen by the introduction of gas in the tube, making the cathode adjustment critical and behavior erratic

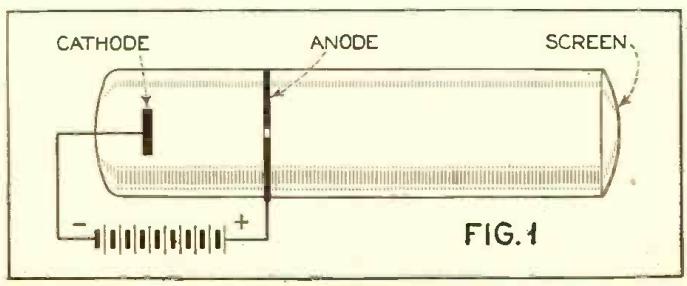


FIG. 1

used as a very high resistance voltmeter. Also, the gas caused non-linearity, that is, the deflection was not proportional to the applied voltage. If high frequencies were applied, the heavy positive ions along the beam could not move rapidly enough to keep the beam focused, and the spot would be blurred. And in addition, gas would cause the screen material to become "burnt" or darkened if a high intensity spot were kept too long in one place.

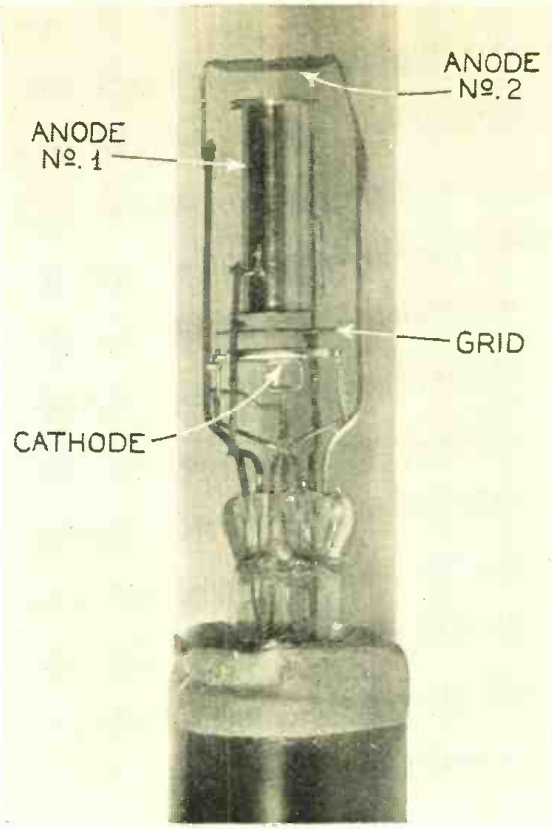
Rogowski of Germany was the next to improve the tube. He added a second anode; a truncated cone the apex of which pointed toward the cathode. For the first time the beam could be focused electrostatically in a high vacuum. The voltages on the two anodes had to be in a definite ratio, which suggested the probability of a general theory of optics for electrons, paralleling light optics.

Static Focusing

Much work has been carried on by independent investigators, our own (Messrs. Wilder and Hollywood are members of the engineering staff of the Telephoto Corporation, manufacturers of cathode ray tubes and apparatus) resulting in charts from which we have been able to determine the voltages and spacing for lenses of any desired focal length. As a result we are able to project the images of our cathode any distance in vacua; to magnify or demagnify; to polarize and refract.

All good camera objectives as well as microscope and projection lenses consist of a series of lenses of different shapes and different kinds of glass, the combination resulting effectively in a simple lens of one focal strength with most of the errors of the corresponding single lens corrected. The same is true in the design of electron lenses. In our studies a four-lens combination was the result of much work along this line and proved, from the viewpoint of simplicity as regards mathematical calculation and focusing potentials, to be the most effective.

The first of our development models employed electrodes supported on wires and glass beads from the press. We found the spot focused exactly as calculated, with a predetermined magnification. Isolantite rings properly machined were finally chosen to support the lenses, deflecting plates and cathode.



AN EXPERIMENTAL MODEL

One of the earlier models developed by the authors, all elements depending upon the glass "press" for support. The final model insured accurate spacing and more rigid support by using isolantite spacers and mounting

Most screens are applied by spraying the fluorescent material in powdered form against a water-glass binder. The first screen materials tried in our experiments were ground up natural Willemite and calcium tungstate. These screens, though very successful proved not to be so brilliant as synthetic Willemite. The screen material adapted is therefore made synthetically, and produces a brilliant soft yellow light, almost white.

Tubes Available

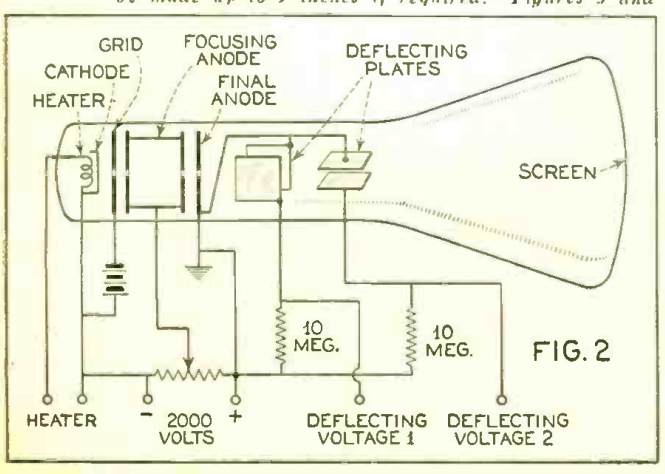
The size of the spot is prearranged and built into the tube in the process of manufacture. The spot size in our type 342G is one millimeter in diameter. The focusing characteristics of our high-vacuum type cathode ray tube remain constant throughout the life of the tube, and over wide ranges of cathode temperature. If a grid is introduced to modulate the light intensity, for instance in television work, modulation has no effect on the focus or the size of the spot, or on its position.

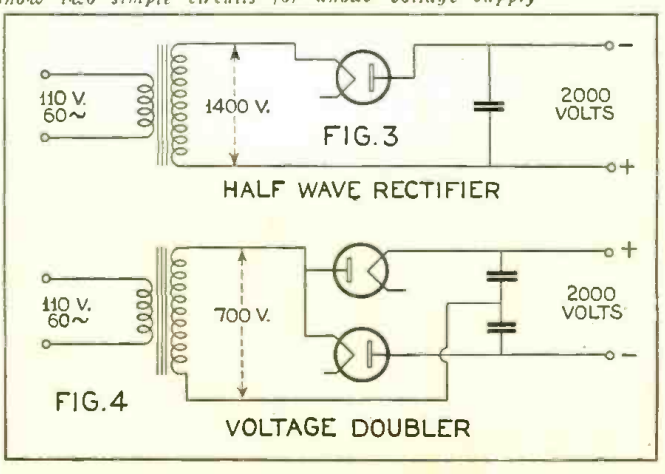
The 342G has a three inch screen and four deflecting plates. Two deflecting plates, one of each pair, are connected inside the tube to the anode, and two are free and brought out to terminals. A modulating grid is also provided. The 343 is the same except for omission of the modulating grid, and the use of four deflecting plates of which three are free and brought out to terminals. These tubes are now available to the public. Others may be manufactured, such as 942G, for instance, which is the same as 342G except for a nine inch screen. All these tubes are of the indirect heater type. The operating voltages are as follows: Heater—2½ volts, 3 amperes; Focusing voltage—½ anode voltage; Max. anode voltage—2000; Negative grid bias—0 to 99 volts.

The sensitivity factor of a cathode ray tube may be given as the percentage of the anode voltage necessary for a one inch deflection. The sensitivity factor of the Telephoto tube is about five percent of the anode voltage per inch deflection of the spot for the standard model. With this manner of denoting the sensitivity it is only necessary to know the anode voltage in order to obtain a voltage measurement by measuring

SCHEMATIC PLAN OF THE NEW TUBE AND ITS CIRCUIT

Figure 2. The diagram shows how operating voltages are applied. Voltages to be studied are connected between ground and the terminals marked "Deflection Voltage." The screen on which the image appears is 3 inches in diameter, but can be made up to 9 inches if required. Figures 3 and 4 show two simple circuits for anode voltage supply



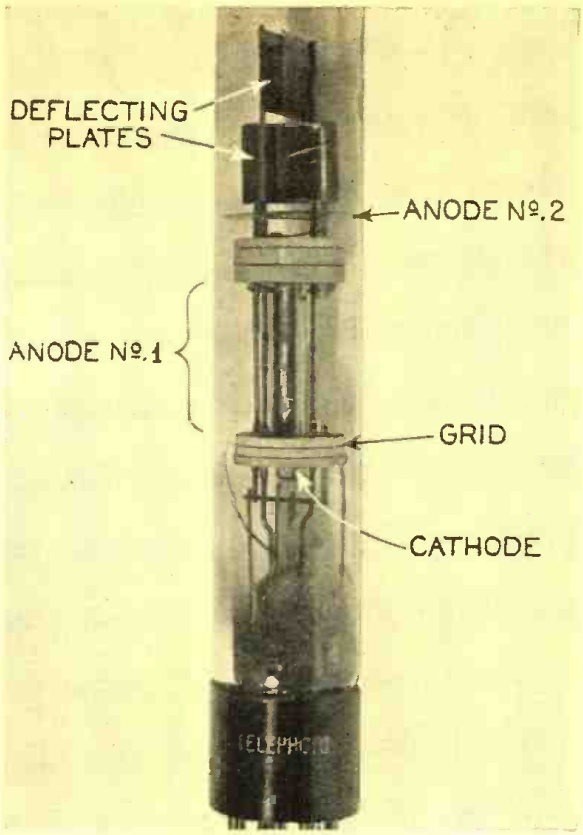


the deflection in inches, knowing the sensitivity factor.

Certain power pack assemblies are particularly recommended, such as the half wave rectifier and the voltage doubler types. The former is simple and effective, and the latter is better for obtaining high voltages without using special transformers and condensers. Voltage doublers have the drawback that two rectifier tubes must be used with a separate filament winding for each tube. The current drawn from the power supply is so small that little filtering is required.

Practical Circuits

In operating these cathode ray tubes, the maximum voltage recommended is 2000 volts, to be applied between cathode and anode. A voltage of half the anode voltage should be applied between the cathode and the focusing electrode, and this should be variable in order to obtain exact focusing. Since some purposes require great brilliance but not much voltage sensitivity, and other purposes demand much sensitivity but not much brilliance, it should be possible to change the anode voltage and focusing voltage simuleaneously over a sufficient range to meet both purposes. Also, in a power supply for the tube, there should be provision for supplying the heater current.



A NEW CATHODE RAY TUBE

A close-up of the stem section of the tube pictured at the head of this article. This tube provides for electron focusing of the beam, the focusing being adjustable to concentrate the beam, forming a sharply defined spot of brilliant light where it strikes the screen. Focusing is accomplished by means of a simple, adjustable external resistor

Since the current drawn by the anode and focusing electrode is a fraction of a milliampere, the components of the power supply need not be built for much power, and a small filter will be sufficient. In a later article of this series, exact information will be given for constructing such a power supply from standard parts.

In studying wave forms of periodic voltages or currents, the wave form studied is connected so as to move the spot of light vertically, while some additional means should be provided for moving it across the screen horizontally at a constant rate of speed. If this is done, the wave form of the voltage or current as a function of time will be obtained; but if the horizontal movement is not at a constant speed, the wave form will be distorted; for example, the peaks of a sine wave might be too close together on one end of the screen and too far apart on the other. Also, in order to have the wave pattern stand still on the screen, it is necessary to have the horizontal movement snap back to the start always at the same part of a cycle of the wave form.

Such a "linear time axis" can be provided by means of a "sweep" circuit in which the voltage across a condenser is applied to the horizontal deflecting plates of the cathode-ray tube. A controllable constant current is sent through the condenser, charging it so that the voltage is proportional to the time; the plate current of screen-grid or pentode tubes is quite constant over a wide voltage range and may be used for this purpose. A thyratron, which is nothing but a hot-cathode, mercury-vapor rectifier with a control grid, is connected across the condenser, and when the voltage reaches a certain value the thyratron discharges the condenser almost instantly, allowing the cycle to repeat itself. The voltage at which the thyratron discharges is controlled by the grid bias of the thyratron. Such a circuit is shown in Figure 5.

This circuit is really a sort of oscillator, in which the voltage across the condenser has a "saw-tooth" wave form as shown in Figure 6. The amplitude of the voltage can be controlled by the thyratron grid bias, since a negative bias will not permit the condenser to discharge until a high voltage is reached. Increasing the amplitude in this way will also decrease the frequency, since the condenser will take more time to accumulate enough voltage to discharge through the thyratron. The frequency can be controlled independently, though, by changing the constant current or the capacity of the condenser. A smaller condenser will charge faster and increase the frequency; a larger current will charge the condenser faster and increase the frequency. For best results, all three controls should be used in the "linear time axis" or "sweep circuit." A transformer with the secondary in series with the thyratron grid should be used to permit synchronizing the saw-tooth frequency with the wave form being observed, by connecting the observed wave form to the transformer primary. Complete constructional details of such a circuit will be given along with the data on a power supply, in a later article.

In concluding this first article of the series, it is of interest to summarize some of the applications of the cathode-ray tube with its attendant power supply equipment. First, it may be used to measure d.c. or a.c. voltages, including radio frequencies up to several megacycles. Currents, d.c. and a.c., may also be measured. With the addition of a "sweep" circuit, a first-class oscilloscope results and the images of wave forms, transients, etc., appearing on the screen are not only clear and sharp to the eye, but may be readily photographed. Used in this way, the quality of the amplifier may be observed, as may also the modulated output of a transmitter or other modulated r.f. wave form. Frequencies may be exactly compared with a standard. Phase difference between two a.c. voltages may be determined. Curves showing relationship between two electrical quantities such as the grid-voltage-plate-current characteristics of vacuum tubes, hysteresis curves of iron, current against voltage for gaseous

(*Continued on page 313*)

A HIGHLY EFFECTIVE "SWEEP" CIRCUIT

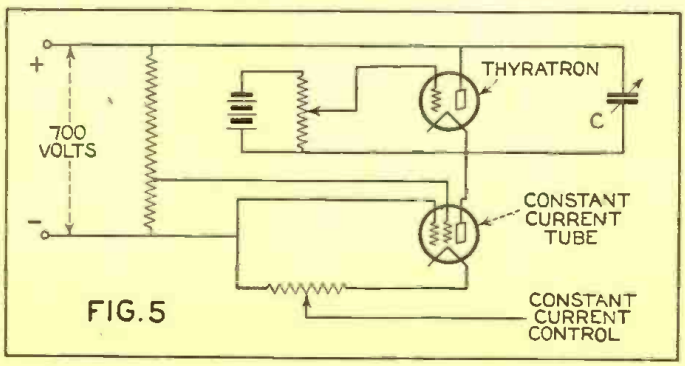


FIG.5

THE SAW-TOOTH WAVE FORM OF THE "SWEEP"

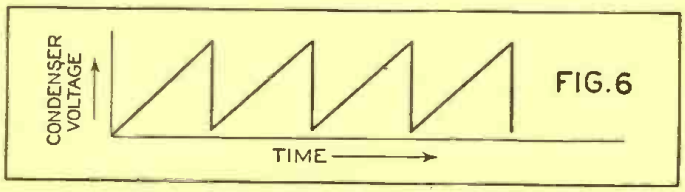
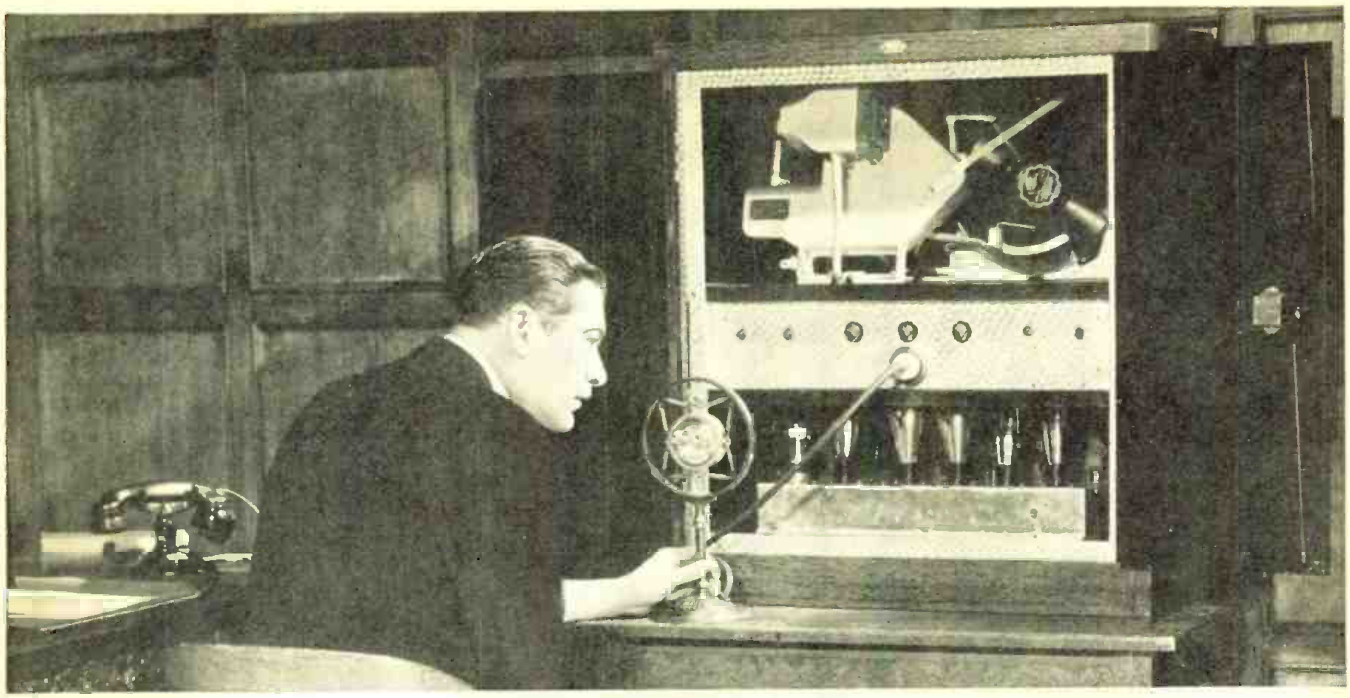


FIG.6



A WELL-DESIGNED P. A. UNIT

This hotel equipment is a good example of modern P. A. design. The simplicity of the control and mixing panel is noteworthy

Mixing Circuits for Public Address Systems

In this article will be found much useful information on various phases of public address design, including volume control, mixing, impedance matching and sound sources

By George E. Fleming

IN the design of a public-address system, one of the things that seems to cause the most difficulty is the choice of circuits and components to be used in the mixing panel. The problems presented here are relatively simple if we but bear in mind that a mixing circuit is nothing more nor less than a system of volume controls and their associated apparatus, so linked that the control of volume from one of a number of sources may be easily accomplished, or two or more sources "mixed" and reproduced simultaneously, as is frequently necessary when an announcer wishes to intersperse musical programs with announcements without interrupting the music.

Almost limitless combinations may be evolved to meet varying conditions, but experience proves that the simpler a mixing circuit is, the more likely it is to be satisfactory in the long run, provided impedance relations are properly maintained and sufficient controls are used to meet the necessary conditions.

Transformers

It is almost impossible to properly design a mixing circuit without using one or more transformers, either to take advantage of their step-up or match impedances. The problem of a choice of proper transformers is not always an easy one, but since each one is chosen to do a definite piece of work, the solution automatically narrows itself.

We are accustomed to thinking of the relationship between the primary and secondary sides of a transformer in terms of turns ratio. However, to properly understand the use of a transformer, we must recognize another relationship; that is, the impedance ratio between the windings.

Considered alone, the primary or input side of a transformer could be considered as almost a pure inductance whose reactance to the flow of current would be determined by the 2 pi f L function with which we are all familiar in inductances. However, if the secondary of the transformer is "loaded," this function ceases to hold, provided, of course, the secondary load is not extremely high. Hence, we can make the impedance of the input side of the transformer almost anything we wish by loading the secondary in relationship to the impedance ratio of the transformer, provided the d.c. resistance of the windings is low. For instance, let us assume that we have a three-to-one turns ratio transformer that we wish to use as a 500-ohm input transformer. If the turns ratio is three-to-one, the impedance ratio will be the square of the turns ratio, or nine to one, so as a determinant of the 500-ohm value, it will only be necessary to load the secondary with nine times 500 ohms, or 4500 ohms, to satisfy our condition. This, of course, is true only where the primary will be over 500 ohms impedance with the secondary unloaded.

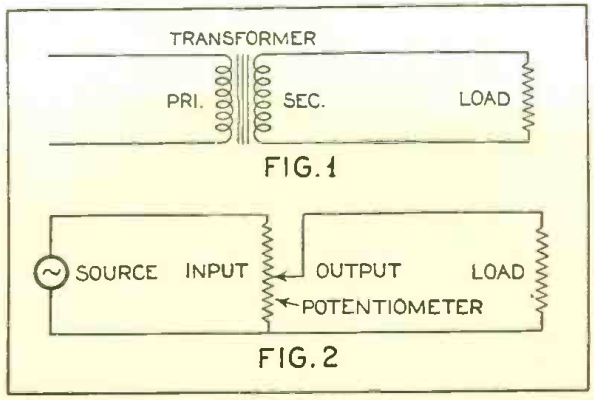
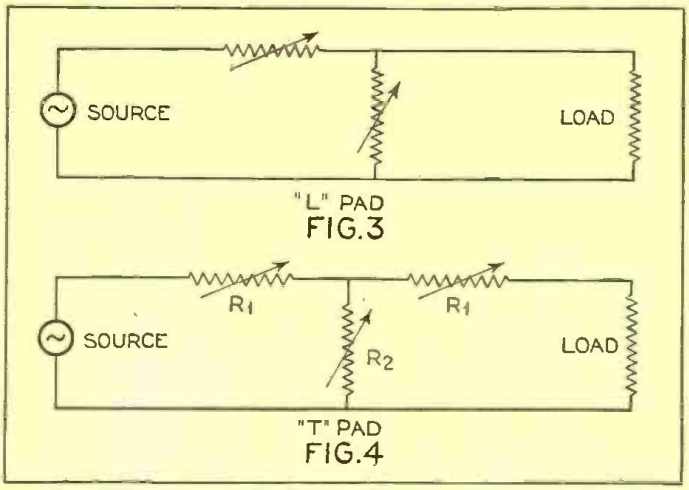


FIG. 1

FIG. 2

It may occur to some to ask why it is necessary to load a circuit. The answer is, if the 2 pi f L function taken above is considered, it will be seen that f or frequency is a distinctly variable factor, so that the impedance of

the input circuit will vary directly with the frequency of the applied signal. This obviously is not a desirable characteristic, so we definitely determine the primary impedance by the secondary load at the lowest frequency to be reproduced, and if the secondary load is purely resistive in nature, the primary impedance cannot rise above this value, regardless of the frequency. It is true, however, that these statements are made neglecting such factors as distributed capacity in the windings, capacity of leads, and so forth, which in a well-designed transformer should be a negligible quantity.



It is axiomatic in engineering that a generator will develop maximum efficiency when working into a load equal to its own internal impedance. Hence, we have the necessity of "matching impedances.' Since a phonograph pick-up or a microphone may be regarded as generators in the strictest sense of the word, we must carefully observe into what impedance we work these instruments so that their maximum efficiency and purest tone quality may be developed. No generator may be worked into a load lower than its internal impedance without serious harm being done to the wave form of the output, or, in everyday words, distortion being introduced. It is possible to work a generator in a load greater than its internal impedance without serious harm to the wave form, but the efficiency will fall off and other detrimental effects will be noticed. It is true that a vacuum tube may be at times worked into a load considerably in excess of its internal impedance, but there are definite reasons for this that do not enter into this discussion.

Volume Controls

Volume, or gain controls, as they are frequently called, fall into several classifications. First, we have the simple potentiometer whose sole function is to serve as a convenient means of applying a potential across a resistance, with a sliding contact arm so that any proportion of this potential may be passed along to the succeeding point in the circuit. The potentiometer is not generally considered a constant impedance control, but under certain circumstances it may be used as such, as will be pointed out later in this article.

The simplest form of the so-called constant impedance controls is the L-pad, as shown in Figure 3. The L-pad consists of two variable resistances, one a series resistance and the other a shunt resistance, that may be varied simultaneously. This combination may be used to present a constant and unvarying impedance looking from the source but not looking backward from the load. This type of control is satisfactory in some instances, and is very frequently used to accomplish a practically constant impedance control.

Figure 4 illustrates what is generally termed a T-pad and is the first of the controls mentioned that really maintains a constant impedance looking from the source or looking backward from the load. This type of control is as a rule highly satisfactory, and since it does not change the circuit constants in any way, cannot introduce distortion, etc., into the circuit. However, it has the drawback that the line is unbalanced, since series resistors are introduced into one side of the line and not into the other.

The H-pad, as shown in Figure 5, overcomes this objection and maintains a constant impedance in all directions as well as serving to maintain a balanced line condition. Frequently the shunt resistance is divided into two parts with the center-tap grounded. This completes both sides of the line at relatively low potential to ground, but has the obvious objection that six resistances must be varied simultaneously to maintain these relationships.

Regardless of what form a volume control may take, its sole purpose is to introduce losses into the circuit so that the power in the loudspeaker is under the control of the operator. As long as the control serves this purpose and does not introduce into the circuit any distortion or other undesirable effects, it is a satisfactory control for the purpose.

Volume controls are not always variable. It is sometimes desirable to introduce into a given circuit fixed losses so that the two input circuits from sources widely different in volume level may be approximately equalled, making the actual control of volume of the two circuits similar. For this reason, we give here simple formulas for computing both T and H pads for any desired attenuation.

Assuming equal impedances on the input and output sides, to detrmine the resistors to be used in a T Pad, the following formulas apply:

$$N\ (\text{a constant}) = \frac{1}{\text{antilog}\ \frac{\text{DB loss}}{20}}$$

$$R_1 = ro\,x\,\frac{(1-N)}{(1+N)}$$

$$R_2 = ro\,x\,\frac{2N}{1-N^2}$$

Where ro is the input and output impedance in ohms.

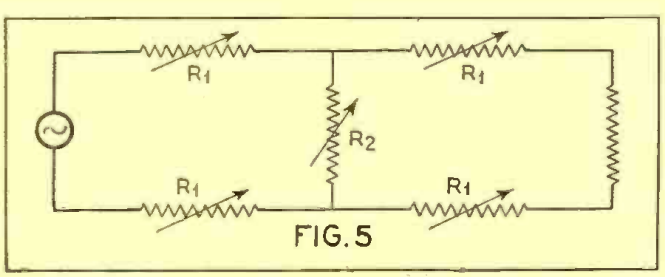
For H-pads it is only necessary to divide R1 into two parts so that five resistors are used, as shown, in place of three, as are used in T-pads.

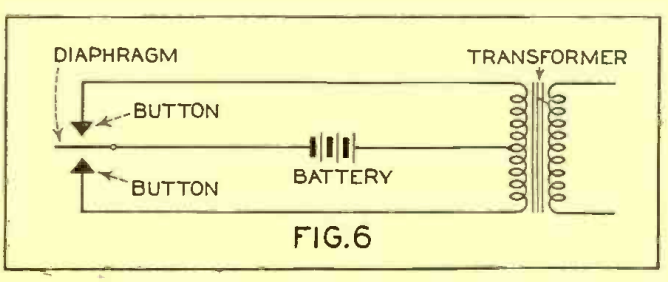
For determining the amount of attenuation that might be required in a circuit to equalize it to another circuit, it will only be necessary to measure the voltage output of the two sources, or if the sources are extremely low level, the output of the amplifier following the two sources at given settings of the volume controls and converting the different voltages into decibels by the following formula. The difference in the two levels may then be compensated for by a fixed loss pad computed as above. To convert the voltage difference into decibels, the following formula applies:

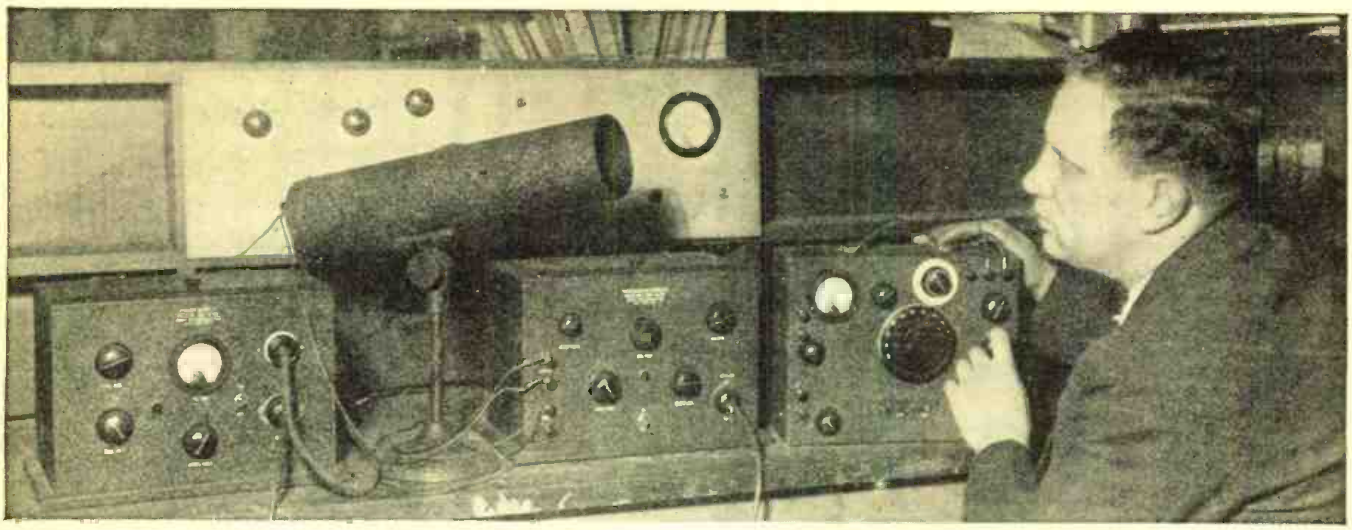
$$DB = 20 \times \log \frac{E1}{E2}$$

In the use of both of these formulas, a table of logarithms will be necessary. Since practically every table of logarithms carries with it full instructions for their use, we will not dwell on that point here.

(*Continued on page* 309)







STUDYING THE SIGNAL GENERATOR OUTPUT

Upon completion of the final model of the signal generator described here, extensive oscilloscopic studies of its output were made to exactly check its wave form, modulation percentage indicator, etc.

A Practical Signal Generator

FOR SERVICEMEN, EXPERIMENTERS AND DESIGNERS

The r.f. signal generator discussed here should fill a long-felt need of servicemen and experimenters, for a reasonably accurate instrument at a price within the means of many who cannot afford the standard equipment heretofore available

By
Samuel Bagno
and
S. S. Egert

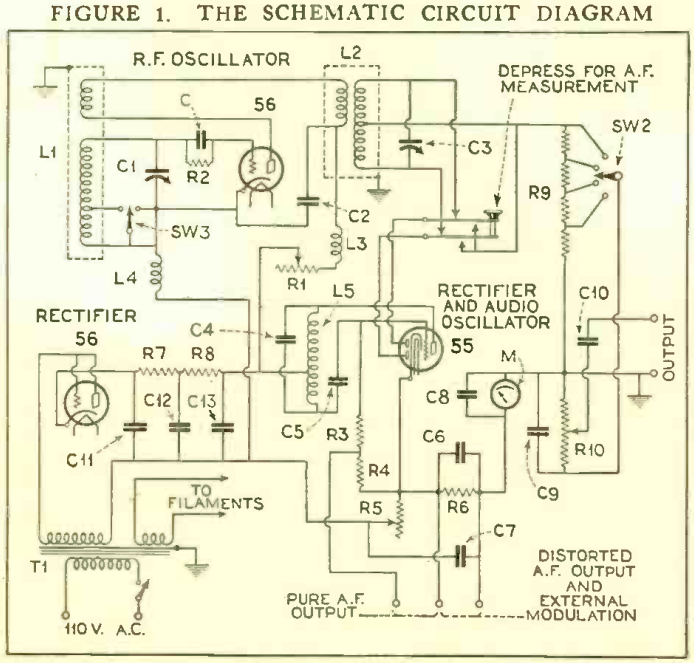
WITH the rapid advancement of the radio art, the radio serviceman has been called upon to diagnose receiver ailments involving problems far more difficult than those experienced in the old days. Gone are those familiar and strictly conventional neutrodynes and r.f. tuners, and now to take their place are the modern receivers with their 6, 7 or 8-element tubes, some of these tubes functioning at times in 2 or 3 circuits. Due to this complexity of circuit design, the overall gain has increasingly become the criterion as a means for checking receivers. Hence the serviceman has been forcibly introduced to those terms, sensitivity and selectivity. Not only has a mere rough check of sensitivity and selectivity been necessary, but very recently it has become more and more imperative to be equipped to determine these values rather exactly, especially with the advent of the now highly popularized automobile radio. In the latter, where the amount of energy picked up by the partially shielded antenna is so small, it becomes imperative for the sensitivity of a good automobile set to be approximately 1 microvolt. This means that the radio-frequency circuit should be sufficiently powerful to amplify a signal to good audibility after detection, even if the incoming signal only produces 1 microvolt across the primary of the antenna circuit, proper.

In order to provide the radio serviceman, at a moderate price, with an instrument which will give him this newly needed information, the Egert Engineering Company has designed the herein described serviceman's signal generator. It is believed that this unit, due to its many other practical applications, fills a marked gap in the laboratory of most servicemen. It should also prove a valuable addition to the equipment of any conscientious dealer or set manufacturer who intends to sell the best. It is an instrument which demonstrates the efficiency of any receiver in its most sensitive ranges and, as mentioned above, eliminates guesswork within reasonable limits.

Detailed information on how to make highly important measurements of a receiver are described later in this article. But first a summary of the outstanding practical features incorporated in the unit is presented:

1—Generates an unmodulated r.f. signal of any intensity and frequency desired with an absolute indication of this intensity and frequency. These intensity indications can be obtained as low as 3 microvolts and as high as 100,000 microvolts. A calibrated curve is supplied covering both broadcast and intermediate-frequency bands.

FIGURE 1. THE SCHEMATIC CIRCUIT DIAGRAM



2—Modulates this signal at measured values anywhere within the range of 0 to 50 percent modulation.

3—Measures the microvolt sensitivity of any broadcast receiver.

4—Allows the user to plot a rough curve of the selectivity of a broadcast receiver.

5—Generates a modulated or unmodulated intermediate-frequency signal, the latter being continuously variable within a range of 110 to 500 kilocycles.

6—Supplies a pure sine-wave audio-frequency signal fixed at 1000 cycles, which can be used for bridge measurements.

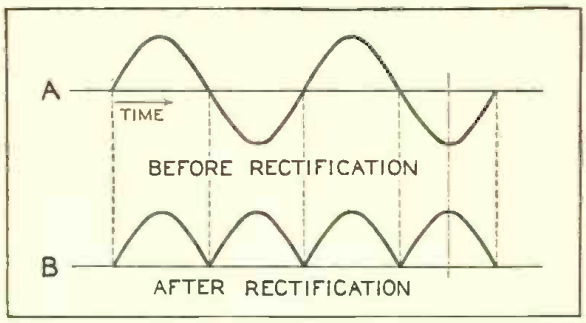
7—Generates a distorted 1000-cycle audio signal variable from 0 to 5 volts. This signal can be used to test the gain of audio amplifiers.

8—Has provision for external modulation at any frequency desired.

9—Permits comparative sensitivity determinations of short-wave receivers at frequencies up to 60 megacycles.

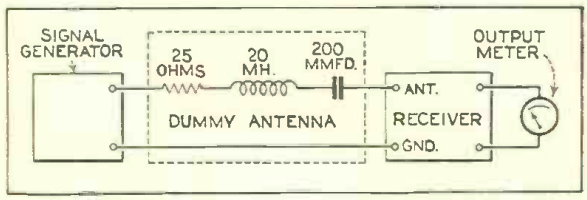
10—Measures the efficiency of detection at different percentages of modulation.

11—Provides means for a dynamic check of the radio-frequency characteristics of any tube.



ACTION OF THE RECTIFIER SYSTEM

Figure 2. In order to permit direct measurement and calibration of the signal generator output a –55 type tube is employed as a full-wave r.f. rectifier. Curve A shows the form of the r.f. oscillator output and curve B the wave after rectification in the –55 tube. Note that B is a pulsating direct current having twice the frequency of A



SET-UP FOR RECEIVER MEASUREMENTS

Figure 3. In order to approximate regular reception conditions a standard dummy antenna consisting of resistance, capacity and inductance is inserted between generator and receiver. The standard values for these components are shown in the diagram above

Figure 1 shows a circuit diagram of the instrument. The r.f. oscillator employs a –56 tube, as shown. When the switch, SW3, is at the short-circuiting position of L1, the oscillator generates a signal variable between 225 to 750 kilocycles. This signal is fed to L2, then to the –55 or r.f. rectifier tube. Figure 2 illustrates what happens in this rectifier circuit. Curve A shows the conventional r.f. signal and is a pictorial representation of the wave before it enters the –55 tube. Curve B illustrates its form after rectification. The signal now becomes a pulsating direct current *which will provide linear measurements.* Also note that the 225 to 750 kc. frequencies generated by the r.f. oscillator are doubled to cover a band of 550 to 1500 kc. after rectification. Hence this method is called the "second harmonic method."

Herein lies the fundamental difference between this signal generator and most others found on the market today. Heretofore signal generators employed an oscillator operating at full strength which fed its full power to a high-power r.f. attenuator. The disadvantages encountered in this method were leakage, cumbersomeness due to shielding, inaccuracy, exorbitant cost of the r.f. attenuator, etc. The method incorporated in the design described here employs an oscillator operating at its minimum power with a rectifier tube which converts the r.f. voltage to pulsating d.c. voltage having a direct-current component of an amplitude equal to the maximum amplitude of the radio signal generated. This pulsating d.c. voltage responds to linear measurements (as is also true of all rectifiers). As the current passing through the rectifier is dependent on the load placed upon the rectifier, the current can be controlled to an infinitesimal amount, if so desired. Finally, due to the low amount of power consumed in the attenuator, both the cost and the size of the attenuator are reduced tremendously.

The pulsating direct current is then fed through a bank of tapped resistors, R9, and also through a meter, M. As the latter two are in a series circuit, it can be seen that with a known current passing through R9 (fixed by the coarse attenuator R1 and observed in M), the voltages across each tap of R9 is known. These voltage taps provide outputs of 50, 500, 5000 and 50,000 microvolts when M reads full scale. Then, as all measurements are linear, a directly calibrated attenuator (potentiometer), R10, reading 0 to 100, is inserted to divide these known voltages into smaller divisions so that any desired signal intensity may be fed to the output posts.

The triode position of the –55 tube is used for the audio oscillator. L5 and C4 furnish the 1000-cycle resonance in the Hartley circuit employed and R5 varies the intensity of the audio signal. Modulation is accomplished electronically (inside the –55 tube), as the r.f. signal is also present in this r.f. rectifier. This method of modulation is ideal, as it allows for no distortion due to plate feed chokes or the like. The circuit is arranged so that any desired modulation percentage may be obtained with ease. It is done as follows: After the desired frequency (radio) is obtained by tuning the main dial and consulting the curve, the coarse attenuator R1 is varied until M reads full scale, the latter being a 0-1 milliammeter. Then switch SW1 is depressed, and the audio-frequency attenuator R5 is varied until the meter M reads, say .3. This position represents 30% modulation. Similarly .2 is 20% modulation, .4 is 40% modulation, .5 is 50% modulation, and so on. The remaining portion of the circuit is shown composed of a conventional 60-cycle rectifying system employing a –56 tube as the rectifier.

In order to obtain intermediate frequencies, switch SW3 is thrown to take in the total coil L1. The intermediate frequencies may be attenuated and modulated by the same controls which vary the broadcast signals. However, microvolt measurements for the intermediate-frequency bands do not hold.

In measuring the sensitivity of a receiver, a dummy antenna should be inserted between the signal generator and the receiver. The dummy antenna is a simple arrangement and is composed of a resistance, capacity and inductance in series. Figure 3 shows the standard circuit and values. It is not necessary to shield the dummy antenna when testing. In the test, the signal generator feeds a known signal to the dummy antenna and then to the receiver. An output meter is connected to the output posts of the receiver to measure the output voltage for each known input voltage. With this set-up, any change affected in the receiver will be immediately recorded by the output meter when the r.f. attenuation and the modulation of the generator is held constant. Changing a tube, condenser or resistor, etc., will record the resultant effect on the overall efficiency of the set immediately. It can (*Continued on page* 303)

SOME INTERESTING INFORMATION ON

Magnetostriction Oscillators

The fact that a bar of iron changes its physical dimensions when magnetized forms the basis of its use as a mechanical oscillator for producing sounds of all frequencies. Some interesting effects of such an oscillator are outlined here

Part One

By Irving J. Saxl, Ph.D.

IN 1863, when Philipp Reis, an obscure school teacher, demonstrated his telephone in Stettin before the Assembly of Natural Scientists he used a design which was promptly forgotten. However, the advanced radio and electronic sciences of today go back to this early and long neglected stepchild, and by greatly increasing its effectiveness, makes it possible to communicate under water, make fine colloidal emulsions, fatigue glass, kill tadpoles, destroy bacteria, precipitate fog, and do many other things of scientific value and interest.

What was this original effect used by Reis? Figure 1 shows a schematic view of the original Reis telephone. A knitting needle, N, was stuck into the resonating box, R. Around the base of this needle, a coil of copper wire, B, was wound. Changes in the current impulses as produced by a microphone were induced in this coil. Under the influence of these changes in the electric current, the knitting needle started to hum or give out sounds which resembled the sounds impressed on the microphone. This sound, of course, was very feeble and only the acoustical resonator, R, made it perceptible at all. Under the influence of the magnetic field developed in the coil, B, the knitting needle was magnetized. It is assumed that under the influence of magnetic attraction between the molecules in the needle, changes in the length of the latter occur.

While various theories exist, as to the actual changes in the length produced, they are extremely small and amount to *less than 100th of the diameter of the average* molecule. A change in length of only 6.3×10^{-10} centimeters is the dimension calculated for a sound which is just at the threshold of aural perception.

The human ear is indeed a marvelous instrument, making possible perception of sound energies like the above and covering a range up to the crashing of thunder, several million times as high, with vibrations which can be easily seen with the unaided eye. The radio sciences have made it possible to follow up this limited range of human ear and to experiment with sound, in nature, which is above or below the human range.

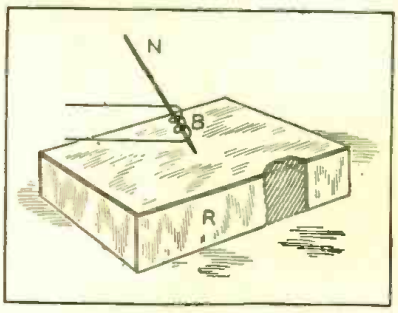
This phenomena is so close to the border line of perception that we must be extremely grateful to radio, which has opened up to us the possibility of scientific investigation in this field which would otherwise be quite impossible.

The effect of sound waves produced by high-powered modern magnetostriction oscillators can be so strong that cork used for closing up a flask near the sonic vibrator is *burnt!* (See Figure 2.) The energy of the elastic waves induced in the inside of this cork is so high that the cork heats up and blows out the vent in approximately twenty-five (25) seconds.

What a difference between the feeble sound made in the Reis telephone, which was just perceptible, and the modern high-powered sonic generator!

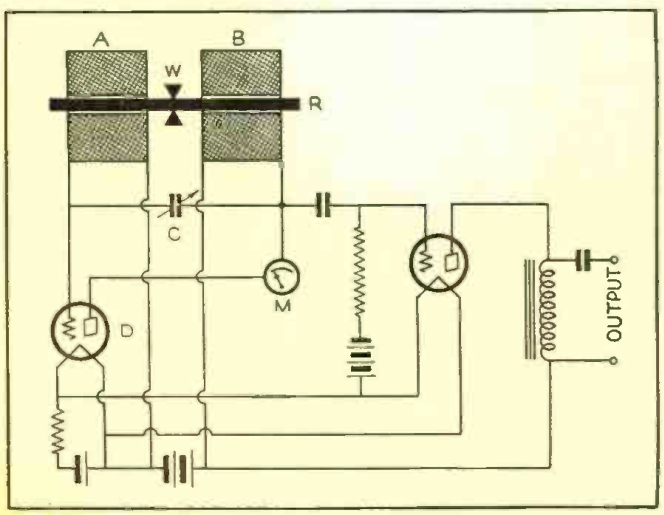
The same effect, considered for a long time as a scientific curiosity, is now able to generate higher frequencies than a loudspeaker is capable of and produce sound of an intensity that is able to lift whole columns of water.

In Figure 3 another experiment with the powerful Gaines sonic oscillator (which will be described later) is shown. This generator, if immersed in water, generates such intensive sound waves that the fluid builds a wall of liquid over the sound source. Making emulsions, killing bacteria, destroying fog are only a few of the tricks which this art has made possible. As a matter of fact, the effect that these high audible frequencies in the supersonic range have upon the condition of various materials has only been



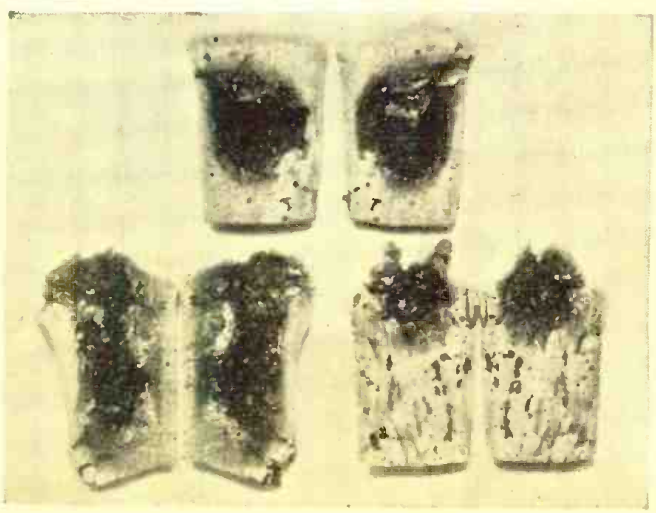
MAGNETOSTRICTION OSCILLATORS

Figure 1, at right, shows a sketch of the original Reis telephone explained in the text. Figure 5, below, is the circuit used in the Pierce magnetostriction oscillator



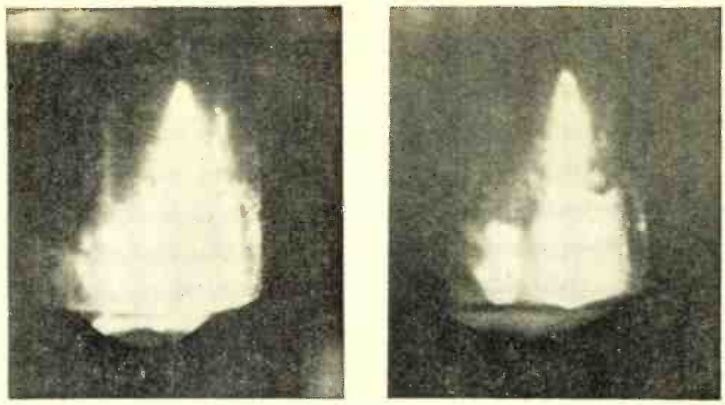
EFFECT OF "SUPER" OSCILLATIONS

Figure 2. The effect of sound waves of super-audible frequency is so strong that corks in bottles containing a liquid vibrating at these frequencies are "burned"



touched. We already know that an extremely fine colloidal dispersion can be made in materials which do not "suspend" under ordinary conditions.

But these are only a few instances illustrating the fundamental physical fact, namely: under the influence of intensive elastical waves in the neighborhood of the supersonic range considerable changes enter the physical structure of materials. They can be innuenced internally, as we have seen in the example of the cork, or they can be made to change their surface condition. An illustration of the latter is shown in the double photograph of picture No. 4. Here a drop of water is attached to the high-powered sonic vibrator. The left-hand picture shows the appearance of the drop of water when the vibrator does not operate, while the right-hand picture shows its appearance when it is oscillating. In the latter case the drop is flattened out, due to the changed surface conditions. It was the power arrangements, brought into existence by the invention and perfection of radio amplifiers, that have made it possible to get these practical amounts of power from *magnetostriction*.



OSCILLATIONS AFFECT SURFACE TENSION

Figure 4. Supersonic sound waves affect the surface tension of fluids. At the left is a drop of water hanging from an oscillator bar without vibration. The right-hand picture shows the same drop flattened out under influence of the super-audible frequency

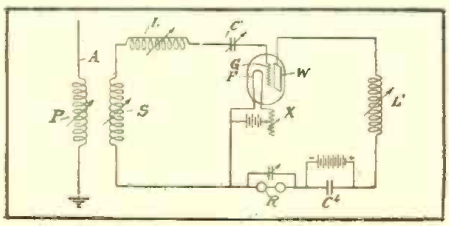
It was Dr. G. W. Pierce[1] of Harvard University who was among the first to do extensive work on magnetostriction oscillators. Among the arrangements employed by him is the following circuit: (See Figure 5.) Two coils, A and B, were put into the circuit of a hi-mu tube, D, in such a way that one is in the grid and the other in the plate circuit of the tube. They are wound and arranged in such a way that the magnetic effect exerted by the plate coil, as well as the grid coil, is in the same direction. Through the center of both coils runs a metallic core, which is magnetized by both of them with the same polarity. This is, practically, a variation of the fundamental Armstrong system.[2]

As shown in Figure 6, the difference exists mainly in the fact that the coils, L and L1, are coupled by the magnetic rod, while in the original patent drawing the coupling was provided by the tube inter-electrode capacity.

The magnetic rod used by Pierce vibrates with the rhythm of the alternating current sent through the coil, provided a magnetization of sufficient extent is impressed upon the rod. If this is not done, the rod will *oscillate at double the frequency* of the alternating current. Magnetization occurs when the current flowing through the coil reaches its peak voltage in *either* direction. Moreover, as each cycle of the alternating current has such a maximum and a minimum, two changes in length for each completed cycle of the alternating current occur. Here is an interesting possibility for frequency doubling.

ARMSTRONG'S OSCILLATOR

Figure 6. This is a reproduction of the original Armstrong regenerative patent drawing. This is almost the same as the Pierce oscillator shown in Figure 5. except that here the coupling is through the tube capacity instead of the iron bar



In connection with this, attention may be called to the fact that this type of winding coils is exactly the opposite of the standard method used in the Hartley type oscillators and their variations. While the Hartley oscillator, as is well known, works as a regenerator, this magnetostriction oscillator may be considered (to create a new word which expresses its action clearly) as a *degenerative* oscillator. The rod, R, in Pierce's oscillator must not touch the coils, A and B, but is suspended in the center on a ring or wedge, W. A tuning condenser, C, is placed between the plate and the grid coil. This condenser, C, serves to adjust the frequency of the oscillating circuit built by the two coils, A and B, and the condenser to the natural frequency at which the rod, R, oscillates best. Of course, any type of amplification can be used, once the frequency is generated, as is illustrated by the resistance-coupled amplifier shown at the right side of Figure 5.

For adjusting the rod, R, to a maximum oscillation, the condenser, C, is adjusted to that point where the d.c. milliammeter, M, gives the biggest deflection. The moment resonance is reached, the plate current in A rises strongly. After this point is reached, the capacity may be increased or decreased without changing to any considerable extent the frequency of the oscillating system. Rods of permalloy of invar (which consists of approximately 64% iron and 36% nickel) are excellent as resonators.

It is interesting to note that metals of very high permeability, such as iron and steel, have only small magnetostriction reactions. Alloys, however, as for instance cobalt and iron or a composition of chrominum nickel and iron (monel metal or nichrome) are highly active magnetostrictive materials.

It is also interesting to note that the effect of annealing on these materials makes itself so strongly shown under magnetostrictive reaction that the extent of this annealing process can be easily measured by this method.

The natural frequency of a rod can be determined by the following equation: $V = 2LF$

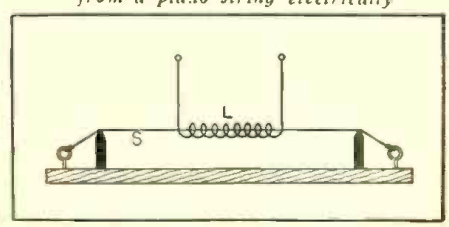
In this equation V = the velocity of sound in the metallic rod, F = the frequency in cycles per second, L = the length of the rod.

As V is practically independent of the length of the rod and the frequency, it is easily possible to prepare frequency standards over a considerable range.

At this stage it is of particular interest to note that these magnetostriction standards are just in the range where quartz oscillators become impractical. While quartz piezo-electric crystals have to be extravagantly large, and therefore their handling is not practical for industrial purposes, (*Continued on page* 312)

A WALL OF WATER

Figure 3, at left, shows the oscillating bar producing a wall of water at the surface. Figure 7, below, shows Fessenden's invention for producing music from a piano string electrically



The International Nine
Short-Wave Receiver

By William C. Dorf

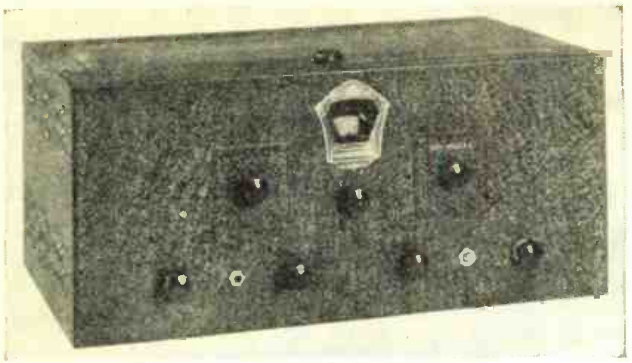


FIGURE 1. THE FRONT VIEW

FIGURE 3. THE REAR VIEW

MANY amateurs and short-wave enthusiasts will welcome this "how to build" article on the new International Nine Short-Wave set. The big feature of this receiver is the "drawer type" plug-in coils. This efficient receiver is a nine-tube superheterodyne circuit (including the type -80 rectifier), is equipped with heterodyne beat oscillator for c.w. signals, tone control, plate-supply switch, jack for headphone reception. It is designed with a stage of radio frequency ahead of the first detector which adds not only to the overall gain of the set but provides greater selectivity so as to prevent image-frequency interference. Another very important feature of the set is the band-spread arrangement on the amateur band of 20, 40, 80 and 160 meters.

The set has a wavelength range from 15 to 200 meters. The wave-bands are divided as follows: 15 to 26 meters; 26 to 45; 45 to 90; and 90 to 200 meters. All wave-bands overlap.

An important feature of the drawer type plug-in coils is their ease of changing from one wave-band to another. The radio-frequency, detector and oscillator coils are all assembled within the one case and it means changing only one unit for the waveband desired.

Figure 3 shows how these new coils work and how they are designed. At the left and nearest the receiver chassis is shown the drawer into which the coil case slides in and out and makes circuit contact by means of the metal buttons and the spring leaves of the socket. On each unit there are six rows of these contact buttons, divided into three sections, to which the coils and the band-spread condensers are connected.

In the same illustration, to the right of the unit, is shown the coil assembly, with the two end coils mounted in the same position and the center coil at right angles to them. Two of the condensers used for band-spreading are shown alongside of the center coil.

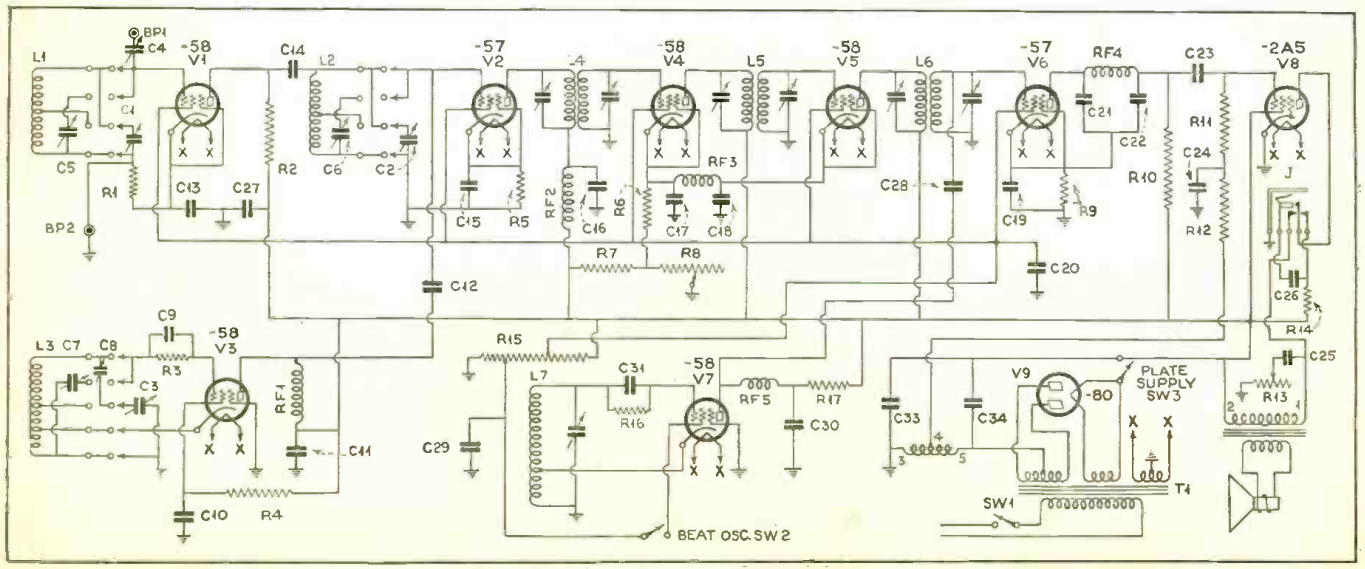
When the coil unit is pushed all the way into the drawer, the contacting leaves of the socket assembly makes connection to the front set of buttons on the Multiformer and in this way the band-spread arrangement is obtained. When the Multiformer is pulled out about ¼ inch from the drawer, connections between the Multiformer socket and the coils are made to the rear set of buttons and full coverage of the inductances is provided.

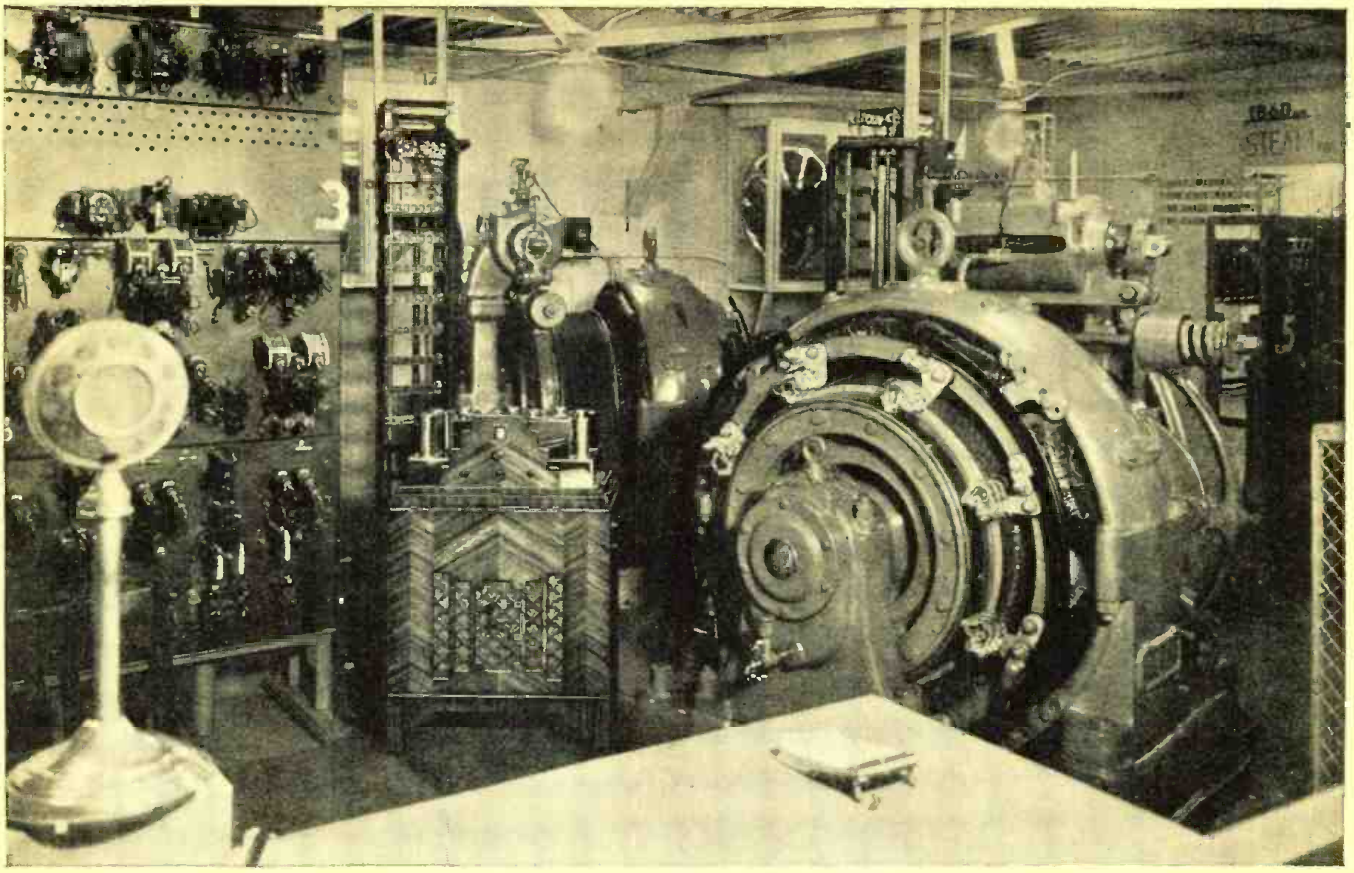
Now, a word as to how band-spreading is obtained. By referring to the circuit diagram, Figure 2, it will be noted that the condensers C5, C6 and C7 are employed for this purpose. When band-spreading is used, the gang tuning condensers C1, C2 and C3 are connected to only a part of the inductances, whereas the band-spread condensers are connected across the complete coil.

A study of the circuit diagram, Figure 2, will show that the set includes a type -58 for the r.f. stage, a type -57 for the first detector, -58's for the oscillator, two-stage intermediate-frequency amplifier and for the c.w. beat-frequency oscillator, a type -57 is used for the second detector and the new type -2A5 power tube for the output stage. The type -80 is used for rectification.

The three ganged tuning (*Continued on page* 299)

FIGURE 2. THE SCHEMATIC WIRING DIAGRAM





A SEVERE TEST FOR ANY RADIO SET

Here in the elevator room atop the observation tower of the "Sky Ride" at "A Century of Progress" in Chicago the author installed the receiver pictured above, which he equipped with a shielded lead-in. Although within a few feet of these gigantic elevator motors, which haul several thousand persons up the tower daily, the loudspeaker output is free from noise

RADIO NOISE

Its Causes, Prevention and Suggested Remedies

[*By* E. H. Scott]

HOW would you like to make a fortune so big you would be in Rockefeller's class! It is easy—if you can solve this problem. Just invent something that will take *all* noise out of radio reception, leaving only the music, speech and song. Invent that, and you can have your own steam yacht, a string of Rolls-Royce cars, your own private fleet of airplanes, or if you prefer to travel by railroad your own private car. Seems rather like a "pipe" dream, but I don't believe the picture drawn is too far fetched, for the man who invents some system which will *entirely* eliminate noise from radio reception, has something that every radio owner in the world will be glad to pay handsomely for to have incorporated in his receiver, and every receiver that will be built from then on would use it. Millions and millions, are waiting for the man who can *entirely* eliminate noise from radio reception.

Some day someone is going to do it—for I sincerely believe it *can* be done. We are working now and have been working off and on for years in the research division of the Scott Radio Laboratories on this problem, and have already made some progress in reducing the effect of static and electrical interference. But some day, someone is going to show the world how to *entirely eliminate* noise, then we will have radio programs free from static, that will come to us from all parts of the world, just as perfect as those we now hear from our local stations. However, I believe that that day is still a long way off.

In the meantime, what has been developed to reduce the effect of noise so that reception from distant stations, even those thousands of miles distant, may be made more enjoyable?

Where Noise Comes From

During the past two years great strides have been made in reducing the effect of noise in radio reception which comes to us from two general sources:

1. Atmospheric noise or static.
2. Electrical interference or noise caused by sparking motors, street car lines, X-Ray machines, defective tubes, defective parts or poor connections in the radio receiver itself.

When reception is noisy, the first thing to do is test to see whether the noise is in the receiver itself or is coming in over the air through the antenna. This can be very quickly decided by tuning in a station at moderate volume, then disconnecting both antenna and ground. If the noise stops when the antenna and ground are disconnected but starts up again as soon as the antenna and ground are connected, then you can be assured your receiver is all right and that the noise is being caused by static or local electrical interference.

How Noise May Be Reduced

Measurements in our laboratory show that static affecting broadcast programs is particularly bad on the higher audio frequencies. This can be proven by a comparatively simple experiment. Tune in a program from a distant station any night when static is fairly bad, then if your set is equipped with a "tone control" vary this control gradually. You notice that as you turn the "tone control", the music becomes more

mellow and also more "boomy", while speech is not as clear as it was, but at the same time the edge is taken off the static or noise, and you find you can cut it down to a point where you can sit and listen to a program, whereas before you cut in the "tone control", the static was so bad it entirely ruined it. The reason the static was minimized when you turned on the "tone control" was due to the fact that the "tone control" enabled you to cut off some of the higher audio frequencies.

In our all-wave receiver, we have what we call a "static control", located at the back of the chassis, which is put there to enable the owner to cut off some of the higher audio frequencies and so secure fairly good reception even when static is bad.

It is well known that a great deal of noise, both static and electrical interference, comes in at frequencies of 4000 cycles and higher (the piano scale range runs from 28 to 4,096 cycles) so that in the carefully designed radio receiver an effort is made to secure as sharp a "cut off" as possible on all frequencies above 4000 cycles, so that the effects of static and noises of a similar nature are minimized. This is one of the reasons why a Scott receiver has such fine tone, yet at the same time has such a low noise-to-signal ratio.

THE author needs no introduction to readers. The engineers in his laboratories have made an intensive study of radio noise, and in this article he passes along some of the experience gained in his study.

How Sensitivity Affects Noise in Receiver

Some receivers which incorporate automatic volume control are also equipped with what is known as a "sensitivity control" or "i.f. gain control", that is, different degrees of sensitivity or gain can be manually secured which enables the receiver to be adjusted for the noise level of the vicinity in which it is used.

Where a receiver is equipped only with a manually operated audio volume control, and there is no means provided for securing additional sensitivity when the receiver is used in a good location, then it must operate at maximum sensitivity at all times.

When, however, there is a manual control provided for adjusting the degree of maximum sensitivity of the receiver, with a separate knob to control the audio gain, you have at your command a means for securing the quietest possible reception.

How Noise in Receivers May Be Compared

The most simple way of gaining a definite idea of the noise level of a receiver is to compare it with other receivers under identical conditions; that is, in the same location, with the same antenna and using the same line for the power supply. It is important that the receivers be adjusted for the same degree of sensitivity, not merely set at the maximum degree of sensitivity on each set. Naturally if the noise levels of various receivers are measured at their maximum sensitivity, the least sensitive receiver will appear to be the quietest, when it is possible that if both receivers were measured at the same sensitivity, the most sensitive receiver might actually have the lowest noise level.

The thing to do is to tune in a distant station on the two receivers which you wish to compare for noise level. When both sets are adjusted to provide the same volume, on the same station, it is apparent that they are adjusted to the same approximate sensitivity. Then by switching the antenna from one receiver to the other one can readily determine their relative noise levels.

Tube Noises

The elimination of tube noise in a receiver, which generally is indicated by a loud hissing sound in the speaker, is a highly technical subject and space does not permit me to treat it in detail in this article. Tube noise in a superheterodyne can be very considerably reduced. Tube noise can be kept low by the proper mixing or modulating of the oscillator voltage, with the signal voltage in the first detector or modulator stage. If the ratio between these two voltages is not correct, noise will be generated in the mixing tube which will be amplified to great volume after it has passed through the many i.f. stages of the receiver. Tube noise can be further reduced by careful consideration of the voltages and biases on the r.f. and i.f. amplifier stages so that the tubes will always be operating under the most favorable conditions.

Noise from Man Made Interference

Noise from electrical apparatus such as sparking motors, street car lines, X-Ray machines, etc., can be eliminated or at least reduced if the defective electrical equipment can be located. This, however, is very often a difficult matter for the interference may be coming from some distance. When, however, the source of the noise can be located, then an electrical filter can be applied and will generally eliminate the trouble. It has been my experience that unless these filters can be applied right at the source of the noise, they are of little value.

This type of trouble is, of course, very much reduced if the shielding in your receiver is good, for then the only entrance of noise into your receiver is through the antenna itself. The illustration showing one of our receivers operating right in the midst of a mass of electrical equipment, gives rather a remarkable demonstration of the effectiveness of the shielding of a well-designed receiver.

The management of the "Sky-Ride" at "A Century of Progress", being held in Chicago, desired to supply the patrons at the top of the Observation Tower with music, and asked my laboratory to make the installation. On inspecting the location where the receiver was to be used, we found it was to be installed in a room at the top of the tower which was completely filled with a mass of electrical equipment including hoisting motors, circuit breakers and all of the equipment that goes with the running of a large passenger elevator. We set up a receiver in the tower, and installed a special shielded antenna. When the set was switched on beautiful, clear, noiseless reception poured out of the speaker. When it is remembered that the receiver operates within five feet of the huge hoisting motors, with nearly a dozen carbon brushes around each commutator, and not more than five feet from a large panel of circuit breakers, it will be realized what a feat this is. This performance is a source of astonishment to the six or seven thousand people who are viewing and listening to it every day.

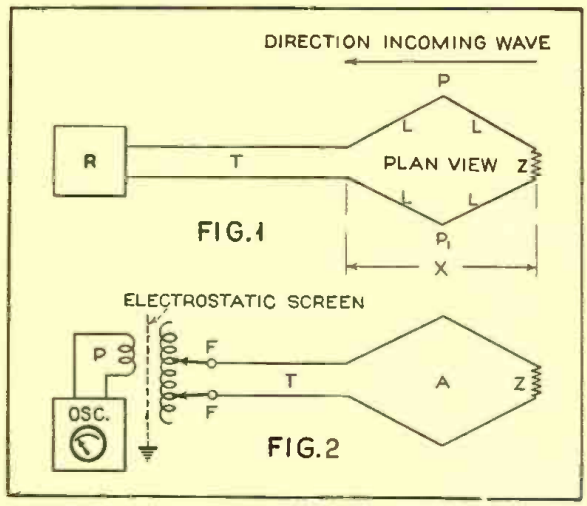
Very often considerable interference is picked up by a receiver operating in a business district or near a street car line where it is impossible to apply filters to remove the cause of the interference. In this case, the interference can very often be minimized and in some cases entirely eliminated if the antenna can be run at a good height, and connected to the receiver with a shielded lead-in with proper transformers to operate the shielded lead-in as a relatively low impedance transmission line to prevent loss of signal. A description of this type of antenna appears on page 148 in the September issue of RADIO NEWS.

In apartment houses noise is frequently caused by an antenna swinging in the wind and touching another antenna or grounded pipe. This results in an irregular clicking sound, not alone in the receiver connected to this antenna, but likewise in the receivers connected to all nearby antennas. If you are an apartment house dweller, therefore, it will be well to check over all the antennas on your roof for possible trouble makers of this type.

Noise in Receiver

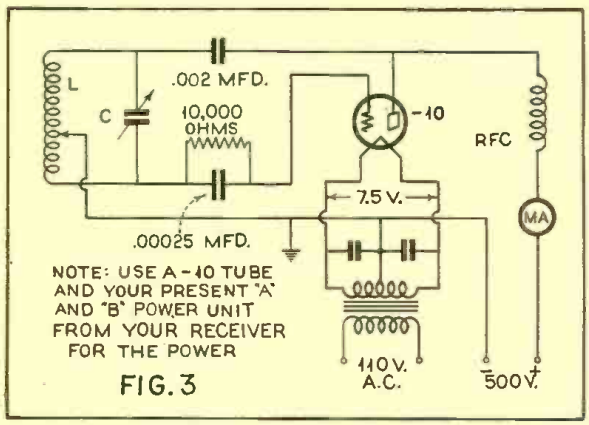
If you find after disconnecting both antenna and ground the noise in your receiver continues, then the probability is that it is caused by a defective tube, a poor connection in the receiver itself, or some part of the antenna grounding.

Tubes should be one of the first things suspected as causing the trouble, and can easily be tested by lightly tapping the top of each tube, when your ear will quickly tell you whether it is noisy or not. If the tubes appear to be okay and the receiver is still noisy every time it is jarred or touched, then every connection must be carefully tested and examined to find out which one is loose. This is a job that should be entrusted to a good serviceman.



THE "TILTED" ANTENNA

Figure 1. This type of antenna is recommended by the author, for those who have "wide open spaces" at their disposal. It is extremely directional and therefore offers an unusually favorable signal-to-noise ratio. Figure 2 shows the set-up for adjusting the antenna to insure uniform pick-up throughout the short-wave band to be covered. The method is described in the text

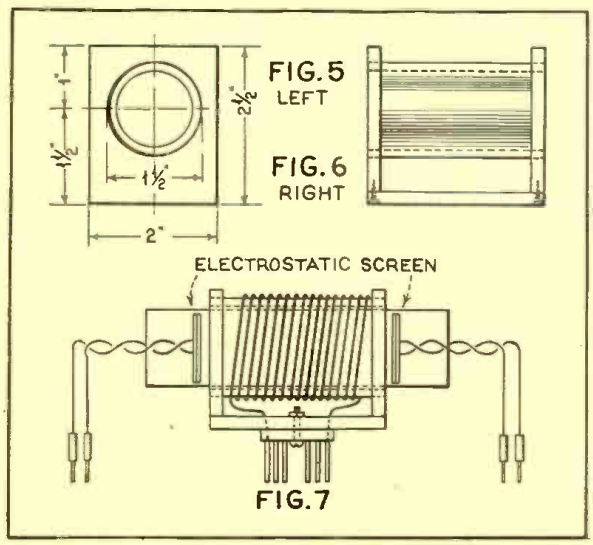


OSCILLATOR CIRCUIT
FOR ANTENNA ADJUSTMENT

Figure 3. Any power "driver" may be used in the set-up of Figure 2. The circuit shown here is simple and effective

THE ANTENNA COUPLING COIL

Figure 7. A sketch of the finished coil (L1, Figure 4). Figures 5 and 6 show details of its assembly



A Crystal Controlled

Short-Wave SUPER

A general discussion of the novel principles involved in the design of this receiver appeared last month in the first of this series of articles. In the present article the author provides data on directional and diversity antenna arrays, and then proceeds with the constructional data on the receiver, which will continue next month

By Frank H. Jones

Part Two

As was stated last month, the receiver being described in this series of articles will work astonishingly well on an ordinary antenna. But for builders who have the outdoor space available for a real antenna, the trouble of erecting a directional antenna array such as described in the following will be well worth while. If one cares to go still further, two or more such antennas may be employed in a "diversity" system, thus not only providing the improvement of approximately 15 to 1 in signal-to-noise ratio (as secured with a single array of the type described in the following paragraphs) but also more constant signals with less trouble from fading.

To make good use of the diversity effect, it is necessary to have at least two antennas separated about 2000 feet if one is working on waves of, say, 25 meters. This means that the antenna must be connected to the receiving station by means of transmission lines and to be effective those transmission lines must not radiate or have any effective radio pick-up.

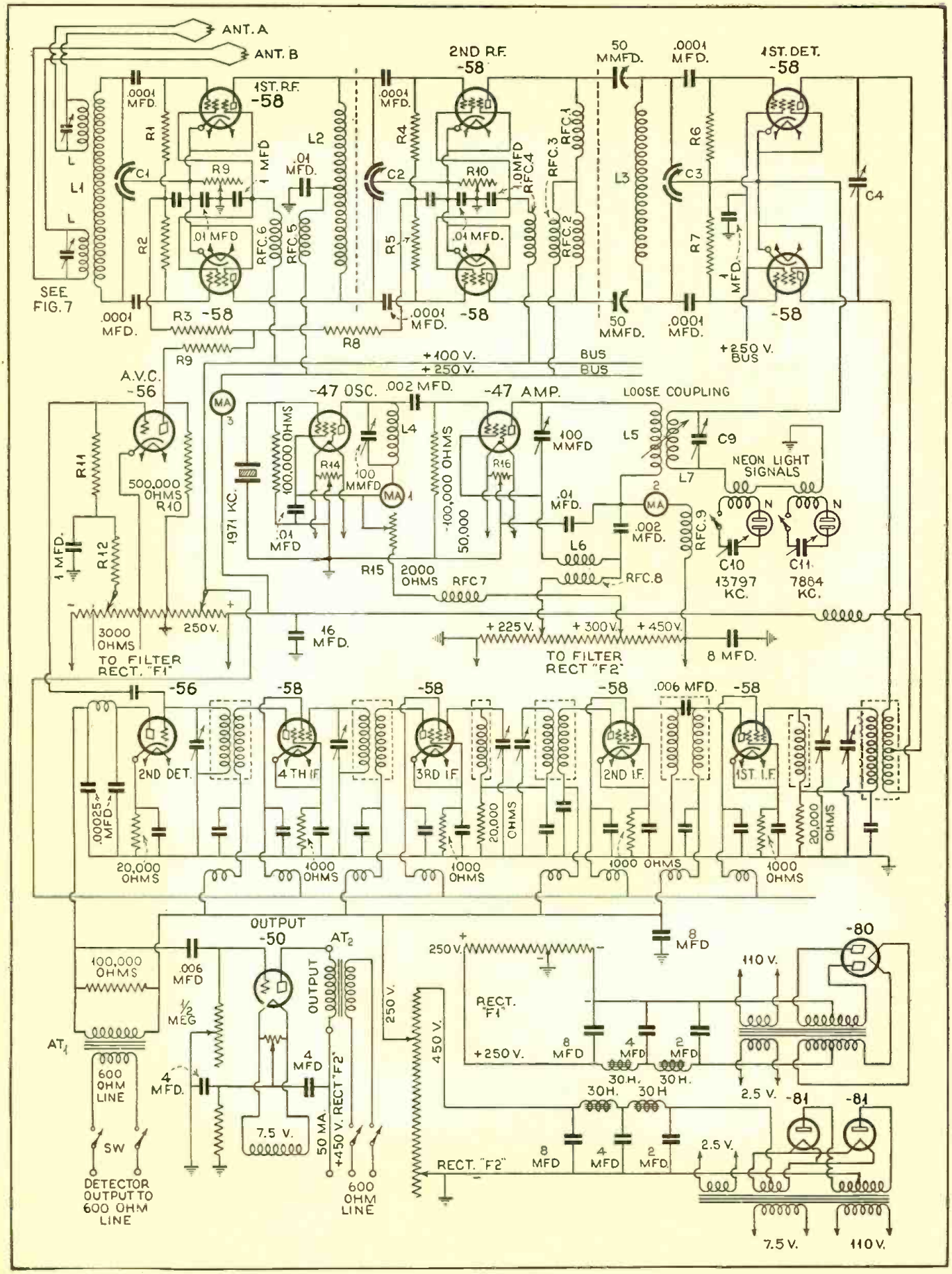
Recently the research engineers of the Bell Telephone Company have developed what they call "diamond-shaped" or "tilted" antennas. An antenna of this nature to cover waves around 20 meters with a directional ratio of about 15 to 1 is shown in plan view in Figure 1. "R" is the receiver, "T" is the transmission line and "A" the antenna array. The line "T" may be any convenient length, the main object of its use is to get "A," the antenna array, out in the open, away from obstacles and also far away from some other similar array.

It receives with a ratio of 15 to 1 from the direction shown by the arrow, which indicates the incoming wave. "Z" is the resistor whose value is to be found by test to be described later. L-L-L-L are equal lengths of wire 262 feet long. Distance from P to P is 220 feet. Spacing of transmission line is 6 inches, using No. 12 enameled copper wire throughout. Distance between L and L at "Z" is also 6 inches. The whole antenna array "A" is strung on ordinary wooden poles 33 feet in height, using standard double petticoat glass insulators. If there is too much sag in the "L" wires, place additional light poles in the center of each span. The transmission line can be preferably down near the ground, very taut and carefully spaced. The length "X" is 472 feet.

If you want to cut the thing down (on account of cost or space) and do it proportionately, the L's are 66 feet, P to P is 55 feet, and "X" is 117 feet. The directional ratio will now be decreased to about 7 to 1. Use the same height poles and the same 6-inch spaced transmission line.

If you don't live in a congested area, you "may" be able to get this up in one of your neighbors' back yards. The transmission line does not have to be straight. It can follow almost any combination of straights and curves so long as you keep it taut and equally spaced all along.

Now a few words as to how to adjust an antenna of this sort so it will work on your receiver (the receiver I describe) or any other receiver, for that matter. (*Continued on page* 310)



THE COMPLETE CIRCUIT DIAGRAM

Figure 4. The receiver and power supply are made up in rack and panel form, as shown in the photographs last month. Each section of this diagram represents one panel assembly. At the top is the r.f. tuner; below it the crystal oscillator and automatic volume-control system; next comes the tuned i.f. amplifier; the two power-supply units are at the bottom

The DX Corner

IN this eighth installment of the DX Corner we have listed a time schedule of Short-Wave Best Bets, a list of stations logged during the past month at the RADIO NEWS Short-Wave Listening Post in Westchester County, New York. The schedule includes only the best received stations, hourly, from 5 o'clock in the morning to 12 midnight, E.S.T. Space has been left for filling in local time. Space has also been left opposite the call letters for your own dial settings for each station you pick up. Unless otherwise noted, stations are heard daily.

Short-Wave "Best Bets"

Wavelengths in Meters	*Call Letters*	*Dial Settings*
10 G.M.T. 5 A.M. E.S.T.		**Local Time**
30.5	JIAA	
31.2+ Sun.	VK2ME	
31.5 Wed.. Sat.	VK3ME	
70.2	RV15	
11 G.M.T. 6 A.M. E.S.T.		**Local Time**
16.9	GSG	
19.7	DJB	
19.8	GSF	
25.5	DJD	
30.5	JIAA	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
31.5 Wed.. Sat.	VK3ME	
49.4+ Irregular	W8XAL	
70.2	RV15	
12 G.M.T. 7 A.M. E.S.T.		**Local Time**
13.9+	W8XK	
16.8+ Irregular	PHI	
16.9	GSG	
19.6	FYA	
19.7	DJB	
19.8	GSF	
23.3+ Sun.	RABAT	
25.5	DJD	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
49.4+ Irregular	W8XAL	
70.2	RV15	
13 G.M.T. 8 A.M. E.S.T.		**Local Time**
13.9+	W8XK	
16.8+ Irregular	PHI	
16.9	GSG	
19.6	FYA	
19.7	DJB	
19.8	GSF	
23.3+ Sun.	RABAT	
25.4	12RO	
25.5	DJD	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
31.8+	PLV	
35.5 Irregular	PRAG	
49.4+ Irregular	W8XAL	
49.9+	VE9DR	
70.2	RV15	
14 G.M.T. 9 A.M. E.S.T.		**Local Time**
13.9+	W8XK	
16.8+ Irregular	PHI	
16.9	GSG	
19.6	FYA	
19.7	DJB	
19.8	GSF	
25.3	GSE	
25.4	12RO	
25.5	DJD	
25.6 Except Sun.	VE9JR	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
31.8+	PLV	
35.5 Irregular	PRAG	
39.4	X26A	
49.0 Except Sat.Sun.	VE9HX	
49.4+ Irregular	W8XAL	
49.9+	VE9DR	
15 G.M.T. 10 A.M. E.S.T.		**Local Time**
13.9+	W8XK	
16.8+ Irregular	PHI	
19.6	FYA	
19.6+	W2XE	
19.7	W8XK	
19.7	DJB	
19.8	GSF	
25.3	GSE	
25.4	12RO	
25.5	DJD	
26.8+ Sun.	CT3AQ	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
31.5+	YV3BC	
31.8+	PLV	
49.0+	VE9HX	
49.4+ Irregular	W8XAL	
49.9+	VE9DR	
16 G.M.T. 11 A.M. E.S.T.		**Local Time**
13.9+	W8XK	
19.6+	W2XE	
19.7	W8XK	
19.7	DJB	
19.8	GSF	
25.2	FYA	
25.3	GSE	
25.4	12RO	
25.5 Irregular	DJD	
25.6 Except Sun.	VE9JR	
26.8+ Sun.	CT3AQ	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
31.5+	GSB	
31.5+	YV3BC	
49.0+Exc.Sat..Sun.	VE9HX	
49.2 Sun.	VE9GW	
49.3+ Sun.	W9XAA	
49.4+ Irregular	W8XAL	
49.9	VE9BJ	
49.9+ Except Sun.	VE9DR	
17 G.M.T. 12 Noon E.S.T.		**Local Time**
13.9+	W8XK	
19.6+	W2XE	
19.7	W8XK	
19.7	DJB	
25.2	FYA	
25.3	GSE	
25.4	12RO	
25.5 Irregular	DJD	
25.6 Sat.	VE9JR	
31.2+	W3XAU	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
31.5+	GSB	
31.5+	YV3BC	
49.0+ Ex.Sat..Sun.	VE9HX	
49.2 Sun.	VE9GW	
49.3+ Sun.	W9XAA	
49.4+ Irregular	W8XAL	
49.9	VE9BJ	
49.9+	VE9DR	
18 G.M.T. 1 P.M. E.S.T.		**Local Time**
13.9+	W8XK	
16.8 Except Sat.	W3XAL	
19.7	W8XK	
19.7	DJB	
25.2	FYA	
25.4	12RO	
25.5	GSD	
25.5 Irregular	DJD	
25.6 Sat.	VE9JR	
30.4 Sat.	EAQ	
31.2+	W3XAU	
31.3+	W1XAZ	
31.5	GSB	
31.5+	YV3BC	
49.2 Sun.	VE9GW	
49.3+ Sun.	W9XAA	
49.4+ Irregular	W8XAL	
49.5 Temporary	OXY	
49.9+	VE9DR	
50.0+	HVJ	
19 G.M.T. 2 P.M. E.S.T.		**Local Time**
16.8 Except Sat.	W3XAL	
19.5 Sun.	W2XAD	
19.7	W8XK	
19.7	DJB	
25.2	FYA	
25.3	12RO	
25.3+	W2XE	
25.5 Irregular	DJD	
25.5	GSD	
25.6 Ex. Sat., Sun.	VE9JR	
30.4 Sat.	EAQ	
31.2+	XETE	
31.3	HBL (code)	
31.3+	W1XAZ	
31.5+	GSB	
31.5+	YV3BC	
49.2 Sun.	VE9GW	
49.3+ Sun.	W9XAA	
49.4+ Irregular	W8XAL	
49.5	W3XAU	
49.5 Temporary	OXY	
49.6+ Sun.	W1XAL	
49.9+	VE9DR	
20 G.M.T. 3 P.M. E.S.T.		**Local Time**
16.8 Except Sat.	W3XAL	
19.5+Ex.Tu.Th.Sat	W2XAD	
19.7	W8XK	
25.2	W8XK	
25.3+	W2XE	
25.4	12RO	
25.5 Irregular	DJD	
25.5	GSD	
25.6	FYA	
25.6 Ex. Sat. Sun.	VE9JR	
30.4 Sat.	EAQ	
31.2+	XETE	
31.3+	W1XAZ	
31.3+	DJA	
31.5+	GSB	
31.5+	YV3BC	
32.3 Sun.	RABAT	
45.3+ (chimes)	REN	
49.1+ Sat.	W3XAL	
49.2	VE9GW	
49.3+ Sun.	W9XAA	
49.4+ Irregular	W8XAL	
49.5	W3XAU	
49.5 Temporary	OXY	
49.6+ Sun.	W1XAL	
49.9	VE9DR	
50.0	RV59	
21 G.M.T. 4 P.M. E.S.T.		**Local Time**
16.8 Except Sat.	W3XAL	
19.7	W8XK	
25.2	W8XK	
25.3+	W2XE	
25.4	12RO	
25.5	GSD	
25.5	DJD	
25.6	FYA	
31.2+	XETE	
31.2+ Tues., Fri.	CT1AA	
31.3+	W1XAZ	
31.3+	DJA	
31.5+	GSB	
31.5+	YV3BC	
32.3 Sun.	RABAT	
46.7 Irregular	W3XL	
48.8+	W8XK	
49.1+	YV1BC	
49.1+ Sat.	W3XAL	
49.1 Except Sat.	W9XF	
49.2	VE9GW	
49.3+ Sun.	W9XAA	

49.4+ Irregular	W8XAL	.....
49.5	W3XAU	.....
49.5 Temporary	OXY	.....
49.9+	VE9DR	.....
50.0	RV59	.....
22 G.M.T. 5 P.M. E.S.T.		**Local Time**
16.8 Except Sat.	W3XAL	.....
19.8	HVJ	.....
25.2	W8XK	.....
25.3+	W2XE	.....
25.4	12RO	.....
25.5	GSD	.....
25.5	DJD	.....
26.8+ Tues., Thurs.	CT3AQ	.....
30.4	EAQ	.....
31.0	T14NRH	.....
31.2+ Tues., Fri.	CT1AA	.....
31.2+	XETE	.....
31.3 Sat.	HBL	.....
31.3+	W1XAZ	.....
31.3+	DJA	.....
31.5+	GSB	.....
31.5+	YV3BC	.....
32.3	RABAT	.....
38.4+ Sat.	HBP	.....
46.7 Irregular	W3XL	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.0+ Sat., Sun.	VE9HX	.....
49.1+	YV1BC	.....
49.1+ Sat.	W3XAL	.....
49.1+ Except Sat.	W9XF	.....
49.2	VE9GW	.....
49.3+ Sun.	W9XAA	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.5 Temporary	OXY	.....
49.9	VE9DR	.....
50.0	RV59	.....
50.6 Irregular	HJ4ABE	.....
23 G.M.T. 6 P.M. E.S.T.		**Local Time**
25.2	W8XK	.....
25.5	GSD	.....
25.6	FYA	.....
26.8+ Tues., Thurs.	CT3AQ	.....
30.4	EAQ	.....
31.0	T14NRH	.....
31.2+ Tues., Fri.	CT1AA	.....
31.2+	XETE	.....
31.3 Sat.	HBL	.....
31.3+	W1XAZ	.....
31.3+ Irregular	DJA	.....
31.4+	W2XAF	.....
31.5+	GSB	.....
31.5+	YV3BC	.....
38.4+ Sat.	HBP	.....
46.7 Irregular	W3XL	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.0+ Sat., Sun.	VE9HX	.....
49.1+	YV1BC	.....
49.1+ Sat.	W3XAL	.....
49.1+ Except Sat.	W9XF	.....
49.2	VE9GW	.....
49.3+	W9XAA	.....
49.4+ Sun.	W8XAL	.....
49.5 Temporary	OXY	.....
49.9+	VE9DR	.....
50.6 Tu., Th., Sat.	HJ4ABE	.....
00 G.M.T. 7 P.M. E.S.T.		**Local Time**
25.2	W8XK	.....
25.5	GSD	.....
25.6 Except Sun.	VE9JR	.....
25.6	FYA	.....
31.0	T14NRH	.....
31.2+	XETE	.....
31.3+	W1XAZ	.....
31.3+	DJA	.....
31.4+	W2XAF	.....
31.5+	GSB	.....
31.5+	YV3BC	.....
46.7 Irregular	W3XL	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.0+ Sat., Sun.	VE9HX	.....
49.1+	YV1BC	.....
49.1+ Sat.	W3XAL	.....
49.1+ Ex. Sat., Sun	W9XF	.....
49.2	VE9GW	.....
49.3+ Sun.	W9XAA	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.8	DJC	.....
49.9	VE9DR	.....
50.4 Irregular	HJ2ABA	.....
50.6 Except Sun.	HJ4	.....
01 G.M.T. 8 P.M. E.S.T.		**Local Time**
25.2	W8XK	.....
25.6	FYA	.....
25.6 Except Sun.	VE9JR	.....
31.2+	XETE	.....
31.3+	W1XAZ	.....
31.3+	DJA	.....
31.4+	W2XAF	.....
31.5+	YV3BC	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.0+ Sat., Sun.	VE9HX	.....
49.1+	YV1BC	.....
49.1+ Sat.	W3XAL	.....
49.1+ Except Sat.	W9XF	.....
49.2	VE9GW	.....
49.3+ Sun.	W9XAA	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.8	DJC	.....
49.9+	VE9DR	.....
50.4 Irregular	HJ2ABA	.....
50.5	HJ1ABB	.....
50.6 Except Sun.	HJ4ABE	.....
73.0+	HCJB	.....
02 G.M.T. 9 P.M. E.S.T.		**Local Time**
25.2	W8XK	.....
25.6	FYA	.....
25.6	VE9JR	.....
31.0	T14NRH	.....
31.2+	XETE	.....
31.3+ Irregular	DJA	.....
31.3+	W1XAZ	.....
314+	W2XAF	.....
31.5+	YV3BC	.....
40.5+	HJ3ABD	.....
45.3 Thurs.	PRADO	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.0+ Sat., Sun.	VE9HX	.....
49.1+	YV1BC	.....
49.1+ Sat.	W3XAL	.....
49.1+ Except Sat.	W9XF	.....
49.2 Except Sun.	VE9GW	.....
49.3+ Sun.	W9XAA	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.8 Irregular	DJC	.....
49.9+	VE9DR	.....
50.4 Irregular	HJ2ABA	.....
50.5	HJ1ABB	.....
50.6 Mon.Wed.Fri.	HJ4ABE	.....
73.0 Except Mon.	HCJB	.....
03 G.M.T. 10 P.M. E.S.T.		**Local Time**
25.6	FYA	.....
25.6 Sat.	VE9JR	.....
31.0	T14NRH	.....
31.2+	XETE	.....
31.3+	W1XAZ	.....
40.5+	HJ3ABD	.....
45.3 Thurs.	Prado	.....
45.0 Fri.	TGW	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.0+ Sat., Sun.	VE9HX	.....
49.1+ Sat.	W3XAL	.....
49.1+ Except Sat.	W9XF	.....
49.2 Except Sun.	VE9GW	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.9+	VE9DR	.....
50.5 Thurs.	HJ1ABB	.....
50.6 Mon.Wed.Fri.	HJ4ABE	.....
04 G.M.T. 11 P.M. E.S.T.		**Local Time**
25.6 Sat.	VE9JR	.....
31.2+	XETE	.....
31.3+	W1XAZ	.....
45.0 Fri.	TGW	.....
48.8+	W8XK	.....
49.1+ Sat.	W3XAL	.....
49.1+ Except Sat.	W9XF	.....
49.2 Except Sun.	VE9GW	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.9+	VE9DR	.....

Station Locations

Wavelength	*Call Letters*	*Location*
19.9+	W8XK	Pittsburgh, Pa.
16.8+	W3XAL	Bound Brook, N. J.
16.8+	PHI	Huizen, Holland
16.9	GSG	Daventry, England
19.5	W2XAD	Schenectady, N. Y.
19.6	FYA	Pontoise, France
19.6+	W2XE	New York, N. Y.
19.7	W8XK	Pittsburgh, Pa.
19.7	DJB	Zeesen, Germany
19.8	GSF	Daventry, England
19.8	HVJ	Vatican City
23.3		Rabat, Morocco
25.2	FYA	Pontoise, France
25.2	W8XK	Pittsburgh, Pa.
25.3	GSE	Daventry, England
25.3+	W2XE	New York, N. Y.
25.4	12RO	Rome, Italy
25.5	GSD	Daventry, England
25.5	DJD	Zeesen, Germany
25.6	FYA	Pontoise, France
25.6	VE9JR	Winnipeg, Canada
26.8+	CT3AQ	Funchal, Madeira
30.4	EAQ	Madrid, Spain
31.0	T14NRH	Heredia, Costa Rica
31.2+	XETE	Mexico City
31.2+	W3XAU	Philadelphia, Pa.
31.2+	VK2ME	Sydney, Australia
31.2+	CT1AA	Lisbon, Portugal
31.3	HBL	Geneva, Switzerland
31.3	GSC	Daventry, England
31.3+	W1XAZ	Springfield, Mass.
31.3+	DJA	Zeesen, Germany
31.4+	W2XAF	Schenectady, N. Y.
31.5	VK3ME	Melbourne, Australia
31.5+	YV3BC	Caracas, Venezuela
31.5+	GSB	Daventry, England
31.8+	PLV	Bandoent, Java
32.3		Rabat, Morocco
35.5	PRAG	Porto Alegre, Brazil
38.4+	HBP	Geneva, Switzerland
39.4	X26A	Nuevo Laredo, Mexico
40.5+	HJ3ABD	Bogota, Col.
45.0	TGW	Guatemala
45.3	PRADO	Riobamba, Ecuador
45.3+	REN	Moscow, U. S. S. R.
48.8+	W8XK	Pittsburgh, Pa.
49.0	W2XE	New York, N. Y.
49.0+	VE9HX	Halifax, N. S.
49.1+	YV1BC	Caracas, Venezuela
49.1+	W3XAL	Bound Brook, N. J.
49.1+	W9XF	Chicago, Ill.
49.2	VE9GW	Bowmanville, Can.
49.3+	W9XAA	Chicago, Ill.
49.4+	W8XAL	Cincinnati, Ohio
49.5	W3XAU	Philadelphia, Pa.
49.5	OXY	Skamleback, Denmark
49.6	GSA	Daventry, England
49.6+	W1XAL	Boston, Mass.
49.8	DJC	Zeesen, Germany
49.9	VE9BJ	New Brunswick, Can.
49.9+	VE9DR	Montreal, Can.
50.0	RV59	Moscow, U. S. S. R.
50.0+	HVJ	Vatican City
50.4	HJ2ABA	Tunja, Colombia
50.5	HJ1ABB	Barranquilla, Colombia
50.6+	HJ4ABE	Medellin, Colombia
70.2	RV15	Khabarovsk, Siberia
73.0	HCJB	Quito, Ecuador

Official RADIO NEWS *Listening Post Observer Appointments*

The following list of persons have been appointed Official RADIO NEWS Listening Post Observers for short-wave reception. These observers will serve conscientiously in helping to expand the usefulness of the DX Corner. They will send in monthly logs of actual reception which will be used to check and augment the results already obtained in our Westchester Listening Post. Official notifications of appointment, suitable for framing, have already been sent to the successful applicants, listed below by states:

Alabama
J. E. Brooks

Florida
James F. Dechert
E. M. Law

Massachusetts
Roy Sanders

Mississippi
Dr. J. P. Watson

Missouri
C. H. Long

New Jersey
William F. Buhl

New York
Donald E. Barne
I. H. Kattell

North Carolina
H. O. Murdoch, Jr.
W. C. Couch

Ohio
C. H. Skatzes

Pennsylvania
K. A. Staats
C. T. Sheaks
George Lilley
John A. Leininger
F. L. Stitzinger

Tennessee
Adrian Smith

Canada
W. H. Fraser

The original plan was to have only one or two observers from each State but in the case of a few States, Pennsylvania, for instance, there were a number of observers who had proven their ability to serve in this capacity and the staff could not choose between them. Applications for observers and Official Listening Posts in the remaining States should be sent in immediately to the DX Corner as we already have made many probationary appointments that are awaiting full recognition. Listeners outside of the United States who feel that they could serve in this capacity are requested to file their applications as soon as possible before final appointments are made.

Short-Wave Reception Conditions

Reception conditions during the last month have undergone some considerable change. The 16 and 19-meter bands have been excellent during the mornings but have fallen down shortly before noon and during the afternoon. The 25-meter band has improved remarkably, especially between the hours of 4 to 6 p. m. E. S. T. The 31-meter band has also shown great improvement and a marked degree of static reduction. During the evening the 48-meter band has produced louder and stronger signals, with much less static than during the summer months. The Australian stations are now coming in like

locals on the 31-meter band. The Japanese station, J1AA, has been reported heard from more listening posts than previously.

VE9JR Transmissions

An official communication from radio station VE9JR at Winnipeg, states that their station will be on the air on 25.6 meters, with 2000 watts power, daily except Saturday and Sunday, from 8:30 to 9:30 a. m., C. S. T., and from 10 to 10:35 a. m., from 1 to 1:15 p. m.; from 2:15 to 2:35 p. m., from 6 to 9 p. m., and on Saturdays from 8:30 to 9 a. m.; from 10 to 10:30 a. m., from 11:45 to 12:15 p. m., from 6 to 7:30 p. m., and from 8 to 9:30 p. m., and on Sundays from 8 to 9 p. m.

W3XAU Transmissions

An official communication from radio station W3XAU in Philadelphia, states that their transmitter will be on the air on 9590 kilocycles, daily, from 12 noon to 6 p. m., and on 6060 kilocycles from 8 p. m. to 1 a. m., the following morning.

W2XE Transmissions

An official communication from radio station W2XE of New York states that they will be on the air from 11 a. m. to 1 p. m., daily, on 15270 kilocycles and from 3 to 5 p. m., daily, on 11830 kilocycles and from 6 to 11 p. m., on 6120 kilocycles. Their programs are the same as those carried by station WABC on the broadcast band.

W8XAL Transmissions

An official communication from station W8XAL of Cincinnati states that their approximate operating schedule will be from 11 a. m. to 3:30 p. m.; from 6:30 to 8:30 p. m. and from 11 p. m. to 6:30 a. m. All times are G. M. T. The power used by this station is 10,000 watts at a frequency of 6060 kilocycles (49.5 meters). The engineers write us that they are now incorporating new technical features in their 10-kilowatt transmitter (which should be on the air again by the time this publication is on the newsstands).

The British Transmissions

An official communication of the Empire Station shows the transmissions as shown in the DX Corner Best Bets for this month, although changes may be made at any time. Station GSD on 25.5 meters may be substituted for GSE on 25.28. Station GSC on 31.3 meters may be substituted for station GSB on 31.5 meters.

VE9GW Transmissions

An official communication from station VE9GW of Bowmanville, Canada, states that they will be on the air on 49.22 meters (6095 kilocycles), daily, from 3:30 p. m. to 12 midnight, with the exception of Sunday, when the schedule will be from 11 a. m. to 9 p. m. All times are E. S. T. The power in the antenna is approximately 500 watts. The antenna employed is a horizontal dipole, coupled to the transmitter by means of a matched impedance feeder system.

VE9HX Transmissions

An official communication from station VE9HX at Halifax, Nova Scotia, states that this station will be on the air on 61.10 kilocycles daily except Saturdays and Sundays from 9:30 a. m. to 12:30 p. m., and on Saturdays and Sundays from 5 p. m. to 11 p. m. All times are E. S. T.

W9XF Transmissions

An official communication from station W9XF in Chicago states that they will be on the air from Mondays to Fridays inclusive from 4:30 to 8 p.m., and from 9:30 to 2 a. m. They are *not* on the air Saturdays. On Sundays they will be on from 4:30 to 7 p. m. and from 9 p. m. to 2 a. m. All times are E. S. T. The station uses an antenna power of 5000 watts and operates on 6100 kilocycles. The vertical radiator antenna is fed by a transmission line and the station uses 100% modulation. The transmitter is located at Downers Grove, Illinois, some 23 miles southwest of Chicago.

I2RO's Transmissions

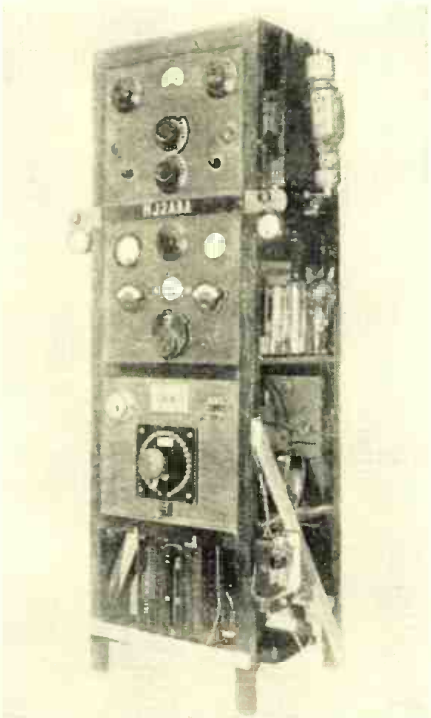
An official communication of station I2RO located at Rome, Italy, shows this station will be on the air on 25.4 meters from 11 a. m. to 12:30 p. m. and from 2:30 to 5:30 p. m.

League of Nation's Transmissions

We have received an official communication from the League of Nations regarding their stations HBP and HBL, who state that they have a weekly broadcasting service every Saturday evening from 5:30 to 6:15 p. m. The program is in English from 5:30 to 5:45, in French from 5:45 to 6:00 p. m., and in Spanish from 6 to 6:15 p. m. The wavelengths of these two stations are 38.47 and 31.3 respectively. The station is announced as "Radio-Nations", the call letters are not used.

HJ2ABA Transmissions

An official communication from radio station HJ2ABA states that their transmitter,



which is at Tunja, Colombia, has been given the name, "La voz del pais." This station is on the air on 50.4 meters and operates irregularly between 7 and 10 o'clock p. m.

News from Porto Rico

"I am a constant reader of the DX Corner and Best Bets. I find they contain the most complete and interesting information ever given about the short waves. I have a Lafayette SW-45 and a 50-foot antenna. Listed below are the stations I receive best here in Santurce: W3XAL, GSD, GSC, GSB, FYA, RABAT, VK2ME, HBL, HBP, DJD, DJC, W2XAF, RV59, HJ1ABB, I2RO, EAQ and TI4NRH."

Pelayo Garcia,
Santurce, Porto Rico.

Best Bets at Norwich, New York

E. Arthur Conklin of Norwich, New York, says that all of the stations of the British Empire System are well received as well as OXY on 49.4 meters. He states that he did not have a long list this month because he is sending his Scott receiver back to the factory to have an attachment included to make it tune up to 4000 meters.

A Report on J1AA

M. A. B. Snyder of Los Angeles, California, mentions that station J1AA of Tokyo, Japan, on 9870 kilocycles is now coming in QSA-4 daily from 1:30 a. m. to 4:40 a. m. P. S. T. He neglected to state what receiver he uses.

Best Bets in Ohio

Mr. Willard Buettner of Cincinnati, Ohio, reports the following list of stations as short-wave Best Bets: W2XAD, W1XAL, W8XK, DJB, HJB, GBS, I2RO, W2XE, GSD, DJD, VE9JR, EAQ, WEF, XETE, GSC, W2XAF, GSB, DJA, W3XL, W9XF, W3XAL, VE9GW, W9XAA and W3XAL. He uses a home-made receiver employing a 551 r.f. tube with a –27 detector and two –27 audio tubes. Mr. Buettner states that he has heard WEL and WEF transmitting NBC programs to South America.

Best Reception on Johannesburg

Mr. C. McCormick of Johannesburg, South Africa, sends in the following list of Best Bets for his location: W8XK, XIQ, XIV, GSB, VK5MU, W3XAU, W3XAL, W2XAF, W2XAD, FYA, RV15, RV59. He neglected to state the type of receiver he uses.

Another South African Report

Using a Stewart Warner 11-tube magic dial set, as well as a 4-tube home-made receiver, an anonymous reader of RADIO NEWS sends in the following Best Bets: PHI, I2RO, RV59, all the Daventry stations, W3XAL, W1XAZ. He states that most of the American stations come on the air too late to listen to them in his part of the world.

A Report on W8XK's 13.9 Meter Transmissions

Chas. E. Hurlburt of Middle Haddam, Connecticut, owner and operator of stations W1CKF and W1FMS bats in R9 plus only when the sky is cloudless and the weather warm. When the sky is partly cloudy or cloudy their signals vary between R5 and R2.

A Report from Pittsburgh

Mr. Edward C. Lips of the Brass Pounders and Modulators Amateur Radio Club of Pittsburgh, Pennsylvania, sends in the following Best Bets for his location: DJD, DJA, DJC, DJB, EAQ, GSA, GSD, GSB, GSE, GSF, I2RO, VK2ME, VK3ME, TJW, YV1BC, TI4NRH, CT3AQ, HBJ, VE9GW, VE9DR, VE9JR. He says he is now awaiting verification cards from OA1B, VK2LZ, K6BAZ, G5BY, G5BJ, G5ML. He reports reception on the 49-meter band bad on account of QRN. He uses a t.r.f. receiver employing a –58 t.r.f. tube, –57 detector and a –56 and a 2A5 for audio. His antenna is a doublet with a 100-foot flat top and an 85-foot transposed lead-in.

A West Virginia Report

An anonymous reader writes in that he uses a home-made adapter with a Bosch model 48 receiver and gives the following stations as Best Bets for Hollidays Cove, West Virginia: GSF, I2RO, XDA, VE9JR, DJA and EAQ.

A Report from Bermuda

Mr. W. P. Cutter of St. George's West, Bermuda, contributes the following: "I have not as yet seen any report from Bermuda on short-wave reception. Although static has interferred considerably, I have found re-

(*Continued on page* 313)

BAND-PASS EFFECT OBTAINED IN

NEW I. F. DESIGN

The intermediate-frequency transformers recently developed by the author demonstrate the possibility of obtaining high i.f. selectivity without side-band cutting

By Kendall Clough

THE writer has recently designed an all-wave receiver embodying a selectivity system that has been under development since the first of the year. The results have been so satisfactory that it was felt that some quantitative data might be of interest to set designers and builders.

The history of radio development has been one of constantly improved selectivity in order to cope with the increased number of stations in operation as well as the popular demand for a higher class of service from a radio receiver. True, the use of high order selectivity has not been of major importance to the average listener for two reasons. The use of chain broadcasting has made most of the more popular programs available for the average listener on one or more clear channels available without interference. Also, the average listener is not greatly interested in short-wave reception where the use of a specific allocation and cleared channel system is not always the case. For the listener who is interested in reception from distant stations, however, first order of selectivity is of the highest importance and is sought by the designers of the better quality receivers.

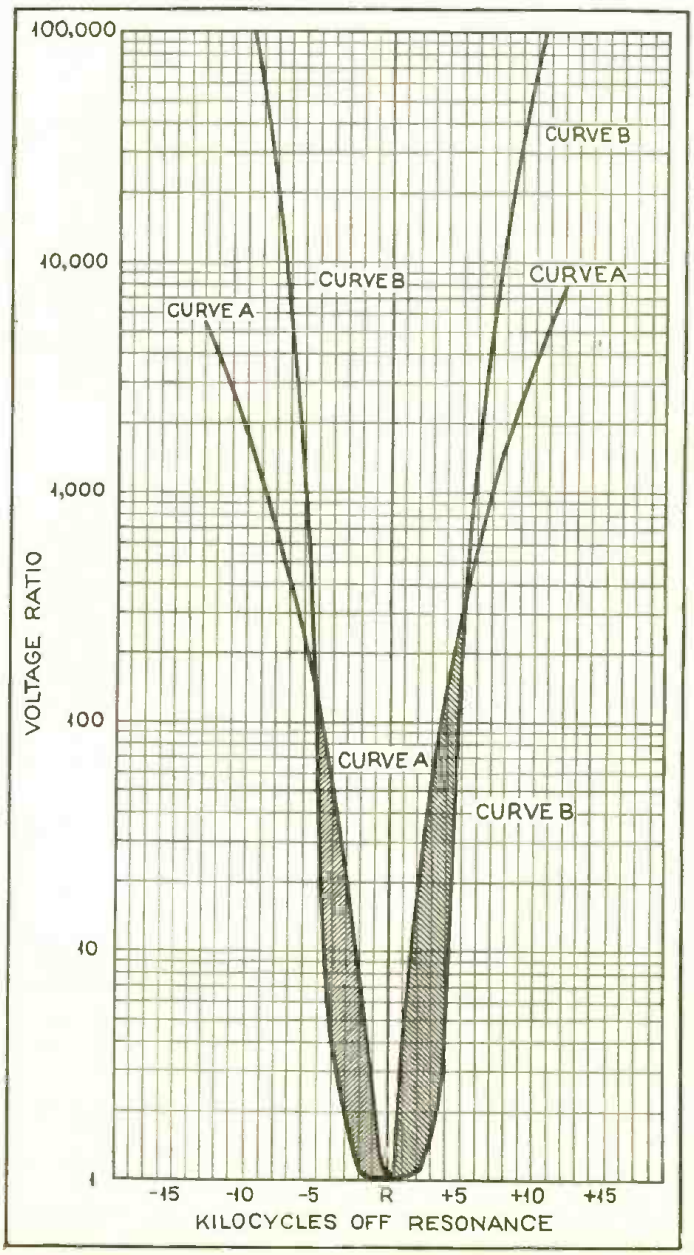
I.F. Selectivity

Many of the recent improvements in selectivity have been brought about in the intermediate-frequency stages of the amplification system. This has been the logical procedure, for the selectivity of tuned circuit is inherently greater at the lower frequencies than at the higher signalling frequencies of broadcast and short-wave band stations. Some of these developments have made use of crystals, taking advantage of the extremely high selectivity of a properly ground quartz crystal. This principle has been very successfully applied in the construction of receivers for the reception of continuous wave stations only (single-signal receivers) but attempts to utilize the crystal for reception of phone signals has been less successful. This is due to the extreme selectivity of crystals as resonators. This selectivity extends not only to the adjacent channel, say 10 k.c. away, but is also high in the audio side band region of 5000 cycles or less of resonance, detracting from the fidelity of reception and high selectivity has been gained with the loss of true reproduction.

Some designers have attempted to overcome this loss in fidelity by reshaping the curve of the audio amplifier in such a way as to increase the relative amplification at the higher audio frequencies. This has been largely unsuccessful due to the type of audio circuit demanded for this type of correction.

THE BAND-PASS EFFECT

Figure 1. Curve A represents the averaged selectivity characteristics of several typical high-grade superheterodyne receivers; Curve B that of a receiver which employs the i.f. coupling system described here. The shaded area represents the improved range over which sidebands are maintained by the new system, without important cutting

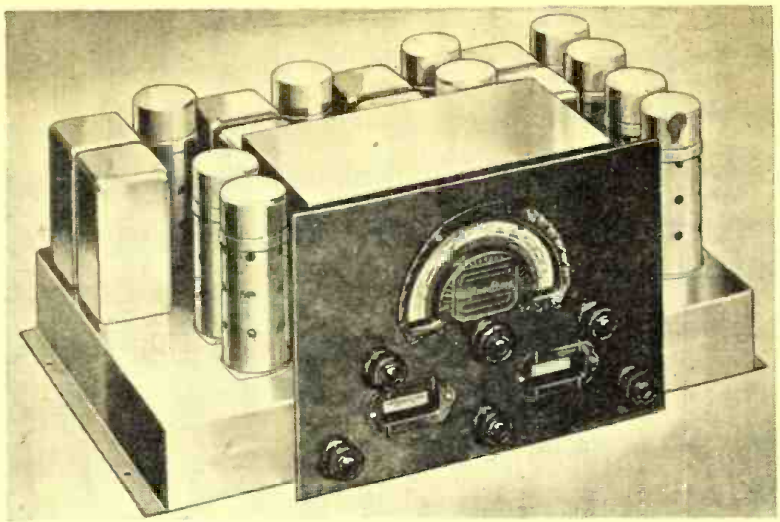


Side-bands

Further gains in selectivity over the ordinary receiver have been made by increasing the number of stages of i.f. amplification. These stages have ordinarily been made of the common type consisting of two tuned circuits coupled at or just below optimum coupling. Sufficient stages of this type will provide a very high order of selectivity on the adjacent channel (10 k.c. off resonance) but the build-up in selectivity within the side band frequencies (0-5000 cycles) is rapid and the design is usually a compromise between the best adjacent channel selectivity that can be accomplished with a loss of side bands that is at least tolerable to the ear. This type of i.f. amplifier design is shown in the curve A of Figure 1, this being a composite of several of the more selective receivers of the past season. It will be seen that the selectivity 10 k.c. off resonance is very good, being 2000 to 4000 times the signal required for response at resonance. The response is down 100 to 300 times 5000 cycles off resonance and as much as 3 to 4 times 1000 cycles off resonance. This represents about the greatest amount of side band cutting that is tolerable and with a certain amount of audio and

speaker compensation, is acceptable to the average ear.

In view of the limitations in design of i.f. amplifiers incorporating either of the two principles suggested above, the writer has spent several months in the development of a dual i.f. system that has some of the properties of a band filter and hence the attainment of high order of adjacent channel selectivity is possible without damaging effect on the side bands. The performance is indicated by the curve of B of Figure 1. It will be noted that the selectivity has been enormously increased, being as high as 75,000 times at 10 k.c. off resonance. At the same time the side band diminution is about the same as the composite curve at 5000 cycles off resonance, while for all audio frequencies between 0 and 5000 cycles the response has been improved. The amount of improvement is clearly indicated by the shaded area of the curve.



THE NEW I.F. SYSTEM IN A MODERN CHASSIS

Figure 2. The coupling units may be seen grouped in pairs along the rear of the chassis. Each coupling unit involves four coils, the first two carefully shielded from the other two

Band-Filter Effect

The electrical nature of the i.f. units employed for the attainment of this selectivity is shown in Figure 3. It will be noted that four coils are employed, each wound with highly stranded litz wire and of suitable shape to secure the best possible performance factor. These coils are paired off into units of two each in separate shields. These dual units can be seen (Figure 2), at the rear of the chassis in the photograph of the new Hallicrafters' receiver recently introduced by the Silver Marshall Mfg. Co. Separate shields are used in order that there may not be any trace of coupling between the input and output coils, forcing the signal voltage through the link circuit. Any coupling between the coils L1 and L4 would, of course, destroy a certain amount of the inherent selectivity of the unit. Three of these units are used in the tuner unit of the receiver illustrated together with a single tuned coupler unit for transfer from the last i.f. tube to the diode and a.v.c. circuits.

This tuner is used with an amplifier that has a slight leakage reactance peak at about 4500 cycles so that the small side band cutting at the higher audio frequencies is offset almost completely with the result that the overall reproduction is unimpaired. This manner of compensation has been found to be much simpler than the necessary equalizer circuit necessary to compensate completely for the type of side band cutting shown in Curve A. Also, compensation in this manner permits an audio curve that drops off sharply beyond 5000 cycles so that a minimum of noise and tube rush is reproduced.

This type of i.f. unit has been used experimentally by several constructors, but this is believed to be the first use of it in commercial form. It was apparent throughouf the development of the unit that it would be possible to so proportion the circuit constants that a flattening of the response at frequencies near resonance would result. That the system has the properties of a band filter is rather apparent from an examination of Figure 4. Here the reactances of the circuit have been separated and thrown into equivalent form, it being assumed that the six coils equivalent to the arrangement of Figure 3 have no coupling between them. As shown in Figure 4, the system has the nature, from a circuit standpoint, of a recurrent system or of a filter. Analysis of the circuit has shown this to be the case. As a matter of fact, if the circuit constants are properly chosen, the evenly transmitted band can be extended for a wide audio range on either side of resonance, although at some sacrifice of selectivity on the adjacent channel. The final design, characteristics of which are shown in Curve B, Figure 1, was believed by the writer to represent the best characteristics possible with the system for a modern radio receiver operating at an i.f. frequency of 465 kc.

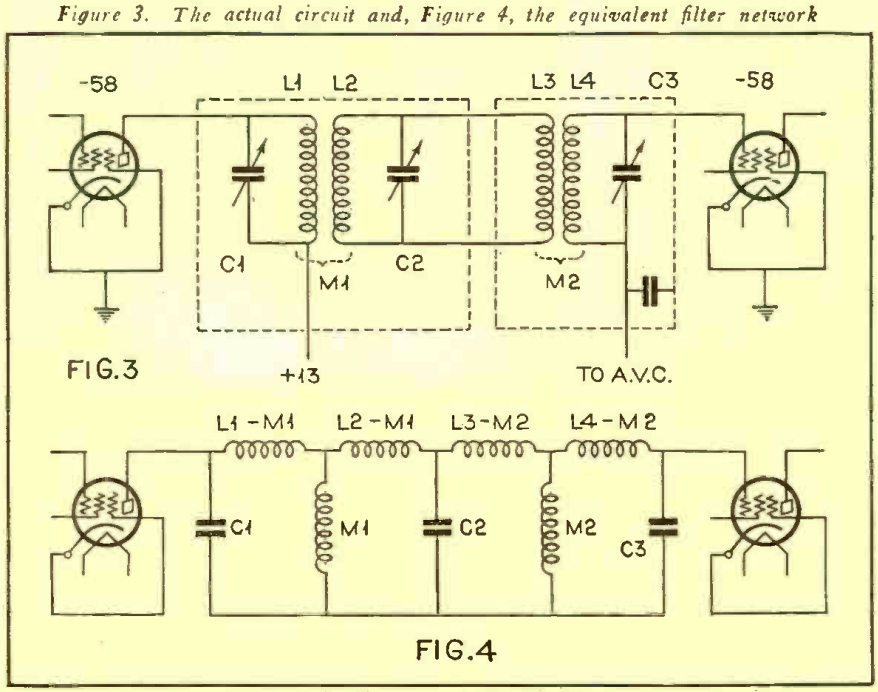
Noise Level Reduction

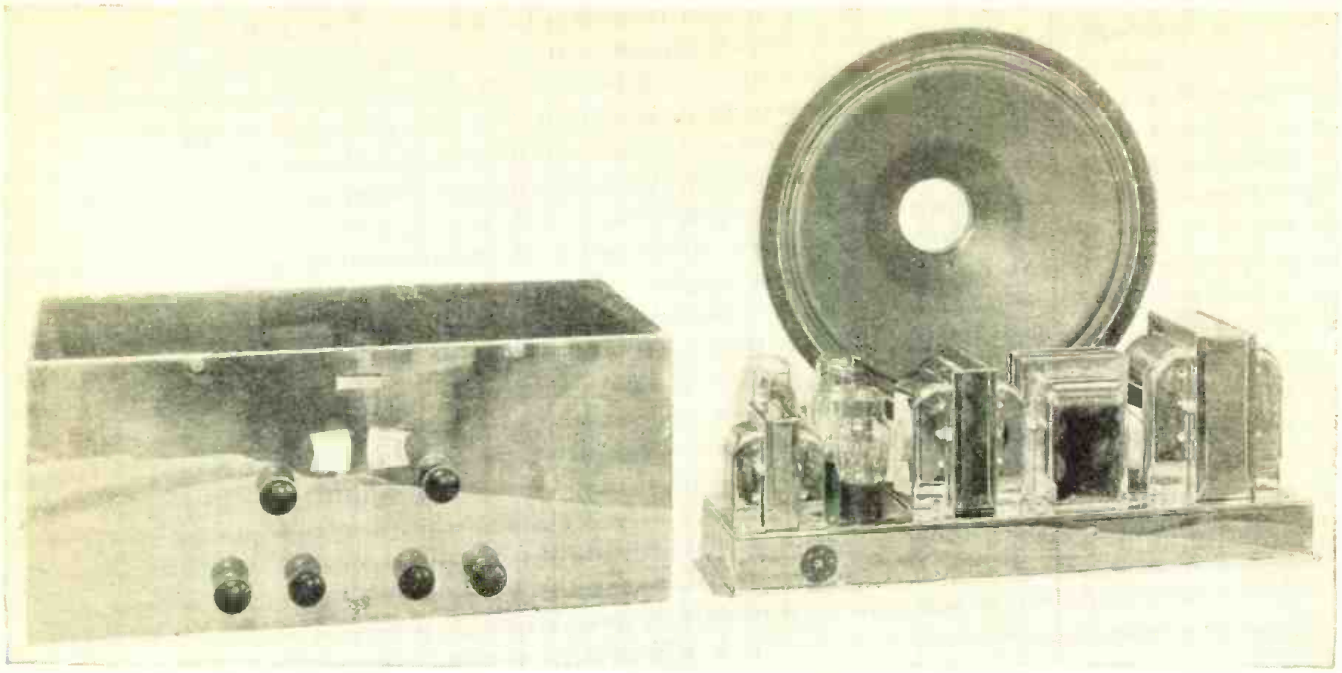
In operation, the tuner has displayed not only an enormous discrimination against interfering signals on the adjacent channel, but a marked reduction in the usual noise level as well. This, no doubt, is due to the selectivity curve, which cuts off severely above 5000 cycles and limits the amount of noise impulses to which the second detector is subjected. It is felt that this system embodies sufficient selectivity to cope with any conditions possible under the modern system of broadcasting.

It is of special importance that this degree of selectivity is obtained without sacrificing side bands, even to the extent normally expected in many of the receivers of today that actually show a lower degree of selectivity than do receivers incorporating the i.f. system described here. Obviously any receiving system which can demonstrate such a combination of characteristics as this may logically be considered a forward step in the quest for improved reception.

CIRCUIT OF ONE OF THE COUPLING UNITS

Figure 3. The actual circuit and, Figure 4, the equivalent filter network





THE COMPLETE 3-UNIT RECEIVER

Figure 1. The tuner chassis is completely enclosed in a chromium-plated case. The power unit and auditorium type dynamic speaker are also finished in chromium

1934 MODEL

Laboratory-Built Super

Employing the newest multiple function tubes, this improved model matches every accomplishment of last year's 15-tube model—and more—yet requires only 12 tubes to do it. Band spreading is an important added feature

[*By* McMurdo Silver]

SINCE the introduction in late October a year ago of the "Masterpiece," a 13 to 570-meter custom-built superheterodyne, these receivers have been put into use all over the world with uniformly gratifying results in all climates and in nearly every country on the globe. As a result of the acid test of operation in all sorts of climates and places, by varying types of users ranging from dyed-in-the-wool radio enthusiasts to the more ordinary type of listeners, a number of suggestions for improvement have been gleaned from a multitude of sources.

Hence, one year after the introduction of the Masterpiece, it has been felt, after analyzing carefully a cross-section of comments and suggestions, that certain mechanical changes could beneficially be made, and that certain simpler electrical means of attaining the same ends, which have been developed during 1933, might also advantageously be incorporated.

These changes are not essential design changes, in that they alter the results obtained scarcely at all; they are merely simplifications of an electrical and mechanical nature, calculated to render the results previously obtained easier to obtain, both for the novice and the experienced engineer alike.

Upon looking at Figure 1, two changes are outstanding. The first is the polished chromium shielding cabinet over the entire chassis. This contributes additional shielding over and above that provided by the individual circuit elements, helping to eliminate extraneous noise, and also keeping dust and dirt out of the set. It further permits of the most advantageous physical location of the parts upon the chassis in terms of electrical efficiency.

The second change referred to is in the use of two dials instead of a single tuning dial. The receiver is completely tuned by the right-hand dial and its single knob, as before. The second dial is simply a vernier, or band-spread tuning dial, to permit the short-wave bands such as the 6000, 9500 and 12,000 kc. short-wave broadcast bands being spread out over a whole full dial scale for easy tuning. It may likewise be used to spread the amateur bands for easy tuning—or even small segments of the broadcast band. It is purely a vernier, not a second tuning control. It need not be used at all in operating the set, yet its use makes for much easier tuning of the short-wave bands.

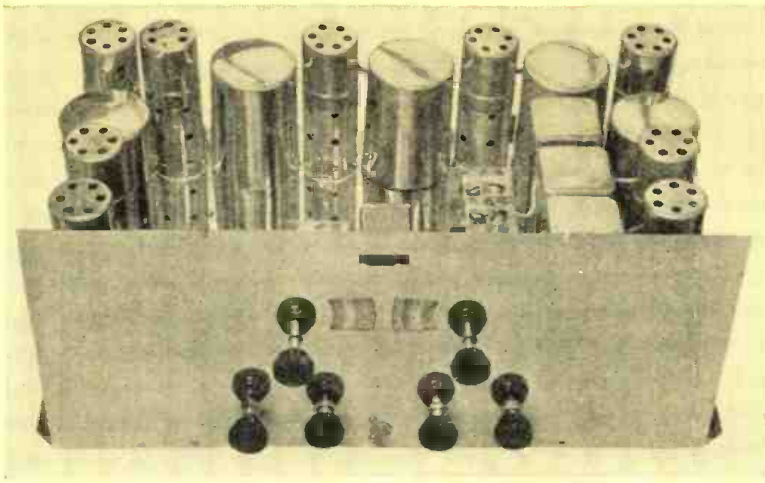
In the first receiver, tuning of the short-wave bands was made easy by a 28:1 dial ratio. This was necessarily slow in tuning over any large range, but even more important, did not permit of spreading the different short-wave stations far enough apart on the dial scale itself to make for easy visual reading. With this new band-spread dial, the main tuning dial need merely be set at, say, 6.2, for the 6000 kc. (50-meter) short-wave broadcast band, and all the stations in this band will be found spread out nicely on the vernier dial.

Any high-ratio tuning dial will necessarily be mechanically stiff, which does not render tuning easy. By the use of 6:1 automatic take-up gear drives with opposed gears (an equivalent of the beautifully smooth helical gear control), the mechanical operation not only is smooth and entirely free of slippage, wear or backlash, but the control knobs turn with delightful ease and absence of effort. Tuning is thus made faster, easier, simpler, and the dial calibration more readable. This simple mechanical change is invaluable, and in the hands of a novice can make all the difference between skipping over foreign short-wave stations or having them about as easy to find as broadcast-band stations.

Looking at the polished chromium front panel, the control knobs are: upper two, the main tuning knob and dial at the

right and the vernier or band-spread dial and knob at the left, with the visual tuning meter at the top center. The five lower controls are, left to right: audio volume level control, manual tone control, audio beat oscillator toggle switch, interstation noise suppressor or sensitivity control, and the four-position wave-change switch.

These controls all duplicate those on the original receiver, described in the February, 1932, issue of RADIO NEWS, except for the vernier tuning control mentioned above, the beat oscillator switch, which has been moved from the rear to the more easily accessible front panel, and the interstation noise-suppressor knob.



THE CHASSIS

Figure 2. The tuner is thoroughly shielded and well laid out, mechanically and electrically. Tuning is single control (upper right-hand knob). The band-spread control (to the left) is provided as a convenience to make tuning easy and is not an essential control

Because in any sensitive receiver having automatic volume control, sensitivity will rise to a maximum in the absence of a carrier signal, the local noise is bound to be heard between stations, and noise will be heard in between as the set is tuned from one station to another.

"Squelch" Circuit Dropped

In the earlier receiver, a special "squelch" tube was used, connected to function as a valve refusing all signals and noise below a useful level when it was switched in. By this means the set could be tuned from station to station with dead silence between stations when desired. This arrangement had two disadvantages: it required an extra tube, and its cut-off level had to be set at some arbitrary point—it could not easily be set to agree with the different local noise conditions found in different locations. Also, it was found that many stations constituting good noise-free entertainment would, in the course of their normal and continuous slight fading, fade across any arbitrarily established cut-off level, resulting in a periodic cut-off of reception, or if fading was rapid, in choppy distorted reception when the squelch circuit was in use.

The squelch circuit as a switch-like valve has been eliminated, therefore, and an r.f. sensitivity control substituted. This control can be adjusted to suppress any prevailing level of local noise, which is obviously advantageous and eliminates entirely the possibility of choppy reception of stations fading slightly across the cut-off level of any automatic squelch or valve circuit. It permits of adjustment of the r.f.-i.f. gain to the exact degree desired, and over all ordinary operating ranges, has no effect on the automatic volume control action, or on the operation of the audio volume-level control.

The elimination of the arbitrarily adjusted squelch tube, together with two new tubes recently introduced, permits of the elimination of a total of three tubes, allowing somewhat better results to be obtained than with the original fifteen at first employed.

The actual tube circuit line-up is: –58 r.f. stage, 2A7 combined first detector and electron-coupled oscillator, three –58 i.f. stages (the third stage used for selectivity, not for gain — its additional gain cannot be used), –56 diode second detector, –56 a.v.c. tube, –58 electron-coupled, audio-beat oscillator, –56 first audio stage, 2A3 push-pull Class A 15-watt power output stage and 5Z3 rectifier.

From the original tube complement it can be seen that the –56 oscillator and –57 first detector have been replaced by the 2A7 tube, which performs both functions with higher gain and the desirable frequency stability and uniform coupling of the electron-coupled oscillator. This one tube is eliminated and performance improved a bit. The next tube eliminated is the squelch tube, referred to previously.

The new 5Z3 high-vacuum rectifier, having twice the power capacity of the –80, allows one of the original two rectifiers to be dropped, thus effecting further simplification.

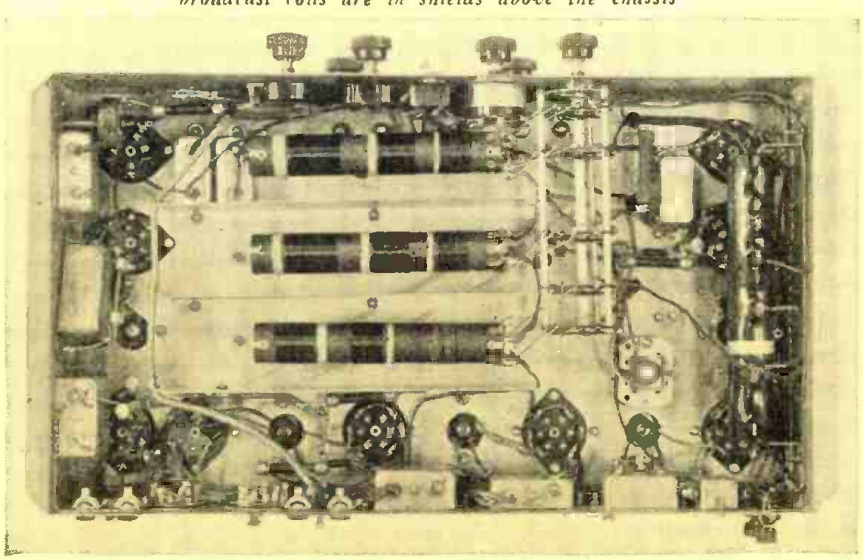
New Output Tubes

The 2A3 tubes possess the advantage of requiring no power from their driving stage, whereas the –45's Class A prime formerly used required power to drive them to full output, hence a pair of –56's in push-pull were required in the power driver stage. Through the use of a pair of 2A3's the maximum power output is increased 50%, a not very important consideration, as the difference between 10 and 15 watts is less than about 2 decibels, or the minimum variation ordinarily perceptible to the human ear. The important point, however, is that the 2A3's, requiring no driving power, may be fed by a single –56 voltage amplifier. Thus these new power tubes, doing a little better job, permit the elimination of one more tube—a not insignificant saving in power and cost.

The original Masterpiece had fifteen tubes, which are now seen to be cut to eleven more efficient ones as a result of the year's engineering advances—not radical advances, but merely progressive improvements—cost-saving steps in a cost-saving age.

UNDER THE CHASSIS

Figure 3. Here the base plate shield has been removed. The r.f., detector and oscillator coils for the three short-wave ranges are shown in the center. The broadcast coils are in shields above the chassis



Actually, the simplified and improved receiver uses twelve tubes, the twelfth being a –58 in the added tuned i.f. stage. This tube is added only because it is the simple and obvious means of coupling the two extra tuned circuits added to the i.f. amplifier to further improve selectivity, which is needed in Europe, where broadcast-band stations are separated by 9 kc. instead of 10 kc. This does (*Continued on page* 311)

Radio Call Book Section

Police and Fire Department Stations in the U. S.

Municipal Police Radio Stations

Call	Location	Kc.	Watts
KGJX	Pasadena, Calif.	1712	100
KGOZ	Cedar Rapids, Iowa	2470	50
KGPA	Seattle, Wash.	2414	250
KGPB	Minneapolis, Minn.	2430	400
KGPC	St. Louis, Mo	1712	500
KGPD	San Francisco, Calif.	2470	400
KGPE	Kansas City, Mo.	2422	400
KGPG	Vallejo, Calif.	2422	7.5
KGPH	Oklahoma City, Okla.	2450	250
KGPI	Omaha, Nebr.	2470	400
KGPJ	Beaumont, Texas	1712	100
KGPK	Sioux City, Iowa	2470	100
KGPL	Los Angeles, Calif.	1712	500
KGPM	San Jose, Calif.	2470	50
KGPN	Davenport, Iowa	2470	50
KGPO	Tulsa, Okla.	2450	100
KGPP	Portland, Ore.	2442	500
KGPQ	Honolulu, T. H.	2450	100
KGPS	Bakersfield, Calif.	2414	50
KGPW	Salt Lake City, Utah	2470	100
KGPX	Denver, Colo.	2442	150
KGPZ	Wichita, Kansas	2450	250
KGZA	Fresno, Calif.	2414	100
KGZB	Houston, Texas	1712	100
KGZC	Topeka, Kansas	2422	50
KGZD	San Diego, Calif.	2430	100
KGZF	Chanute, Kansas	2450	5
KGZG	Des Moines, Iowa	2470	100
KGZH	Klamath Falls, Ore.	2442	25
KGZI	Wichita Falls, Texas	1712	50
KGZJ	Phoenix, Arizona	2430	100
KGZM	El Paso, Texas	2414	100
KGZN	Tacoma, Wash.	2414	100
KGZO	Santa Barbara, Calif.(CP)	2414	100
KGZP	Coffeyville, Kansas	2450	50
KGZQ	Waco, Texas	1712	50
KGZR	Salem, Ore.	2442	25
KGZS	McAlester, Okla. (CP)	2450	50
KGZT	Santa Cruz, Calif. (CP)	2470	50
KGZU	Lincoln, Nebr. (CP)	2470	50
KGZV	Aberdeen, Wash. (CP)	2414	50
KGZW	Lubbock, Texas (CP)	2458	50
KSW	Berkeley, Calif.	2422	400
KVP	Dallas, Texas	1712	150
WCK	Belle Isle, Mich.	2414	500
WKDU	Cincinnati, Ohio	1712	500
WMDZ	Indianapolis, Ind.	2442	400
WMJ	Buffalo, N. Y.	2422	500
WMO	Highland Park, Mich.	2414	50
WPDA	Tulare, Calif.	2414	150
WPDB	Chicago, Ill.	1712	500
WPDC	Chicago, Ill.	1712	500
WPDD	Chicago, Ill.	1712	500
WPDE	Louisville, Ky.	2442	200
WPDF	Flint, Mich.	2442	100
WPDG	Youngstown, Ohio	2458	150
WPDH	Richmond, Ind.	2442	50
WPDI	Columbus, Ohio	2430	200
WPDK	Milwaukee, Wis.	2450	500
WPDL	Lansing, Mich.	2470	50
WPDM	Dayton, Ohio	2430	400
WPDN	Auburn, N. Y.	2458	50
WPDO	Akron, Ohio	2458	100
WPDP	Philadelphia, Pa.	2470	500
WPDR	Rochester, N. Y.	2458	200
WPDS	St. Paul, Minn.	2430	500
WPDT	Kokomo, Ind.	2470	50
WPDU	Pittsburgh, Pa.	1712	400
WPDV	Charlotte, N. C.	2458	50
WPDW	Washington, D. C.	2422	400
WPDX	Detroit, Mich.	2414	500
WPDY	Atlanta, Ga.	2414	150
WPDZ	Ft. Wayne, Ind.	2470	100
WPEA	Syracuse, N. Y.	2458	400
WPEB	Grand Rapids, Mich.	2470	400
WPEC	Memphis, Tenn.	2470	400
WPED	Arlington, Mass.	1712	100
WPEE	Brooklyn, N. Y.	2450	400
WPEF	Bronx, N. Y.	2450	400
WPEG	New York, N. Y.	2450	500
WPEH	Somerville, Mass.	1712	100
WPEK	New Orleans, La.	2430	100
WPEI	E. Providence, R. I.	1712	50
WPEM	Woonsocket, R. I.	2470	50
WPES	Saginaw, Mich.	2442	50
WPET	Lexington, Ky.	1712	200
WPFA	Newton, Mass. (CP)	1712	50
WPFC	Muskegon, Mich.	2442	50
WPFD	Highland Park, Ill. (CP)	1712	100
WPFE	Reading, Pa.	2442	100
WPFF	Toms River, N. J.	2430	50
WPFG	Jacksonville, Fla.	2442	100
WPFH	Baltimore, Md.	2414	500
WPFI	Columbus, Ga.	2414	50
WPFK	Hackensack, N. J.	2430	200
WPFM	Birmingham, Ala.	2414	150
WPFN	Fairhaven, Mass.	1712	100
WPFO	Knoxville, Tenn.	2470	250
WPFP	Clarksburg, W. Va. (CP)	2414	7.5
WPFQ	Swarthmore, Pa.	2470	50
WPFR	Johnson City, Tenn.	2470	50
WPFS	Asheville, N. C.	2458	100
WPFT	Lakeland, Fla. (CP)	2442	50
WPFU	Portland, Me. (CP)	2422	100
WPFV	Pawtucket, R. I. (CP)	2470	50
WPFW	Mt. Pleasant, N. Y. (CP)	2414	250
WPFX	Palm Beach, Fla. (CP)	2442	50
WPFY	Yonkers, N. Y. (CP)	2414	100
WPFZ	Miami, Fla. (CP)	2442	100
WPGA	Bay City, Mich. (CP)	2442	50
WPGB	Port Huron, Mich. (CP)	2414	50
WPGD	Rockford, Ill. (CP)	2458	50
WPGS	Mineola, N. Y. (CP)	2414	200
WRBH	Cleveland, Ohio	2458	500
WRDQ	Toledo, Ohio	2470	200
WRDR	Grosse Pointe Village, Mich.	2414	50
WPY	New York, N. Y. (Harbor Police)	438 & 500	200

State Police Radio Stations

KGHO	Des Moines, Iowa	1534	400
KGZE	San Antonio, Texas	2506	500
WBA	Harrisburg, Pa.	190	300
WBR	Butler, Pa.	190	300
WDX	Wyoming, Pa.	190	300
WJL	Greenburg, Pa.	190	500
WMB	W. Reading, Pa.	190	300
WMP	Framingham, Mass.	1574	1100
WPEL	Middleboro, Mass.	1574	1100
WPEW	Northampton, Mass. (CP)	1574	500
WPGC	S. Schenectady, N. Y.	1534	5000
WRDS	E. Lansing, Mich.	1574	1000

Marine Fire Radio Stations

KGPD	San Francisco, Calif.	1558	400
WEY	Boston, Mass.	1558	50
WKDT	Detroit, Mich.	1558	500

Police Stations (Municipal, State and Marine Fire)

(By Frequency)

190 kc.—1578 meters

WBA	Harrisburg, Pa.
WBR	Butler, Pa.
WDX	Wyoming, Pa.
WJL	Greenburg, Pa.
WMB	W. Reading, Pa.

438 kc.—684.5 meters

WPY	New York, N. Y.

500 kc.—599.6 meters

WPY	New York, N. Y.

1534 kc.—195.5 meters

WPGC	S. Schenectady, N. Y.
KGHO	Des Moines, Iowa

1558 kc.—192.5 meters

KGPD	San Francisco, Calif.
WEY	Boston, Mass.
WKDT	Detroit, Mich.

1574 kc.—190.5 meters

WMP	Framingham, Mass.
WPEL	Middleboro, Mass.
WPEW	Northampton, Mass. (CP)
WRDS	E. Lansing, Mich.

1712 kc.—175.1 meters

KGJX	Pasadena, Calif.
KGPC	St. Louis, Mo.
KGPJ	Beaumont, Texas
KGPL	Los Angeles, Calif.
KGZB	Houston, Texas
KGZI	Wichita Falls, Texas
KGZQ	Waco, Texas
KVP	Dallas, Texas
WKDU	Cincinnati, Ohio
WPDB	Chicago, Ill.
WPDC	Chicago, Ill.
WPDD	Chicago, Ill.
WPDU	Pittsburgh, Pa.
WPED	Arlington, Mass.
WPEH	Somerville, Mass.
WPEI	E. Providence, R. I.
WPET	Lexington, Ky.
WPFA	Newton, Mass. (CP)
WPFN	Fairhaven, Mass.

2414 kc.—124.2 meters

KGPS	Bakersfield, Calif.
KGZA	Fresno, Calif.
KGZM	El Paso, Texas
KGZN	Tacoma, Wash.
KGZO	Santa Barbara, Calif. (CP)
KGZV	Aberdeen, Wash. (CP)
WCK	Belle Isle, Mich.
WMO	Highland Park, Mich.
WPDA	Tulare, Calif.
WPDX	Detroit, Mich.
WPDY	Atlanta, Ga.
WPFH	Baltimore, Md.
WPFI	Columbus, Ga.
WPFM	Birmingham, Ala.
WPFP	Clarksburg, W. Va. (CP)
WPFW	Mt. Pleasant, N. Y. (CP)
WPFY	Yonkers, N. Y. (CP)
WPGB	Port Huron, Mich. (CP)
WPGS	Mineola, N. Y. (CP)
WRDR	Grosse Pointe Village, Mich.

2422 kc.—123.8 meters

KGPE	Kansas City, Mo.
KGPG	Vallejo, Calif.
KGZC	Topeka, Kansas
KSW	Berkeley, Calif.
WMJ	Buffalo, N. Y.
WPDW	Washington, D. C.
WPFU	Portland, Me. (CP)

2430 kc.—123.4 meters

KGPB	Minneapolis, Minn.
KGZD	San Diego, Calif.
KGZJ	Phoenix, Ariz.
WPDI	Columbus, Ohio
WPDM	Dayton, Ohio
WPDS	St. Paul, Minn.
WPEK	New Orleans, La.
WPFF	Toms River, N. J.
WPFK	Hackensack, N. J.

2442 kc.—122.8 meters

KGPP	Portland, Ore.
KGPX	Denver, Colo.
KGZH	Klamath Falls, Ore.
KGZR	Salem, Ore.
WMDZ	Indianapolis, Ind.
WPDE	Louisville, Ky.
WPDF	Flint, Mich.
WPDH	Richmond, Ind.
WPEB	Grand Rapids, Mich.
WPES	Saginaw, Mich.
WPFC	Muskegon, Mich.
WPFE	Reading, Pa.
WPFG	Jacksonville, Fla.
WPFT	Lakeland, Fla. (CP)
WPFX	Palm Beach, Fla. (CP)
WPFZ	Miami, Fla. (CP)
WPGA	Bay City, Mich. (CP)

2450 kc.—122.4 meters

KGPH	Oklahoma City, Okla.
KGPO	Tulsa, Okla.
KGPQ	Honolulu, T. H.
KGPZ	Wichita, Kansas
KGZF	Chanute, Kansas
KGZP	Coffeyville, Kansas
KGZS	McAlester, Okla. (CP)
WPDK	Milwaukee, Wis.
WPEE	Brooklyn, N. Y.
WPEF	Bronx, N. Y.
WPEG	New York, N. Y.
WPFD	Highland Park, Ill. (CP)

2458 kc.—122.0 meters

KGZW	Lubbock, Texas (CP)
WPDG	Youngstown, Ohio
WPDN	Auburn, N. Y.
WPDO	Akron, Ohio
WPDR	Rochester, N. Y.
WPDV	Charlotte, N. C.
WPEA	Syracuse, N. Y.
WPFS	Asheville, N. C. (CP)
WPGD	Rockford, Ill. (CP)
WRBH	Cleveland, Ohio

2470 kc.—121.4 meters

KGOZ	Cedar Rapids, Iowa
KGPD	San Francisco, Calif.
KGPI	Omaha, Nebr.
KGPK	Sioux City, Iowa
KGPM	San Jose, Calif.
KGPN	Davenport, Iowa
KGPW	Salt Lake City, Utah
KGZG	Des Moines, Iowa
KGZT	Santa Cruz, Calif. (CP)
KGZU	Lincoln, Nebr. (CP)
WPDL	Lansing, Mich.
WPDP	Philadelphia, Pa.
WPDT	Kokomo, Ind.
WPDZ	Ft. Wayne, Ind.
WPEC	Memphis, Tenn.
WPEM	Woonsocket, R. I.
WPFO	Knoxville, Tenn.
WPFQ	Swarthmore, Pa.
WPFR	Johnson City, Tenn. (CP)
WPFV	Pawtucket, R. I.
WRDQ	Toledo, Ohio

2506 kc.—119.7 meters

KGZE	San Antonio, Texas

(CP)—Construction permit.

RADIO PROGRAM FEATURES

AN OFFICIAL PROGRAM SERVICE

THE radio receiver is worth only what it receives. One of the main difficulties in broadcast listening is to determine just when the more popular programs are on the air. Most listeners miss as much as 50 percent of the worth-while programs for this reason. RADIO NEWS is therefore presenting this sixth instalment of a monthly broadcast schedule, listing day by day what is felt to be the most noteworthy programs on the air in the evenings, on Saturday afternoons and all day Sunday. The programs have been chosen by a committee of art, music and educational critics, as well as representative listeners. The programs listed are for the period of October 10th-November 10th inclusive. The listings include the name of the program, the time the program is on the air, the type of program, the name of the sponsor, the chain and the national stations through which it is transmitted. To use the lists one should refer to the day of the week and then run down the hours, marking off those programs you wish to listen to. If you want to find the time for a given program, the name of the program is shown in bold face and is easily picked out. The list is correct up to the day of going to press. Programs are sustaining, unless otherwise noted. All listings are in Eastern Standard Time. Deduct one hour for Central Standard Time, two hours for Mountain Standard Time, and three hours for Pacific Standard Time. All time is p.m. unless otherwise noted.

Compiled by

Samuel Kaufman

MONDAYS

5:00—SKIPPY. Drama. Sponsor: Sterling Products, Inc. CBS. WABC, WAAB, WGR, WDRC, WCAU, WEAN. Also, 6:00 WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:30—THE SINGING LADY. Nursery jingles, songs and stories. Sponsor: Kellogg Co. NBC. WJZ, WHAM, KDKA, WJR, WGAR, WLW, WBAL, WBZ, WBZA.

5:30—JACK ARMSTRONG, ALL-AMERICAN BOY. Drama. Sponsor: General Mills, Inc. CBS. WABC, WNAC, WGR, WDRC, WCAU, WEAN. Also, 6:30—WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:45—PAUL WING, THE STORY MAN. Children's program. Sponsor: General Foods Corp. NBC. WEAF, WGY, WWJ, WBEN, WTAM.

5:45—LITTLE ORPHAN ANNIE. Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, CRCT, CFCF.

6:45—THE KING'S HENCHMEN. Jane Froman and Charles Carlisle, vocalists. Fred Berrens Orchestra. Sponsor: Kings Brewing, Inc. CBS. WABC.

6:45—LOWELL THOMAS. News. Sponsor: Sun Oil Co. NBC. WJZ, WBZA, WHAM, WSYR, CRCT, WGAR, WBAL, WBZ, KDKA, WLW, WJR, WJAX, WIOD, WFLA.

6:45—GEORGE SCHERBAN'S RUSSIAN GYPSY ORCHESTRA. CBS. WOKO, WCAO, WNAC, WAAB, WKBW, WGR, WBBM, WHK, CKLW, WDRC, WCAU, WJAS, WEAN, WSPD, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, WTAQ, WLBW, WBIG, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WMBG, WDBJ, WHEC, KTSA, CFRB, WACO, WMT, KFH, WSJS, WORC, WKBN, WIP, KSL, KTRH, WDAE, WBT, KOH.

7:00—AMOS 'N' ANDY. Drama. Sponsor: Pepsodent Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WLW, WGAR, WMAL, CRCT, WRVA, WPTF, WIOD, WFLA. Also, 11:00—WMAQ, WENR, KWK, WREN, KOIL, WTMJ, KSTP, WSM, WMC, WSB, WSMB, KTHS, KDYL, WJR, WOAI, WKY, KOA, KGO, KFI, KGW, WHAM, WFAA, KOMO, KHQ, KPRC, WDAF, WCKY.

7:30—LUM AND ABNER. Sketch. Sponsor: Ford Dealers. NBC. WEAF, WFBR, WBEN, WGY, WTAM. (WLW on 7:45 to 8:00). WTAG, WEEI, WJAR, WCSH, WRC, WCAE. Also, 11:15—WENR, KSD, WOC, WHO, WDAF, WKBF, WTMJ.

7:30—RICHFIELD COUNTRY CLUB. With Grantland Rice, Betty Barthell, Mary McCoy, Double Quartet and Jack Golden's Orchestra. Sponsor: Richfield Oil Co. of N. Y. NBC. WJZ, WBZ, WBZA, WBAL, WHAM, KDKA, CRCT, WMAL, WSYR.

7:30—DOLPH MARTIN'S ORCHESTRA AND TRAVELERS' QUARTET. Sponsor: Tide Water Oil Co. CBS. WABC, WOKO, WCAO, WNAC, WGR, WDRC, WCAU, WJAS, WEAN, WFBL, WJSV, WLBZ, WHP, WFEA, WHEC, WORC, WICC.

7:45—THE GOLDBERGS. Drama. Sponsor: Pepsodent Co. NBC. WEAF, WEEI, WSAI, WENR, WOW, WTAG, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WDAF.

7:45—BOAKE CARTER. News. Sponsor: Phileo Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, WCAU, WJAS, WBT, WJSV, CKLW.

8:00—HAPPY BAKERS. Vocal trio. Piano accompanist. Sponsor: Continental Baking Corp. CBS. WABC, WADC, WNAC, WGR, WGN, WHK, CKLW, WDRC, WFBM, WSPD, WJSV, WICC, WCAH, WHEC, WORC, WKBN, WMAS.

8:00—SOCONYLAND SKETCHES. Drama. Sponsor: Standard Oil Co. of N. Y. NBC. WEAF, WTIC, WTAG, WEEI, WJAR, WCSH, WGY, WBEN.

8:30—THE SIZZLERS. Male trio. NBC. WEAF, WSMB, WKY, WCSH, WBEN, WTAM, WSAI, WMAQ, KSD, WOC, WHO, WOW, WTAG, WJAR, WFBR, KFYR, WDAF, WIS, WCAE, WSB, WIBA, WEBC, WJDX, KTBS, WOAI, WRC, WMC, KVOO, KOA, KDYL, KPO, CFCF, WWNC, WJAX, WIOD, WSM.

8:30—POTASH AND PERLMUTTER. Drama. Sponsor: Health Products Co. NBC. WJZ, WBAL, WMAL, WGAR, WCKY, WLS, WJR, WHAM, KDKA, WSYR.

8:45—FERDE GROFE'S ORCHESTRA WITH CONRAD THIBAULT. Sponsor: Philip Morris & Co. NBC. WEAF, WTIC, WCAE, WJAR, WCSH, WLIT, WGY, WBEN, WWJ, WMAQ, WTAM, WEEI, WFBR, WTMJ.

9:00—A. & P. GYPSIES. Sponsor: Great Atlantic & Pacific Tea Co. NBC. WEAF, WTIC, WTAG, WEEI, WJAR, WHO, WCSH, WLIT, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WMAQ, KSD, WOC, WOW, WDAF.

9:00—SINCLAIR GREATER MINSTRELS. Sponsor: Sinclair Refining Co. NBC. WJZ, WGAR, WSB, WLS, KWK, WREN, KWCR, KSTP, WEBC, WDAY, KFYR, WFAA, WRVA, WWNC, WIS, WJAX, WIOD, WMC, WFLA, WSM, WSMB, WJDX, WBZ, KPRC, WOAI, KTBS, WKY, KOIL, WBZA, WHAM, KDKA, WLW, KSO, KVOO, WTMJ, WIBA, WBAL, KOA.

9:30—JACK FROST MELODY MOMENTS. Sponsor: National Sugar Refining Co. NBC. WJZ, WBAL, WHAM, KDKA, WGAR, WLW, WJR, WENR.

9:45—THE WITCH'S TALE. Drama and music. WOR.

10:00—THE HOUR GLASS. Chorus and soloists. Orchestra directed by Harold Sanford. NBC. WJZ.

10:00—ANDRE KOSTELANETZ PRESENTS. Orchestra and vocal soloists. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WPG, WBRC, WICC, WDOD, KVOR, WCAH, KRLD, KLZ, WLBW, WBIG, WHP, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KTSA, WIBW, CFRB, WACO, KFH, WSJS, WORC, KSL, KTRH, WDAE, WBT, KOH.

10:30—GUS HAENSCHEN'S PARADE OF MELODY. Variety program. Sponsor: Buick-Olds-Pontiac Sales Co. NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WOC, WHO, KOA, WTIC, WLW, WTMJ, KSTP, WEBC, WSM, WSB, WMC, KVOO, KGO, WKY, WFAA, KPRC, WOAI, KGIR, KGHL, WMAQ, KSD, WOW, KOMO, KHQ, KDYL, KFI, KGW, WDAF, WIBA, KFYR.

10:30—LITTLE JACK LITTLE. Vocalist and pianist. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, CKLW, WDRC, WFBM, KMBC, WHAS, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, KLZ, WLBW, WBIG, WHP, WFEA, WREC, WCCO, WSFA, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KTSA, WIBW, CFRB, WACO, WMT, KFH, WSJS, WORC, WKBN, WIP, KSL, KTRH, WDAE, WBT, KOH.

10:45—HOWARD BARLOW'S SYMPHONY ORCHESTRA. CBS. WABC, WADC, WOKO, WCAO, WAAB, WGR, WHK, CKLW, WDRC, WFBM, KMBC, WHAS, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, KLZ, WLBW, WBIG, WHP, WFEA, WREC, WCCO, WSFA, WLAC, WDSU, WMBD, WMBG, WDBJ, WHEC, KTSA, WIBW, CFRB, WACO, WMT, KFH, WSJS, WORC, WKBN, WIP, KSL, KTRH, WDAE, WBT, KOH.

TUESDAYS

5:00—SKIPPY. Drama. Sponsor: Sterling Products, Inc. CBS. WABC, WAAB, WGR, WDRC, WCAU, WEAN. Also, 6:00—WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:30—SINGING LADY. Nursery jingles, songs and stories. Sponsor: Kellogg Co. NBC. WJZ, WBAL, WBZ, WBZA, WHAM, WJR, WLW, KDKA, WGAR.

5:30—JACK ARMSTRONG, ALL-AMERICAN BOY. Drama. Sponsor: General Mills, Inc. CBS. WABC, WNAC, WGR, WDRC, WCAU, WEAN. Also, 6:30—WCAO, WBBM, WKRC, WKH, CKLW, WJSV.

5:45—LITTLE ORPHAN ANNIE. Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, CRCT, CFCF.

6:30—MID-WEEK HYMN SING. Vocal soloists and organist. NBC. WEAF, WGY, WMAQ, WIS, KVOO, WOAI, WWNC, WIBA, KTBS, WSAI, KGIR, WJDX, KPO, KFYR, WDAY, KPRC, KDYL, KTHS, WFI, WTAG, WRC, WOC, WHO, WJAX, WFAA.

6:45—LOWELL THOMAS. News. Sponsor: Sun Oil Co. NBC. WJZ, WBZ, WBZA, CRCT, WJR, WBAL, KDKA, WGAR, WHAM, WLW, WSYR, WJAX, WIOD, WFLA.

7:00—AMOS 'N' ANDY. Drama. Sponsor: Pepsodent Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WLW, WMAL, CRCT, WIOD, WFLA, WRVA, WGAR, WPTF. Also, 11:00—WMAQ, KDYL, WDAF, KOIL, WTMJ, KSTP, WSM, WMC, WSB, WSMB, KTHS, WCKY, KPRC, WOAI, WKY, KOA, KGO, KFI, WHAM, KGW, KOMO, KHQ, WENR, KWK, WJR, WREN.

7:30—LUM AND ABNER. Sketch. Sponsor: Ford Dealers. NBC. WEAF, WFBR, WGY, WBEN, WTAM, WTAG, WRC, WEEI, WJAR, WCSH, WCAE, (WLW on 7:45-8:00). Also, 11:15—WFI, WENR, KSD, WOC, WHO, WTMJ, WDAF, WKBF.

7:45—**THE GOLDBERGS.** Drama. Sponsor: Pepsodent Co. NBC. WEAF, WTAG, WEEI, WJAR, WFI, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WCSH, WFBR, WSAI, WENR, WOW, WDAF.

7:45—**DON CARNEY'S DOG STORIES.** Sponsor: Spratt's Patent, Ltd. NBC. WJZ, WBAL, WMAL, KDKA, WBZ, WBZA, WGAR, WSYR, WHAM, WJR, WCKY, KYW.

7:45—**BOAKE CARTER.** News. Sponsor: Philco Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, WCAU, WJAS, WJSV, WBT, CKLW.

8:00—**BLACKSTONE PLANTATION. JULIA SANDERSON AND FRANK CRUMIT.** Sponsor: Waitt & Bond Co., NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WFI, WRC, WGY, WBEN, WCAE, WTAM, WWJ.

8:00—**ENO CRIME CLUES.** Mystery drama. Sponsor: Harold S. Ritchie & Co. NBC. WJZ, WBAL, WMAL, WBZ, WBZA, WHAM, KDKA, WGAR, WLW, WMAQ, KWK, WREN.

8:30—**WAYNE KING'S ORCHESTRA.** Sponsor: Lady Esther. NBC. WEAF, WTAG, WCAE, WTMJ, WEEI, WBEN, WJAR, WFI, WRC, WGY, WTAM, WCSH, WWJ, WSAI, KSD, WOC, WHO, WOW, KSTP, WMAQ, WDAF, WKY, KPRC, WOAI, WSMB, WSM, WSB, WMC.

8:30 — **HORLICK'S ADVENTURES IN HEALTH.** Talk by Dr. Herman Bundesen. Sponsor: Horlick's Malted Milk Co. NBC. WJZ, WBAL, WBZ, WBZA, WHAM, KDKA, WLS, KOIL, WREN, CRCT, WLW, KSO, WGAR. Also, 11:45—KGO, KGW, KOMO, KHQ, KOA, KDYL, KFI.

8:45—**POET'S GOLD.** Poetic Readings by David Ross. Music by Vincent Sorey's Orchestra. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WHK, CKLW, WDRC, KMBC, WHAS, WCAU, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WICC, WDOD, KVOR, WCAH, KRLD, WTAQ, WLBW, WBIG, WHP, KLRA, WFEA, WCCO, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, KTSA, WSBT, CFRB, WACO, WMT, WWVA, KFH, WSJS, WORC, WKBN, WJAS, WBT, KSL, WDAE, KOH, KTRH.

9:00—**BEN BERNIE'S BLUE RIBBON ORCHESTRA.** Sponsor: Premier Pabst Sales Co. NBC. WEAF, WBAP, WTMJ, WTAG, WEEI, WJAR, WCSH, KOA, KSD, WRC, WFBR, WFI, WGY, WBEN, WTAM, WCAE, WLS, WWJ, WOC, WHO, WLW, WOW, KSTP, WDAY, KFYR, WSM, WMC, WSMB, WKY, WOAI, KPRC, WRVA.

9:30—**TEXACO FIRE CHIEF PROGRAM.** Comedians, vocalists, orchestra. Sponsor: Texas Co. NBC. WEAF, WCSH, WFI, WJDX, WSMB, WRC, WFBR, WGY, WBEN, WJAR, WWJ, WEEI, WCAE, WTAM, WTAG, WMAQ, KDYL, KSD, WOW, WHO, WOC, WLW, WDAF, WIBA, KSTP, WEBC, WDAY, KFYR, WIS, WFLA, WRVA, WWNC, KFSD, WJAX, WIOD, KVOO, WMC, WKY, WOAI, KOA, KGIR, KGHL, KTAR, KTBS, KGO, KFI, KGW, KOMO, KHQ, WBAP, KPRC, WSM, WTMJ, WPTF, WSB.

9:30—**NINO MARTINI.** Songs. Music by Howard Barlow's Symphony Orchestra. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WHK, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WPG, WBRC, WDOD, KVOR, WCAH, KRLD, KLZ, WTAQ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, WHEC, KTSA, WIBW, CFRB, WACO, WMT, KFH, WSJS, WORC, WKBN, KSL, KTRH, WDAE, WBT, KOH.

10:00—**HOUSEHOLD MUSICAL MEMORIES.** Edgar A. Guest, poet. Vocalists and orchestra. Sponsor: Household Finance Corp. NBC. WJZ, WBZ, WBZA, WBAL, WHAM, KDKA, WMAQ, WJR, WREN, KSO, WSYR, KWK.

10:00—**LIVES AT STAKE.** Dramatic Sketch and Orchestra. Sponsor: General Tire & Rubber Co. NBC. WEAF, WTAG, WJAR, WCSH, WFI, KHQ, WRVA, WFBR, WRC, WGY, WBEN, WTAM, WLW, WENR, WCAE, WWJ, KSD, WOC, WHO, WDAF, WSB, WMC, WJDX, WKY, KOMO, WSMB, WBAP, KPRC, KTBS, KOA, KTHS, WOAI, KDYL, KGO, KFI, KGW, KVOO, WOW, WSM, WEEI.

10:45—**LIGHT OPERA GEMS.** Channon Collinge, conductor. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WHK, CKLW, WDRC, WFBM, KMBC, WHAS, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WPG, WBRC, WICC, WDOD, KVOR, WCAH, KLZ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WCCO, WSFA, WLAC, WDSU, WMBD, WMBG, WDBJ, WHEC, KTSA, WIBW, CFRB, WACO, WMT, WWVA, KFH, WSJS, WORC, WKBN, WIP, KTRH, KSL, WBT, WDAE, KOH.

WEDNESDAYS

5:00—**SKIPPY.** Drama. Sponsor: Sterling Products, Inc. CBS. WABC, WAAB, WGR, WDRC, WCAU, WEAN. Also, 6:00—WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:30—**SINGING LADY,** Nursery jingles, songs and stories. Sponsor: Kellogg Co. NBC. WJZ, WBZ, WBZA WBAL, WHAM, WJR, KDKA, WGAR, WLW.

5:30—**JACK ARMSTRONG. ALL AMERICAN BOY.** Drama. Sponsor: General Mills, Inc. CBS. WABC, WNAC, WGR, WDRC, WCAU, WEAN. Also, 6:30—WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:45—**PAUL WING, THE STORY MAN.** Children's program. Sponsor: General Foods Corp. NBC. WEAF, WGY, WWJ, WBEN, WTAM.

5:45—**LITTLE ORPHAN ANNIE.** Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, CRCT, CFCF.

6:30—**BACK OF THE NEWS IN WASHINGTON.** Political News Comment. NBC. WEAF, WJAR, WFBR, WRC, WWJ, WOC, WHO, KDYL, KFYR, WSM, WIS, WWNC, WIBA, WDAY, WGY, WSAI, WSB, WJDX, KVOO, KPO, WMAQ, KTHS, KPRC, KTBS, KOA, WOAI, KGIR, KGHL, WFAA.

6:45—**LOWELL THOMAS.** News. Sponsor: Sun Oil Co. NBC. WJZ, WBZ, WBZA, KDKA, WGAR, WHAM, WSYR, WLW, WBAL, WJR, CRCT, WJAX, WIOD, WFLA.

7:00—**AMOS 'N' ANDY.** Drama. Sponsor: Pepsodent Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WLW, CRCT, WMAL, WRVA, WPTF, WIOD, WGAR, WFLA. Also, 11:00—WMAQ, WENR, KWK, WREN, WDAF, KOIL, WFAA, KSTP, WSM, WMC, WSMB, KTHS, KPRC, WOAI, WKY, KOA, KGO, WJR, KGW, KFI, KDYL, KOMO, KHQ, WHAM, WCKY.

7:00—**MORTON DOWNEY.** Songs. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WHK, CKLW, WDRC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, KLZ, WTAQ, WLBW, WBIG, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WDBJ, WHEC, KTSA, CFRB, WACO, WMT, WWVA, KFH, WSJS, WORC, WKBN, WDAE, WBT, KOH, KSL, KTRH.

7:30—**LUM AND ABNER** Sketch. Sponsor: Ford Dealers. NBC. WEAF, WRC, WFBR, WGY, WBEN, WTAM, WTAG, WEEI, WJAR, WCSH (WLW on 7:45-8:00), WCAE. Also, 11:15—WLIT, KSD, WOC, WHO, WTMJ, WDAF, WKBF, WENR.

7:30—**DOLPH MARTIN'S ORCHESTRA AND TRAVELERS QUARTET.** Sponsor: Tide Water Oil Sales Co. CBS. WABC, WOKO, WCAO, WNAC, WGR, WDRC, WCAU, WJAS, WEAN, WFBL, WJSV, WLBZ, WHP, WFEA, WHEC, WORC, WICC.

7:45—**THE GOLDBERGS.** Drama. Sponsor: Pepsodent Co. NBC. WEAF, WTAG, WSAI, WEEI, WJAR, WCSH, WFBR, WLIT, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WENR, WOW, WDAF.

7:45—**BOAKE CARTER.** News. Sponsor: Philco Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, WCAU, WJAS, WJSV, WBT, CKLW.

8:00—**BERT LAHR AND GEORGE OLSEN'S ORCHESTRA.** Sponsor: Standard Brands, Inc. NBC. WEAF, WTIC, WTAG, WEEI, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WLS, KSD, WOW, WDAF, WOC, WHO, WCKY, CFCF, CRCT.

8:00—**ENO CRIME CLUES.** Mystery drama. Sponsor: Harold S. Ritchie & Co. NBC. WJZ, WBAL, WMAL, WBZ, WBZA, WHAM, KDKA, WGAR, WLW, WMAQ, KWK, WREN.

8:00—**HAPPY BAKERS.** Sponsors: Continental Baking Co. CBS. WABC, WADC, WNAC, WGR, WGN, WHK, CKLW, WDRC, WFBM, WSPD, WJSV, WICC, WCAH, WHEC, WORC, WMAS, WKBW.

8:15—**CURTAIN CALLS.** Mark Warnow's Orchestra and vocalists. CBS. WABC, WADC, WOKO, WCAO, WAAB, WGR, WHK, CKLW, WDRC, KMBC, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WPG, WBRC, WICC, WDOD, KVOR, WCAH, KRLD, WTAQ, WLBW, WBIG, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, WHEC, KTSA, WSBT, WIBW, CFRB, WACO, WWVA, WSJS, WORC, KTRH, WDAE, WBT, KOH.

8:30—**TERRAPLANE REVIEW.** Orchestra and vocalists. Sponsor: Hudson Motor Car Co. NBC. WEAF.

8:30—**POTASH AND PERLMUTTER.** Drama. Sponsor: Health Products Co. NBC. WJZ, WBAL, WMAL, WHAM, KDKA, WGAR, WCKY, WLS, WJR, WSYR.

9:00—**FERDE GROFE'S ORCHESTRA AND CONRAD THIBAULT, BARITONE.** Sponsor: Philip Morris & Co. NBC. WEAF, WTIC, WEEI, WJAR, WCSH, WLIT, WRC, WGY, WBEN, WCAE, WTAM, WMAQ, KSD, WDAF, WWJ, KSTP, WTMJ.

9:00—**IRVIN S. COBB AND AL GOODMAN'S ORCHESTRA.** Sponsor: Gulf Refining Co. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WKRC, WHK, CKLW, WDRC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WLBZ, WBRC, WBT, WDOD, WCAH, KRLD, WBIG, KTRH, KLRA, WFEA, WREC, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, KTSA, WTOC, WACO, WORC, WMAS, WGLC, WGL.

9:15—**VERA VAN.** Songs. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, KLZ, WTAQ, WLBW, WBIG, WHP, KLRA, WFEA, WISN, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, WHEC, KTSA, WBST, WIBW, CFRB, WACO, WMT, KFH, WSJS, WORC, KSL, WBT, KTRH, KOH, WDAE.

9:30—**WHITE OWL PROGRAM.** Burns and Allen; Guy Lombardo's Orchestra. Sponsor: General Cigar Co. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WGN, WKRC, WHK, CKLW, WOWO, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WBT, KRLD, KLZ, WBIG, KTRH, WCCO, KOMA, KSL, KTSA, WORC.

10:00—**CORN COB PIPE CLUB,** Sponsor: Larus & Bros. Co. NBC. WEAF, WTIC, WTAG, WCSH, WRC, WGY, WFBR, WLIT, WBEN, WTAM, WCAE, WENR, WWJ, WLW, KSD, WOC, WHO, WOW, WDAF, KOA, KGIR, KGHL, KGO, KFI, KGW, KOMO, WEEI, WJAR, KHQ, KDYL, WTMJ, WIBA, WEBC, WDAY, KFYR, KSTP, WRVA.

10:00—**OLD GOLD PROGRAM.** Fred Waring's Pennsylvanians. Songs and comedy. Sponsor: P. Lorillard Co. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WGN, WKRC, WHK, CKLW, WOWO, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, KERN, KMJ, KHJ, KOIN, KFBK, KGB, KFRC, KDB, KOL, KFPY, KWG, KVI, WGST, WPG, WLBZ, WBRC, WICC, WBT, WDOD, KVOR, WCAH, KRLD, KLZ, WLBW, WBIG, WHP, KTRH, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, KOMA, WMBD, KOH, WMBG, WDBJ, WHEC, KSL, KTSA, WTOC, WIBW, WMT, KFH, WORC, WMAS, WNAX, WKBH, KFOR.

10:30—**BOSWELL SISTERS.** Vocal trio. CBS. WABC, WADC, WOKO, WCAO, WKBW, WHK, CKLW, WDRC, WFBM, KMBC, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WDOD, KVOR, WCAH, KLZ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WCCO, WSFA, WLAC, WDSU, WMBD, WMBG, WDBJ, WHEC, KTSA, WSBT, WIBW, CFRB, WACO, WMT, KFH, WSJS, WORC, WBT, WDAE, KSL, KOH, KTRH.

11:00—**HOWARD BARLOW'S SYMPHONY ORCHESTRA.** CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, CKLW, WDRC, WFBM, KMBC, WHAS, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WCCO, WSFA, WLAC, WDSU, WMBD, WMBG, WDBJ, WHEC, KTSA, WIBW, CFRB, WACO, WMT, WSJS, WORC, WIP, KSL, WBT, KOH, WDAE, KTRH.

THURSDAYS

5:00—**SKIPPY.** Drama. Sponsor: Sterling Products, Inc. CBS. WABC, WAAB, WGR, WDRC, WCAU, WEAN. Also, 6:00—WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:30—**SINGING LADY.** Nursery jingles, songs and stories. Sponsor: Kellogg Co. NBC. WJZ, WBZ, WBZA, WBAL, WHAM, WLW, KDKA, WGAR, WJR.

5:30—**JACK ARMSTRONG, ALL AMERICAN BOY.** Drama. Sponsor: General Mills, Inc. CBS. WABC, WNAC, WGR, WDRC, WCAU, WEAN. Also, 6:30—WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:45—**LITTLE ORPHAN ANNIE.** Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, CFCF, KDKA, CRCT.

6:45—**LOWELL THOMAS.** News. Sponsor: Sun Oil Co. NBC. WJZ, WBAL, WBZ, WBZA, WJR, WSYR, KDKA, WGAR, WLW, CRCT, WHAM, WJAX, WIOD, WFLA.

7:00—**AMOS 'N' ANDY.** Drama. Sponsor: Pepsodent Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WLW, WMAL, CRCT, WRVA, WPTF, WIOD, WFLA, WGAR. Also, 11:00—WMAQ, WENR, KWK, WREN, WDAF, KOIL, WFAA, KTHS, KPRC, WOAI, WKY, KOA, KDYL, KGO, KFI, KGW, KOMO, KHQ, WSMB, KSTP, WSM, WMC, WSB, WHAM, WCKY, WJR.

7:00—**MORTON DOWNEY.** Songs. CBS. WABC, WADC, WOKO, WNAC, WGR, WHK, CKLW, WDRC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, KLZ, WTAQ, WLBW, WBIG, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WDBJ, WHEC, KTSA, CFRB, WACO, WMT, WWVA, KFH, WWJS, WORC, WKBN, WIP, KOH, KTRH, WBT, KSL, WDAE.

7:15—**COUNTESS OLGA ALBANI.** Songs. NBC. WEAF, WJAR, WMAQ, WSAI, KSD, WTAG, WFI, WBEN.

7:15—**BABY ROSE MARIE.** Songs. Sponsor: Tastyeast, Inc. NBC. WJZ, WBZ, WBZA, WBAL, WMAL, WSYR, KDKA.

7:30—**LUM AND ABNER.** Sketch. Sponsor: Ford Dealers. NBC. WEAF, WFBR, WRC, WBEN, WTAM, WTAG, WJAR, WCSH, WEEI, WGY, (WLW on 7:45-8:00), WCAE. Also 11:15—WENR, WDAF, KSD, WOC, WHO, WTMJ, WKBF.

7:45—**THE GOLDBERGS.** Drama. Sponsor: Pepsodent Co. NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WFI, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WENR, WOW, WDAF.

7:45—**BOAKE CARTER.** News. Sponsor: Philco Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, WCAU, WJAS, WJSV, WBT, CKLW.

8:00—**FLEISCHMANN HOUR—RUDY VALLEE AND GUEST STARS.** Sponsor: Standard Brands, Inc. NBC. WEAF, WTAG, WEEI, WCSH, WFI, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WMAQ, KSD, WOC, KDYL, WDAF, WHO, WOW, CRCT, CFCF, KSTP, WEBC, WDAY, WSM, WIOD, WJAX, WFLA, WMC, WAPI, WJDX, WJAR, WRVA, WSMB, WOAI, WKY, KOA, KFI, KGO, KGW, KOMO, WBAP (WTMJ on 8:30), KTHS, WPTF, WLW, WSB, KTAR, KFYR, KHQ, KPRC, KVOO.

8:00—**CAPTAIN DIAMOND'S ADVENTURES.** Dramatic sea story. Sponsor: General Foods Corp. NBC. WJZ, WBZ, WBZA, KDKA.

8:30—**HORLICK'S ADVENTURES IN HEALTH.** Talk by Dr. Herman Bundesen. Sponsor: Horlick's Malted Milk Co. NBC. WJZ, WBZ, WBZA, WBAL, WHAM KSO, WJR, KDKA, WLS, KOIL, WREN, KWK.

8:30—**COLUMBIA DRAMATIC GUILD.** CBS. WABC, WADC, WOKO, WCAO, WAAB, WGR, WHK, CKLW, WDRC, KMBC, WHAS, WCAU, WJAS, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WPG, WDOD, KVOR, WCAH, WTAQ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WCCO, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, KTSA, WSBT, CFRB, WACO, WMT, WWVA, KFH, WSJS, WORC, WKBN, KOH, WBT, WDAE, KTRH, KSL.

8:45—**THE ROLLICKERS.** Male quartet. NBC. WJZ.

9:00—**CAPTAIN HENRY'S MAXWELL HOUSE SHOW BOAT.** Charles Winniger, Lanny Ross, Annette Hanshaw, others. Sponsor: General Foods Corp. NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WFI, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WMAQ, KSD, WOC, WHO, WOW, WDAF, WTMJ, WRVA, WWNC, WIS, WJAX, WIOD, WFLA, WJDX, WMC, WSB, WAPI, WSMB, KTBS, WKY, KPRC, WOAI, WSM, WBAP, WCKY, KTSP. Also 1 A. M., Friday—KOA, KDYL, KGO, KFI, KGW, KOMO, KHQ, KFSD, KTAR.

9:00—**PRESENTING MARK WARNOW.** Vocalists and Mark Warnow's Orchestra. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WPG, WBRC, WICC, WDOD, KVOR, WCAH, WRLD, KLZ, WTAQ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, WHEC, KTSA, WSBT, CFRB, WACO, WMT, WWVA, KFH, WSJS, WORC, WKBN, KSL, KOH, WBT, WDAE, KTRH.

9:00—**DEATH VALLEY DAYS.** Drama. Sponsor: Pacific Coast Borax Co. NBC. WJZ, WBZ, WBZA, WJR, WLW, WLS, KOIL, WREN, KDKA, WBAL, WHAM, WGAR, KWK.

10:00—**AL JOLSON.** Songs and comedy. Paul Whiteman's Orchestra, vocal specialties. Sponsor: Kraft-Phenix Cheese Corp. NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WFI, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WLW, KSD, WMAQ, WOC, WHO, WOW (WDAF on 10:00-10:45), WTMJ, WIBA, KSTP, WEBC, WDAY, KFYR, WRVA, WPTF, WWNC, WIS, WJAX, WIOD, WFLA, WMC, WSB, WAPI, WJDX, WSMB, WKY, KTHS, WBAP, KTBS, KPRC, WOAI, KOMO, KOA, KDYL, KGO, KFI, KGW, KHQ, WSM.

10:00—**DEEP RIVER.** Willard Robison—"Evangelist of Rhythm." CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WPG, WBRC, WICC, WDOD, KVOR, WCAH, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, KTSA, WIBW, CFRB, WACO, WMT, KFH, WSJS, WORC, WKBN, KOH, WBT, KSL, WDAE, KTRH.

10:30—**TED HUSING AND LEON BELASCO.** Sponsor: General Motors Corp. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WBBM, WKRC, WHK, CKLW, WOWO, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WJSV, KERN, KMJ, KHJ, KOIN, KFBK, KGB, KFRC, KDB, KOL, KFPY, KWG, KVI, WGST, WLBZ, WBRC, WBT, WCAH, KLZ, KTAT, KTRH, WREC, WHAD, WCCO, WLAC, KOMA, WMBG, WHEC, KSL, KTSA, WIBW, WMT, KFH, KSCJ, WRR.

FRIDAYS

5:00—**SKIPPY.** Drama. Sponsor: Sterling Products, Inc. CBS, WABC, WAAB, WGR, WDRC, WCAU, WEAN. Also, 6:00—WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:30—**SINGING LADY.** Nursery jingles, songs and stories. Sponsor: Kellogg Co. NBC, WJZ, WBZ, WBZA, WBAL, WHAM, WJR, KDKA, WGAR, WLW.

5:30—**JACK ARMSTRONG, ALL-AMERICAN BOY.** Drama. Sponsor: General Mills, Inc. CBS. WABC, WNAC, WGR, WDRC, WCAU, WEAN. Also, 6:30—WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:45—**PAUL WING, THE STORY MAN.** Children's program. Sponsor: General Foods Corp. NBC. WEAF, WGY, WBEN, WTAM, WWJ.

5:45—**LITTLE ORPHAN ANNIE.** Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, CRCT, CFCF.

6:45—**LOWELL THOMAS.** News. Sponsor: Sun Oil Co. NBC. WJZ, WLW, WHAM, CRCT, WSYR, WGAR, WBZ, WBZA, KDKA, WJAX, WIOD, WFLA, WJR, WBAL.

7:00—**AMOS 'N' ANDY.** Drama. Sponsor: Pepsodent Co. NBC. WJZ, WBZ, WBZA, WBAL, KDKA, WLW, CRCT, WRVA, WPTF, WMAL, WFLA, WIOD, WGAR. Also, 11:00—WMAQ, WENR, KWK, WREN, WDAF, KOIL, KSTP, WSM, WMC, WSB, WSMB, WHAM, KTHS, WFAA, KPRC, WOAI, WHQ, WKY, KOA, KGO, KFI, KGW, KOMO, KDYL, WJR, WCKY.

7:00—**LUM AND ABNER'S OLD-TIME FRIDAY NIGHT SOCIABLE.** Sponsor: Ford Dealers. NBC. WTAG, WEEI, WJAR, WCSH. Also 10:30—WEAF, WLIT, WRC, WFBR, WGY, WBEN, WTAM, WENR, KSD, WOC, WHO, WTMJ, WKBF, WLW, WTIC, WCAE.

7:45—**THE GOLDBERGS.** Drama. Sponsor: Pepsodent Co. NBC. WEAF, WTAG, WENR, WOW, WEEI, WJAR, WCSH, WLIT, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WDAF, WFBR.

7:45—**BOAKE CARTER.** News. Sponsor: Philco Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, WCAU, WJAS, WJSV, WBT, CKLW.

8:00—**JESSICA DRAGONETTE AND THE CAVALIERS.** Sponsor: Cities Service Co. NBC. WEAF, WTIC (WGY off 8:30), WDAF, WBEN, WTAG, WOAI, WTAM, WWJ, WSAI, KYW, KSD, WOC, WHO, WOW, CRCT, KOA, KPRC, KTBS, (WTMJ, WRVA, on 8:30), WEBC, WKY, WFAA, WCSH, WCAE, WLIT, WFBR, WEEI, KDYL, WJAR, KVOO, KTHS, WRC.

8:00—**NESTLE'S CHOCOLATEERS.** Ethel Shutta, Walter O'Keefe and Don Bestor's Orchestra. Sponsor: Lamont Corliss & Co. NBC. WJZ, WBAL, WMAL, WBZ, WBZA, WSYR, WHAM, KDKA, WGAR, WCKY, WLS, KWK, WJR.

8:00—**HAPPY BAKERS.** Sponsor: Continental Baking Co. CBS. WABC, WADC, WNAC, WGR, WGN, WHK, CKLW, WFBM, WSPD, WJSV, WCAH, WICC, WHEC, WORC, WMAS, WDRC.

8:15—**KING ARTHUR AND ARABIAN KNIGHTS.** Don Voorhees Orchestra and soloists. Sponsor: Pioneer Ice Cream. WOR.

8:30—**GOLDENROD REVUE.** Julius Tannen and Phil Spitalny's Orchestra. Sponsor: Hittleman Goldenrod Brewery. CBS. WABC, WCAO, WNAC, WDRC, WCAU, WEAN, WLBZ, WICC, WFEA, WORC, WMAS.

9:00—**FRED ALLEN'S SALAD BOWL REVUE.** Fred Allen and his dramatic company. Ferde Grofe's Orchestra. Sponsor: Best Foods, Inc. NBC. WEAF, WTIC, WTAG, WEEI, WJAR, WCSH, WGY, WBEN, KSD, WTAM, WWJ, WRC, WFBR, WLIT, WMAQ, WLW. Also, 11:30—KOA, KGO, KGW, KHQ, KOMO, KDYL, KFI, KFSD, KTAR, WDAF.

9:00—**LET'S LISTEN TO HARRIS.** Phil Harris and his orchestra. Leah Ray, blues singer. Sponsor: Northam Warren Corp. NBC. WJZ, WBAL, WMAL, WBZ, WBZA, WSYR, KDKA, WGAR, WCKY, WLS, KWCR, KSO, KWK, WREN, KOIL, KGO, KFI, KGW, KOMO, KHQ, KOA, KDYL, KGIR, KGHL, WSM, WSB, WAPI, WSMB, WKY, WOAI, WFAA, CFCF, CRCT.

9:00—**IRVIN S. COBB AND AL GOODMAN'S ORCHESTRA.** Sponsor: Gulf Refining Co. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WKRC, WHK, CKLW, WGL, WDRC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WLBZ, WBRC, WBT, WDOD, WCAH, KRLD, WBIG, KTRH, KLRA, WFEA, WREC, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, KTSA, WTOC, WACO, WORC, WMAS, WGLC.

9:30—**POND'S PROGRAM.** Comedy and Songs. Sponsor: Lamont Corliss & Co. NBC. WEAF, WDAF, WWJ, WTAG, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WSAI, KSD, WOC, WHO, WOW, WMAQ, WTIC.

9:30—**PHIL BAKER.** Variety. Sponsor: Armour & Co. NBC. WJZ, WBAL, WBZ, WBZA, KDYL, KSO, WHAM, KDKA, WGAR, WJR, WMAQ, KWK, WREN, KOIL, WTMJ, KSTP, WEBC, WRVA, WWNC, WJAX, WIOD, WSM, WMC, WSB, WAPI, WSMB, WFAA, KPRC, WOAI, WKY, KOA.

9:30—**RICHFIELD COUNTRY CLUB.** With Grantland Rice, Betty Barthell, Mary McCoy, Double Quartet and Jack Golden's Orchestra. Sponsor: Richfield Oil Co. of N. Y. CBS. WABC, WOKO, WCAO, WNAC, WGR, WDRC, WCAU, WJAS, WEAN, WFBL, WJSV, WPG, WICC, WLBW, WHP, WHEC, WMAS.

10:00—**UNITED STATES NAVY BAND.** NBC. WEAF (WFBR off 10:15), WBEN, WWJ, WCAE, WENR, KSD, WOC, WHO, WOW, WDAF, WIS, WRVA, WWNC, WIOD, WFLA, CFCF (WRC, WJAX on 10:15).

10:00—**THE FIRST NIGHTER.** Drama. Sponsor: Campana Corp. NBC. WJZ, WBAL, WBZ, KDKA, WTMJ, WGAR, WEBC, KDYL, WSB, KGO, KFI, KGW, KOMO, KHQ, WKY, WFAA, WENR, WSM, WAPI, WSMB, WJR, WBZA, WOAI, KPRC, WCKY, WREN, KOIL, KSTP, KOA.

10:30—**BOSWELL SISTERS.** Vocal trio. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WHK, CKLW, WDRC, WFBM, KMBC, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WDOD, KVOR, WCAH, KLZ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WCCO, WSFA, WLAC, WDSU, WMBD, WMBG, WDBJ, WHEC, KTSA, WIBW, CFRB, WACO, WMT, KFH, WSJS, WORC, KSL, KTRH, WBT, WDAE, KOH.

SATURDAYS

2:30—**SAVITT STRING QUARTETTE.** CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WBBM, WHK, CKLW, WDRC, WFBM, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WPG, WBRC, WICC, WDOD, KVOR, WCAH, KLZ, WTAQ, WLBW, WHP, KFAB, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, WHEC, KTSA, WSBT, CFRB, WACO, WMT, WWVA, KFH, WSJS, WORC, WDAE, KTRH, WBT, KSL, KOH.

4:00—**WEEK-END REVUE.** Variety. NBC. WEAF, WTAG, WEEI, WJAR, WFBR, WRC, WGY, WTAM, WWJ, WMAQ, WSAI, WCAE, WDAF, WBEN, KSD (WOW, WLIT on 4:30), WHO (WFI off 4:30), WCSH, WOC.

5:30—**JACK ARMSTRONG, ALL-AMERICAN BOY.** Drama. Sponsor: General Mills, Inc. CBS. WABC, WNAC, WGR, WDRC, WCAU, WEAN. Also, 6:30—WCAO, WBBM, WKRC, WHK, CKLW, WJSV.

5:45—**LITTLE ORPHAN ANNIE.** Drama.

Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, CRCT, CFCF.

7:15—MILDRED BAILEY. Songs. CBS. WABC, WADC, WOKO, WCAO, WNAC, WAAB, WKBW, WGR, WBBM, CKLW, WDRC, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, KLZ, WTAQ, WLBW, WHIG, WHP, KFAB, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, KTSA, CFRB, WACO, WWVA, KFH, WSJS, WORC, KOH, KTRH, WBT, WDAE.

8:00—GOLDEN GLOW PROGRAM. Dr. Sigmund Spaeth, Shirley Howard, Louis Witten and Jack Denny's Orchestra. Sponsor: Liebmann Breweries, Inc. NBC. WJZ.

8:45—GERTRUDE NIESEN. Songs. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WHK, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WPG, WICC, WDOD, KVOR, KRLD, WTAQ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WMBG, KTSA, WSBT, WIBW, CFRB, WACO, WMT, WWVA, KFH, WSJS, WORC, KOH, KSL, KTRH, WBT, WDAE.

10:00—SATURDAY NIGHT DANCING PARTY. B. A. Rolfe's Orchestra. Sponsor: Hudson Motor Car Co. NBC. WEAF, WEEI, WJAR, WTAG, WCSH, WFI, WFBR, WGY, WBEN, WTAM, WCAE, WWJ, WLW, WMAQ, KSD, WOC, WHO, WOW, WDAF, WRC, CRCT, KSTP, WSB, WSMB, WBAP, KOA, KDYL, KGO, KFI, WTMJ, KOMO, WOAI, KGW, WRVA, WJAX.

SUNDAYS

11:00 A. M.—HORN & HARDART HOUR. Juvenile entertainers. Sponsor: Horn & Hardart Co. CBS. WABC.

11:15 A. M.—MAJOR BOWES' CAPITOL FAMILY. Variety. NBC. WEAF, WJAR, WFBR, WRC, WTAM, WDAF, WFLA, KFYR (WAPI, WHO, WOC off 11:45), WSMB, WTAG, KDYL, WEBC, WJAX, WFAA, WGY, WDAY, WSAI, KSTP, WMC, WIOD, WKY, KTBS, WOAI, WMAQ, WWNC, KPRC, KOA, WCAE, KVOO, WRVA.

12:30—RADIO CITY CONCERT. S. L. Rothafel (Roxy), master-of-ceremonies. Variety. NBC. WJZ, WBAL, WHAM, WGAR, WFLA, WLW, KDKA, KWK, WREN, KOIL, WJAX, WIOD, KFSD, WBZ, WBZA, CFCF, WDAY, KFYR, WSMB, KPRC, KOA, KDYL, WAPI, KTAR, KGO, KOMO, KHQ, WMAL, WEBC, WJDX, WIS, WSB, WCKY, KSO, WBAP, WOAI, KVOO, CRCT, WENR, KWCR, KSTP, WIBA, WMC, WJR, WMAQ, WSYR (KTHS off 1:00).

3:00—WAYNE KING'S ORCHESTRA. Sponsor: Lady Esther. NBC. WEAF, WTAG, WEEI, WCSH, WLW, KOMO, WRC, WGY, WBEN, WCAE, WTAM, WWJ, KSD, WOC, WHO, WOW, WJAR, WTMJ, KSTP, KGW, KHQ, KVOO, KDYL, WKY, WOAI, KPRC, WFAA, KOA, KGO, WLIT, KFI, WLS.

3:00—SYMPHONIC HOUR. Howard Barlow's Symphony Orchestra. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WHK, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WICC, WDOD, KVOR, WCAH, KLZ, WTAQ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WISN, WCCO, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KTSA, WSBT, WIBW, CFRB, WACO, WMT, KFH, WSJS, WORC, WKBN, WBT, WDAE, KOH.

4:00—CATHEDRAL HOUR. Channon Collinge conducting orchestra, choir and soloists. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WHK, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, KRLD, KLZ, WTAQ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WISN, WCCO, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KTSA, WSBT, WIBW, CFRB, WMT, KFH, WSJS, WORC, WKBN, KTRH, KSL, WBT, WDAE, KOH.

5:00—WILLARD ROBISON SYNCOPATED SERMONS. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WHK, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WICC, WDOD, KVOR, WCAH, KLZ, WTAQ, WHP, WLBW, WBIG, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KTSA, WSBT, WIBW, CFRB, WMT, WWVA, KFH, WSJS, WORC, WKBN, KTRH, WBT, WDAE, KOH.

5:30—FRANK CRUMIT AND JULIA SANDERSON. Songs. Sponsor: General Baking Co. CBS. WABC, WADC, WOKO, WCAO, WAAB, WGR, WHK, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WEAN, KMOX, WFBL, WSPD, WJSV, WICC, WCAH, KFAB, WDSU, WTAR, KOMA, WHEC, WWVA, KFH, WORC, WMAS.

6:00—CATHOLIC HOUR. NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WIOD, WEBC, KFYR, WRVA, WOAI, WSAI, WOC, WHO, WOW, WDAF, WIBA, WFLA, WSM, WMC, WSMB, WKY, KOA, KGHL, WJDX, WBAP, KPRC, WWNC, KGIR, KTAR, KPO, WAPI, WJAX, WIS, WSB, KTBS, KDYL, KECA, KGW, KOMO, WENR, KSTP, KVOO, WDAY.

7:30—JOHN HENRY—BLACK RIVER GIANT. Drama. CBS. (First Part.) WABC, WADC, WOKO, WCAO, WNAC, WGR, WBBM, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WDOD, KVOR, WCAH, KLZ, WTAQ, WLBW, WHP, WBIG, KLRA, WFEA, WREC, WISN, WCCO, WSFA, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KTSA, WIBW, WACO, WMT, WWVA, KFH, WSJS, WORC, WKBN, WBT, WDAE, KOH, KSL, KTRH.

8:00—CHASE & SANBORN HOUR. Stage stars; songs and humor. Dave Rubinoff's Orchestra. Sponsor: Standard Brands, Inc. NBC. WEAF, WTIC, WTAG, WIOD, WFLA, WMC, WJDX, KTAR, WBEN, WCAE, WTAM, WWJ, WLW, KSD, WOC, WHO, WDAF, CFCF, WSB, KFYR, WWNC, WIS, KDYL, KPRC, WKY, CRCT, WTMJ, KSTP, WEBC, WDAY, KVOO, WFAA, WOAI, KOA, KGO, KFI, WFBR, WRC, WGY, KGW, KOMO, KHQ, WPTF, WSM, WOW, WJAR, WCSH, WMAQ, WRVA, WAPI, KTHS, WSMB, WJAX, WLIT.

8:15—JOHN HENRY—BLACK RIVER GIANT. Drama. CBS. (Second part.) WABC, WADC, WOKO, WCAO, WNAC, WGR, WBBM, CKLW, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WDOD, KVOR, WCAH, KLZ, WTAQ, WLBW, WBIG, WHP, KLRA, WFEA, WREC, WISN, WCCO, KTSA, WLAC, WDSU, WTAR, WDBJ, WHEC, KSL, WIBW, CFRB, WACO, KFH, WSJS, WORC, WKBN, KTRH, KOH, WBT, WDAE.

8:30—CHOIR INVISIBLE. Orchestra directed by George Shackley; vocal soloists and poet. WOR.

9:00—MANHATTAN MERRY-GO-ROUND. Orchestra and vocalists. Sponsor: R. L. Watkins Co. NBC. WEAF, WTIC, WJAR, WFBR, WRC, WGY, WWJ, WSAI, WENR, KSD, WOC, WHO, WOW, WDAF, KHQ, KOA, KDYL, KGO, KFI, KGW, KOMO, WFI, WTAM.

9:00—GULF HEADLINERS. Sponsors: Gulf Refining Co. NBC. WJZ, WBAL, WBZ, WBZA, WHAM, WGAR, WJR, WLW, WSYR, WMAL, WRVA, WPTF, WWNC, WJDX, WSMB, KTHS, WFAA, KTBS, WJAX, KPRC, WOAI, KDKA, WIS, KVOO, WFLA, WSM, WMC, WSB, WIOD.

9:30—AMERICAN ALBUM OF FAMILIAR MUSIC. Orchestra and vocalists. Sponsor: Bayer Co. NBC. WEAF, WTAG, WEEI, WCKY, WJAR, WCSH, WFI, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, KSD, WSAI, WENR, WOC, WHO, WOW, WIOD, WFLA, WMC, WSB, WOAI, WJDX, WFAA, KFI, KGW, KOMO, KHQ, WSMB, KDYL, WKY, KOA, KPRC, KGO, WDAF, KVOO, WRVA, WJAX, WTMJ, KSTP, WPTF, CFCF, CRCT, WSM.

Our "Uncle Sam" Says

LOWELL THOMAS causes NBC production men much worry by walking out of the studio just before air time. He always manages to get back just as the announcement is being concluded. . . . Since the return of beer, the networks have been signing up many big breweries as sponsors. . . . Jeff Sparks, former NBC announcer, is on the production staff of WLW. The Cincinnati station has been signing up many big-name chain artists. . . . James Wallington has appeared as straight man for so many air comics that he can't remember them all. . . . WNYC, New York's municipal transmitter, gets some of its programs from NBC and WOR. . . . Major Edward Bowes, impresario of the Capitol Family program on NBC, will direct the new full-time station being built in New York by the Loew and Metro-Goldwyn-Mayer theatrical and motion picture interests; the new station is the result of merging WHN, WPAP, WQAO and WRNY. . . . Will Rogers and Fred Stone made a grand radio team on their recent Gulf Headliners program. . . . Sayle Taylor, better known as "The Voice of Experience" on CBS, recently appeared on a Brooklyn vaudeville stage. . . . Taylor Holmes is one of the most unfunny "comedians" ever to get a big-time air spot. . . . There is strong indication that some of the NBC Radio City studios will be opened in October, although no definite announcement has been made up to the time of this writing. . . . Sigmund Spaeth, the Tune Detective, is a very versatile fellow, indeed; he recently served as an NBC tennis announcer and appeared in a stage show in the Radio City Music Hall. . . . Willie and Eugene Howard, frequently heard as guest air comics, have one of the most hilarious comedy styles. . . . George M. Cohan, on the Gulf Headliners program, recently mentioned Ed Wynn in a song review. It is not unusual for artists to mention contemporaries, but in this instance Wynn happened to be sponsored by Texaco, a rival of Cohan's sponsor. . . . It seems that many sponsors are reviving mail-baiting ideas. . . . New York's de luxe movie theatres are heavily featuring personal appearances of radio stars. . . . Networks anticipate one of the most elaborate football broadcast schedules for this Fall. . . . Swanee Taylor, a former WOR man, is teaching many radio celebrities how to fly.

LEON BELASCO

ETHEL SHUTTA

FRED ALLEN

Personal interviews with broadcast artists and executives

Backstage in

By Samuel

THE Columbia Broadcasting System recently launched two new series sponsored by subsidiaries of the General Motors Company. They are the Oldsmobile and Pontiac programs, each heard twice weekly. The Oldsmobile series, heard Tuesday and Thursday evenings, features Ted Husing's sport talks, Leon Belasco's Orchestra, Barbara Maurel, contralto, and the Hummingbirds Quartet. The Pontiac programs, presented Tuesday and Thursday afternoons, feature Don Ross, baritone. Ted Husing, who recently launched his own sports series on CBS, also discusses athletics on the Oldsmobile programs. Leon Belasco's Orchestra is already well known to CBS audiences for programs from the St. Moritz Hotel, New York. Belasco is also heard in special vocal bits. Miss Maurel has been a staff vocalist with CBS for four years and has been featured on many commercial programs. The Hummingbirds Quartet is also well known to radio audiences for past performances. Listeners might be interested to know that Don Ross is the husband of Jane Froman, also a CBS vocalist. Ross has been heard over the air from Chicago as a member of the harmony team of Brooks and Ross. As a soloist, Ross was presented over WTAM, Cleveland, and WLW, Cincinnati.

FRED ALLEN, one of the few radio comics who manage to keep away from old wheezes and gags, is back on the air as the star of the new Best Foods Revue over NBC Friday nights. Allen replaces the Tom Howard series. Ferde Grofe, eminent composer and arranger of modern American music, directs the orchestra on the half-hour feature. Allen has built up an excellent supporting cast for his comic capers. Portland Hoffa, his wife, does the chief straight rôle opposite him. Roy Atwell, stuttering comedian, has a major part in the show. The Allen-Hoffa-Atwell combine was featured on last season's CBS Linit series. A large company of dramatic artists is used on each broadcast. Phil Duey, baritone, is the featured vocal soloist on the programs.

GLADYS RICE, a soprano member of the original Roxy Gang and a familiar personality to light opera, vaudeville and radio audiences throughout the United States, is now featured on two weekly CBS periods. Monday nights, she is heard on "Andre Kostelanetz Presents" while on Thursdays she appears with Howard Barlow's Orchestra. She is the daughter of Sally Cohen and John Rice, a famous vaudeville team of a generation ago. Most of her life has been identified with the theatre. She has appeared in several motion pictures. On Mondays she sings solos and ensemble numbers with the Columbia Mixed Chorus and the Andre Kostelanetz Orchestra. Her Thursday programs with Barlow's Orchestra are devoted primarily to musical comedy, light opera and popular works.

PHIL HARRIS and his orchestra recently arrived in New York from Los Angeles and were received with wide acclaim in radio circles. It seems that Phil has the makings of a new sensation. Many fans predict that he will duplicate the personality success of Rudy Vallee. Harris has the type of voice that points toward a successful broadcasting career. His talking picture appearances in "So This Is Harris" and "Melody Cruise"

AT RIGHT:
"GINGER" BAKER

CENTER:
LEAH RAY

LEFT:
GLADYS RICE

PHIL REGAN

ARLENE JACKSON

FERDE GROFE

Broadcasting

Chatty bits of news on what is happening before the microphone

Kaufman

certainly created many new followers. We are told that Rudy Vallee himself selected Harris to succeed him on the Pennsylvania Roof in New York. Harris's arrival in New York after his spectacular rise in radio and talkies on the West Coast was celebrated by a gala opening night on the Pennsylvania Roof. His NBC program that night was augmented by special "Welcome to Harris" broadcasts by other dance bands. The orchestras of Ben Bernie, Jack Denny, Vincent Lopez, Meyer Davis and Buddy Rogers paid musical tribute to the young Californian's opening. Radio, movie and theatrical celebrities turned out en masse for the Harris New York premiere. In addition to his sustaining dance music and vocal programs, Harris is featured with his singing partner, Leah Ray, on a Friday night commercial program sponsored over NBC by the Northam Warren Corporation.

WALTER O'KEEFE, master of ceremonies of the erstwhile Lucky Strike programs, and Ethel Shutta, popular songstress, have been teamed to head the new Nestlé series heard over NBC on Friday nights. Although both artists established their radio reputations through past microphone efforts, this series marks the first time the pair is heard together. Their routine consists of comedy dialogue and songs. Don Bestor's Orchestra, long a radio dance favorite, supplies the instrumental background for the new series. O'Keefe was recruited from the Broadway musical stage. He has made many vaudeville and night club appearances and is the author of many of the sketches and songs he presents on the air. Miss Shutta is the wife of George Olsen, the conductor, and appeared on many programs with him in the past. She also established a following on the stage and screen. She was seen in both the stage and talkie versions of "Whoopie" and was featured in Ziegfeld's production of "Louis the Fourteenth."

PROMINENT among Philadelphia's contributions to the CBS schedule is the daytime script and song program known as Bill and Ginger. The series is heard Monday, Wednesday and Friday mornings as a sponsored feature and Tuesday and Thursday mornings as a sustaining program. Lyn Murray, the "Bill" of the program, was born in London in 1909. He came to America eight years ago, his family settling in Philadelphia. He tried various occupations, including seamanship, reporting and organ and piano playing. After serving as a theatre organist and a night club pianist, he launched his radio career over a Virginia station. He joined the staff of WCAU, the CBS Philadelphia outlet, over a year ago. With Virginia Baker, a WCAU vocalist, he inaugurated the Bill and Ginger series over the CBS. Murray also arranges music for other performers at WCAU, serves as studio accompanist and presents his own local pro-

(*Continued on page* 315)

AT LEFT:
VERA VAN

CENTER:
GUSTAVE
HAENSCHEN

RIGHT:
BARBARA MAUREL

Technical Review

RADIO SCIENCE ABSTRACTS

Radio engineers laboratory and research workers will find this department helpful in reviewing important current radio literature, books, Institute and Club proceedings and free technical booklets

Conducted by

Joseph Calcaterra

Radio Service Questions and Answers; Volume 1, by John F. Rider. Radio Treatise Co., 1933. This book should be of considerable help to the serviceman (especially the beginner) who wishes to know how to go about the more complex adjustments and repairs of modern receivers. Mr. Rider describes in detail the procedure of neutralizing receivers, aligning t.r.f. sets, superheterodynes, etc. In the answer to each question he tells what equipment is needed. Some of the chapter headings are: Neutralization and Alignment; General Receiver Questions; Oscillators; Excessive Regeneration or Oscillation; Fading; Condensers and Replacement; Resistors and Replacement; Vacuum Tubes; Selectivity.

Perpetual Trouble Shooter's Manual, Volume III, by John F. Rider. Radio Treatise Co. No serviceman needs to be introduced to Rider's Trouble Shooter's Manual. Consistent with the promise of last year, a new volume has appeared. Volume 3 contains schematic diagrams, picture diagrams and resistance data on an entirely new group of receivers (hundreds of them), none of which is a duplication of any published in Volumes 1 and 2. The new volume contains more data on resistance volume and condenser sizes than the previous ones. In many cases information on the adjustment of the receivers are given. A complete index of all receivers appearing in all three books comes with Volume 3. This shows, for every model, on what page and in what volume one can find it, and it tells whether or not the diagram gives resistance values and other data. No serviceman can afford to be without these manuals, since there is no other book of the same scope.

28 Tested Methods for Making Extra Money. National Radio Institute. Radio has become so complex that many servicemen lose sight of the simpler jobs which can be done profitably by the average radio man. In this booklet, prepared by a well-known correspondence school, 28 rather simple jobs are described in detail. Pictures are shown of the equipment so that one can hardly go wrong. An example of the kind of jobs included are: installation of a receiver in the home; installing noise filters; installing noise-reducing antennas; adding tone control; adding loudspeakers; operating 25-cycle sets on 60 cycles; running a.c. receivers on d.c., etc. We call special attention to the first job. The different possible locations of a receiver are shown and their merits are discussed from an acoustical as well as electrical standpoint.

Les Récepteurs Radiophoniques Modernes à la Portée de Tous (Modern Radiophone Receivers Within the Reach of All), by Franck Duroquier. A practical book for the man who wishes to build his own receiver. Approximately 16 different receivers are described, varying from the crystal set to the superheterodyne. Constructional details are given for each. The receivers are designed for service in Europe; they cover the long wave-bands in addition to our broadcast band; some cover short waves. Regeneration is used in the majority of cases and one tuned r.f. amplifier stage seems to be the limit. Shielding is incomplete or entirely absent.

Review of Articles in the August, 1933, Issue of the Proceedings of the Institute of Radio Engineers

The Application of Graphite as an Anode Material to High Vacuum Transmitting Tubes, by E. E. Spitzer. The advantages of graphite over other materials in the construction of anodes for high-vacuum transmitting tubes is discussed in this paper. Its higher radiation emissivity results in lower glass temperatures and less danger of glass electrolysis and strain cracking. It also avoids anode warping, with consequent improvement in electrical uniformity of tubes.

A Life Test Power-Supply Utilizing Thyratron Rectifiers, by H. W. Lord. This paper outlines the advantages of a thyratron rectifier power supply for radio transmitting tube life test racks over a motor-generator type of power supply.

Determination of Grid Driving Power in Radio-Frequency Power Amplifiers, by H. P. Thomas. In this paper, an approximate method of determining the power required to drive the grid circuit of a vacuum-tube power amplifier of the Class C type, when operating at radio frequencies is developed, and a comparison is given between the results obtained by this method, and more exact measurements made at 60 cycles.

Amplitude Characteristics of Coupled Circuits Having Distributed Constants, by Ronald King. A description of a general solution for the amplitude characteristics (resonance curves) for bridge-coupled circuits having distributed line constants is obtained and applied to typical circuit arrangements.

Frequency Modulation and the Effects of a Periodic Capacity Variation in a Non-Dissipative Oscillatory Circuit, by W. L. Barrow. This paper develops certain fundamental characteristics of the theory of frequency modulation for arbitrarily large degrees of modulation and unrestricted modulation frequencies from the differential equation for a dissipationless circuit with fixed inductance and variable capacitance.

Review of Contemporary Literature

Seeing Sound at the Chicago Exposition, by R. F. Mallina. Bell Laboratories Record, August, 1933. A description of the principle of operation of the oscilloscope and the method developed by the Bell Laboratories to make an oscilloscope in which the images can be observed by a large gathering of people.

Carrier on Cable. Bell Laboratories Record, August, 1933. A brief description of the methods employed to make possible the use of carrier telephony to telephone circuits.

The 13A—A Radio Receiver for Diversified Uses, by H. T. Budenbom. Bell Laboratories Record, August, 1933. This article gives a description of the circuit and construction of a receiver developed by the Bell Laboratories for the Tropical Radio Tele-

graph Company. The receiver is a sensitive superheterodyne operating from the usual 110 to 120-volt supply system at any frequency from 50 to 60 cycles.

A Radio Transmitter for Central American Service, by J. G. Nordahl. Bell Laboratories Record, August, 1933. A description of the 9-type transmitter, designed as the ground station transmitter for airplane service, which also meets the requirements of low-cost, high-quality transmission required for comparatively moderate distances.

A Fast and Economical Type of Photographic Oscillograph, by C. S. Draper and D. G. C. Luck. The Review of Scientific Instruments, August, 1933. This article contains a description of a recording oscillograph by means of which records which require moderate or high film speeds over a relatively long period of time can be obtained economically.

Distortion Cancellation in Audio Amplifiers, by W. Baggally. The Wireless Engineer and Experimental Wireless, August, 1933. A method of amplification is described in this article in which the input and output terminals of an amplifier are connected through a high resistance, the voltage existing between a point on this resistance and the ground side of the circuit being amplified and fed back to the input circuit.

The Use of the Cathode-Ray Oscillograph at Ultra-High Frequencies, by Dr. H. E. Hollmann. The Wireless Experimenter and Experimental Wireless, August, 1933. This article points out the advantage of the cathode-ray type of oscillograph from the standpoint of comparative lack of inertia as compared to oscillographs using mechanical systems.

A Summary of the Provisions of the NRA Radio Industry Code. Electronics, August, 1933. A brief summary of the important provisions of the code covering employment, wages, price-determining factors, conditions governing sale and prices of obsolete and surplus stocks, etc.

Transformers and Chokes, by O. A. Pearson. Radio Retailing, August, 1933. A description of a simple circuit and methods for testing transformers and chokes for opens, shorts and "crosses," with additional data on the importance of wire and core size and insulation in such units.

Estimating Amplifier Gain. Service, July, 1933. A simple explanation of the method used to calculate the approximate gain of an amplifier and determining its output impedance.

Table of I.F. Peak Frequencies. Service, 1933. A table showing the peak frequencies of the intermediate-frequency stages of a large list of the popular makes and models of superheterodyne receivers.

How to Get Copies of Articles Abstracted in This Department

The abstracts of articles featured in this department are intended to serve as a guide to the most interesting and instructive material appearing in contemporary magazines and reports. These publications may be consulted at most of the larger public libraries, or copies may be ordered direct from the publishers of the magazines mentioned.

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Review of Technical Booklets Available

2. *1933 R.F. Parts Catalog.* Specifications on the entire line of Hammarlund variable and adjustable condensers, r.f. transformers, sockets, shields and miscellaneous parts and components.

4. *A to 15 200-Meter Superheterodyne.* A description of the outstanding features of the Hammarlund-Roberts high-frequency superheterodyne designed especially for commercial operators for laboratory, newspaper, police, airport and steamship use.

5. A *1933 Volume-Control and Resistor Catalog.* This 12-page catalog, issued by Electrad, Inc., gives data on standard and special replacement volume controls, adjustable resistors, vitreous wire-wound fixed resistors, voltage dividers and other resistor specialties and public-address amplifiers.

6. *Line Voltage Control.* Characteristics and uses of a voltage regulator and chart showing the correct Amperite recommended by set manufacturers for their receivers. Also tells how to improve your customers' sets and make a profit besides.

7. *Rich Rewards in Radio.* Valuable and interesting information on the growth of radio and the opportunities existing in the field of radio manufacturing, radio servicing, broadcasting, talking pictures, television, public-address systems and commercial operation. The book also contains detailed information on the NRI home-study courses in radio and allied subjects. This book is available only to the RADIO NEWS readers who are over 16 years of age and who are residents of the United States or Canada.

9. *Resistor Catalogue.* Specifications of the International Resistance Co. 1933 line of metallized, wire wound and precision wire wound resistors, motor radio suppressors, handy servicemen's kits, technical data and list of free bulletins available on the building of servicemen's test equipment.

10. *Suppression of Motor Radio Noises.* This interesting and useful folder of the International Resistance Co. gives complete information on how to overcome motor-generator, ignition coil, interrupter and spark plug noises in automobile radio installations.

16. *RMA Standard Resistor Color-Code Chart.* A postcard size color-code chart designed by the Lynch Mfg. Co. to simplify the job of identifying the resistance values of resistors used in most of the standard receivers. Contains a list of the values of resistors with their color designations.

18. *Volume Controls, Fixed Resistors, Motor-Radio Spark Suppressors and Power Rheostats.* Descriptions, specifications and prices of Centralab standard, special and replacement volume controls for receivers, amplifiers, public address systems and talkie installations, fixed resistors, motor radio spark suppressors, wire-wound rheostats and potentiometers. How to obtain, without charge, a copy of the Centralab volume control guide for servicemen.

25. *Noise-Reducing Antenna Systems.* Describes types of noise-reducing system developed by the Lynch Mfg. Co. for broadcast and short-wave reception.

34. *Service Man's Replacement Volume-Control Guide.* A revised list, in alphabetical order, of all old and new receivers showing model number, value of control in ohms and a recommended Electrad control for replacement purposes. Contains specifications and volume control circuits for over 2,000 different receiver models.

39. *Radio Servicing and Radio Physics.* Descriptions and tables of contents of two books on every phase of radio. The books are written by A. A. Ghirardi and Bertram M. Freed and should be in the libraries of every radio student, experimenter and serviceman. The fact that they are used as standard texts by many radio schools and that chapters have been reprinted in RADIO NEWS Magazine is an indication of their value.

41. *How to Build the "Economy Eight."* A folder prepared by Wholesale Radio Service Co. giving construction information, diagrams, list of parts, etc., of an 8-tube receiver which can be built from a kit which sells for $13.75. Servicemen and set builders can put in their spare time to advantage building and selling these sets.

42. *How to Build Useful Servicing and Testing Instruments with Simple, Standard Meters.* Data, with diagrams, showing how any meter—preferably a low range milliammeter—can be used to measure amperes, volts and ohms over any desired range through the use of proper shunt and series resistors. The bulletin, prepared by the Lynch Mfg. Co. gives both the theoretical and practical data required to make all the calculations.

43. *How to Modernize Old Set Analyzers.* Describes the new set analyzer remanufacture plan of the Supreme Instruments Corp. for the conversion of obsolete set analyzers into efficient, up-to-date testing equipment, at low cost. Servicemen and experimenters, who have been working under the handicaps imposed by the use of analyzers which are no longer able to cope efficiently with the problems introduced by new tubes and receivers, will find this folder of value. Special auxilliary units for increasing the usefulness of standard analyzers are also described.

44. *How to Add a Remote Control and Station Selector Unit to Any Receiver.* Shows how any single-tuning-control receiver can be converted into a remote control and station selector set at a total cost of only /12.50. The R. C. A. Victor automatic remote control unit used makes it possible to operate a set at a distance up to 75 feet from the tuner. Information is also given on how to add a remote control unit to a P. A. Tuner.

45. *Condenser Bulletin for 1933.* Descriptions, specifications and prices on the entire line of Potter paper and electrolytic condensers for by-pass, filter and replacement use in home and auto radio sets. It also describes interference filters and tone controls.

46. *Book of Facts on High Speed Radio and Telegraph Code Sending and Receiving.* Opportunities for pleasure and profit in radio and telegraph operating and three inexpensive courses available through the Candler System for attaining high speed in sending, receiving and copying code on the "mill." Different courses are suited for different students such as beginners and experienced operators who wish to increase their speed. Please do not send for this material unless you are interested in learning how to operate or increase your speed.

47. *A Modern, Low-Cost, Portable, Public-Address System.* Describes and gives the specifications and price of an exceptionally efficient, low-cost portable public address system—the Type U-19—designed and manufactured by the United Sound Engineering Co. The unit employs the latest tubes and a 10-inch dynamic speaker, and is capable of amplifying normal speech and music for crowds up to 1,000 people. With auxiliary equipment it can be used for crowds up to 3,000 people.

November, 1933

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

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PLEASE NOTE: To avoid disappointment, please make your selection of booklets from the latest issue of RADIO NEWS, since our supply of booklets not listed in the current issue is exhausted. The list and coupon contained in this (November) issue should not be used after November 30th, 1933.

48. *A Low-Cost Superheterodyne Receiver.* Describes the Goldentone midget radio manufactured. It is especially suited to fill the needs of the serviceman seeking a well-designed chassis for replacement purposes. The set contains many modern improvements and features not usually available in a set in its low price class. The set is sold on a 30-day free trial basis.

49. *Portable and Home Type Receivers.* Descriptions and prices of a line of receivers and chassis made by the Commonwealth Radio Mfg. Co. The list of receivers ranges from the most inexpensive midget sets to the higher cost console models. The line offers many profitable sales opportunities for dealers and servicemen.

52. *The Servicer.* Contains helpful information designed to help the serviceman do better work and make more money doing it. A sample copy will be sent on request through this booklet service, after which you can subscribe to it, if you like it.

53. *Practical Training for Radio Service Men.* Prepared by the Radio Training Association of America, gives an outline of a course of instruction for radio servicemen—a course that is endorsed and recommended by more than thirty leading radio manufacturers and trade associations.

54. *Public-Address Systems, Transmitting, and Short-Wave Receivers and Accessories.* This catalog issued by the Wholesale Radio Service covers the requirements of men engaged or interested in these fields for amplifiers, loudspeakers, microphones and other special and standard equipment required for such work.

56. *Servicing and Testing Instruments.* Descriptions of a new line of Supreme low-priced analyzers, set testers, tube testers, ohmmeters, capacity testers, oscillators and universal meters. Complete information is also given on the new Model 55 tube tester and the new master diagnometer which employs the "free reference point system of analysis."

International "9"

(*Continued from page 277*)

condensers have 140 mfd. in each section. The circuit features the use of an electron-coupled oscillator which means stability. The beat frequency oscillator is extremely helpful in locating distant broadcasting and phone stations by means of the heterodyne "birdies". When the carrier of a distant station is heterodyned the set is tuned to zero beat, the oscillator is then cut off and the set will be tuned exactly to the desired broadcast station.

The two-stage intermediate-frequency amplifier is both plate and grid tuned.

The type -2A5 power tube is coupled to a dynamic type speaker providing loudspeaker reception.

Complete shielding is employed throughout the receiver and by further reference to the illustration in Figure 3 it is shown that the coil drawer is divided into three sections furnishing a complete shield for each inductance.

The power pack is of the conventional type, using the type -80 rectifier with two high capacity electrolytic type condensers and employing the field winding of the dynamic type speaker as a choke coil. The field winding has a resistance of 1800 ohms and is tapped at 300 ohms to supply a bias to the type -2A5 power tube.

The constructor should find no difficulty in building this set. To guide him, there is the schematic wiring diagram, Figure 2, the top view Figure 3.

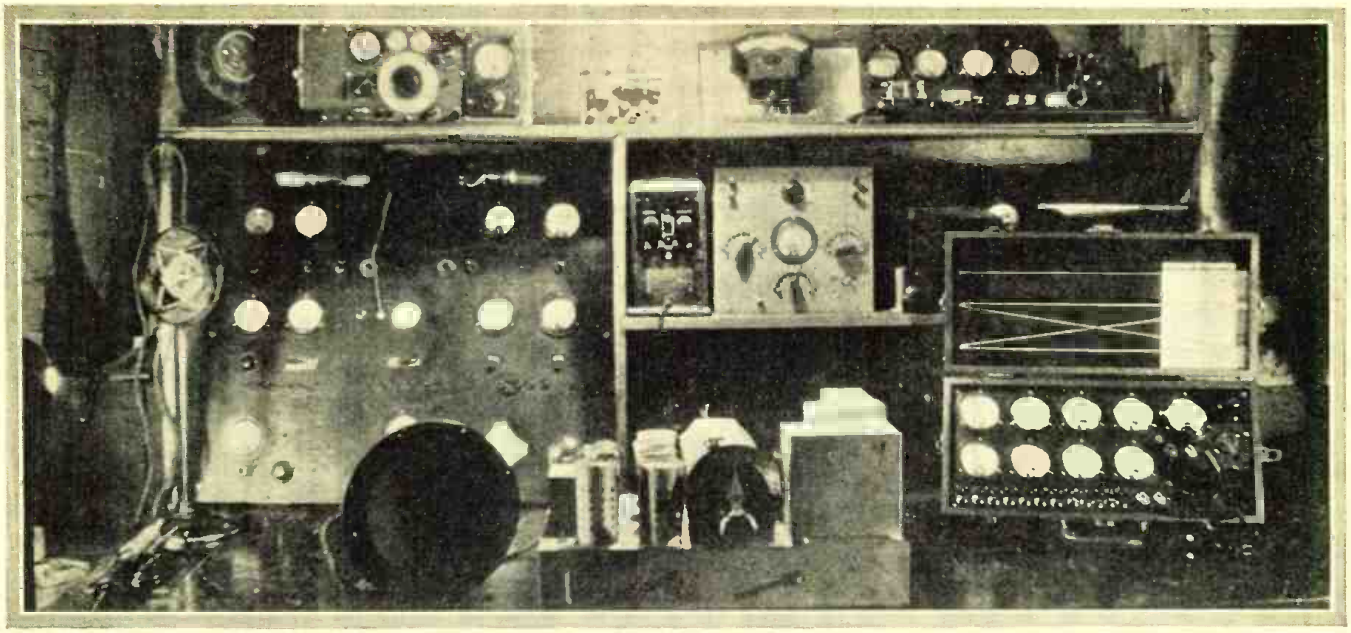
In mounting the parts the following procedure is suggested. First mount the nine tube sockets with their associate tube shield bases, V1 to V9. Next, mount all the inductances which can be followed with the assembly of the multi-former socket. After this, mount the power transformer T1 and the electrolytic condensers C33 and C34. In mounting the parts beneath the receiver chassis, begin with the various resistors and condensers follow with the r.f. chokes and controls, and the power resistors R14 and R15. The tuning condensers, dial and front panel may be mounted last.

Reference to the photograph of the receiver panel discloses seven control knobs, one switch and one jack. The knob at the bottom extreme left is the rotor switch SW2 for the plate supply of the beat frequency oscillator. Next, is the headphone jack, followed by the tone control, which employs the condenser C25 and resistor R13. To the right of this knob is the combined volume control and power switch, R8 and SW1. This is followed by the plate supply cut-off switch SW3. The knob to the extreme right is the antenna tuning control, C4. The knob directly under the dial window is the main tuning knob, to the right of this is the Multiformer compartment. To the left of this tuning dial there is a square metal panel conforming to the dimensions of the Multiformer drawer so as to retain the harmonious appearance of the front panel.

The following components comprise the kit for the International Nine short-wave receiver. These kits are made available to RADIO NEWS readers by Postal Radio Corp.

Parts List

BP1, BP2—Dual antenna-ground binding post strip
C1, C2, C3—Three-gang variable condenser, 140 mmfd. each section
C4—40 mmfd. antenna condenser
C5, C6, C7, C8—Multiformer condenser
C9, C14, C31—.0001 mfd. mica condenser
C10, C13, C16, C17, C18, C20, C24, C26, C27, C29, C30—.1 mfd. bypass condenser
C11, C15, C21, C22, C23—.001 mfd. mica condenser
C12, C28—.6 mmfd. condenser
C19, C25—.5 mfd. bypass condenser
C33—8 mfd. electrolytic condenser
C34—12 mfd. electrolytic condenser
J—Single circuit jack, with single-pole double-throw switch
L1, L2, L3—Multiformers (set of four)
L4, L5, L6—465 kc. i.f. transformers
L7—Audio beat oscillator coil, 465 kc.
MS—Multiformer socket
RF1, RF2, RF3, RF4, RF5—8 mh. r.f. chokes
R1—350-ohm resistor, 1 watt
R2—15,000-ohm resistor, 1 watt
R3, R4, R16—60,000-ohm resistor, 1 watt
R5-R9, R17—25,000-ohm resistor, 1 watt
R6—200-ohm resistor
R7—50,000-ohm resistor, 1 watt
R8—12,000-ohm potentiometer
R10—100,000-ohm resistor, 1 watt
R11, R12—250,000-ohm resistor, 1 watt
R13—75,000-ohm potentiometer
R14—1,000-ohm resistor, 10 watt
R15—27,440-ohm resistor, 25 watt
SW1—Power switch
SW2—s. p. s. t. rotor switch
SW3—s. p. s. t. toggle switch
T1—Power transformer
V1, V2, V3, V4, V5, V6, V7, V8—Wafer sockets, 6-prong
V9—Wafer socket, 4-prong
1—Vernier illuminated dial
1—Speaker 5-prong socket
1—Drilled metal chassis, 3 inches by 11 inches by 19 inches
1—Drilled crystal finish steel front panel, 9¼ inches by 20½ inches
1—Steel cabinet.



The Service Bench

Shop Talk—Standardized Service Charges—Service Sidelines—Equipment—Wind Driven Power Supply—Service Sales Promotion—P. A. Equipment—Shorted Turn Indicator—Service Shops—SERVICING: Bosch, Scott, Westinghouse and RCA Receivers

Conducted by
Zeh Bouck

THE Philco service plan, known as the Radio Manufacturers Service, makes a definite contribution toward the standardization of service charges. Their standard Tune-up costs the customer $1.50 and includes the following work: 1—Inspect chassis; 2—Test tubes; 3—Check speaker; 4—Inspect and lubricate tuning condenser; 5—Inspect and lubricate tuning condenser drive; 6—Precision kilocycle alignment of receiver; 7—Inspect and test aerial, lightning arrestor and leadin; 8—Inspect and check ground connection; 9—Check power connection; 10—Clean and polish cabinet.

The idea of a flat rate for a collection of services is borrowed from the automotive field. It offers an impressive catalog to the customer which is often an excellent sales argument. And while the work is essential to the efficient maintenance of the receiver, it imposes no great labor upon the serviceman.

The first item should include general tightening, dusting and, where necessary, refitting of removable tube shields and shield covers.

Consistent with the effort toward standardization, Philco recommends the following job prices:

Also in the $1.50 class: Any one of the following jobs: Replace fixed resistor; Replace by-pass condenser; Replace mica condenser; Replace on-off switch; Remove short-circuit or repair open circuit; Repair tuning indicator. Standard Tune-up included. Parts extra.

In the $1.75 class: Any one of the following jobs: Replace power transformer; Replace tone control; Replace hum control; Replace voltage-divider resistor; Install new dial; Replace dial cable; Replace padding condenser; Replace electrolytic condenser; Center speaker cone. Standard Tune-up included. Parts extra.

In the $2.00 class: Any one of the following jobs. Replace audio transformer; Replace filter choke; Replace speaker cone; Replace multi-section by-pass condenser; Replace r.f. coil; Replace i.f. coil; Replace tube socket. Standard Tune-up included. Parts extra.

In the $2.25 class: Any one of the following jobs: Replace power transforer; Replace condenser bank; Replace speaker field-coil; Replace tuning condenser; Replace multipolar switch. Standard Tune-up included. Parts extra.

Philco also recommends $3.00 as a minimum labor charge for any two of the above jobs, with additional jobs over two at $.75 each. This last suggestion is somewhat inconsistent, for it is obvious that an additional job over two in a higher price class should be worth more than an additional job over two in a lower price class. Also, arbitrary prices for specific jobs cannot be applied to all receivers. In many instances it will be much easier to replace an electrolytic condenser (in the Philco $1.75 class) than to remove a short circuit or repair an open circuit (in the Philco $1.50 class).

FIGURE 1

When considerations such as these complicate the figuring of the total charge by simple addition, resort should be made to an hourly labor charge plus cost of parts. The time of the expert serviceman, who is willing to guarantee his work for ninety days, is certainly worth $1.50 an hour.

All charges above hold for work brought to the shop by the customer, or done in a local home. Where pick-up and delivery are effected by the serviceman, an additional charge of $.75 is levied.

These prices, recommended as standard, are fair and equitable, and present a workable basis in the average urban community. It is conceivable, however, that minor variations, based on local conditions, might be justified—as has been found desirable with the NRA wage scale.

Side-line Item for the Serviceman

The Shure Brothers Company, of Chicago, have recently introduced their "Radio Modulator" which offers interesting sales possibilities to the radio serviceman. The device (Figure 1) consists of a modulated oscillator, a high-quality, two-button microphone and a generous extension cord. The "Modulator" is plugged into a convenient 110-volt receptacle, connected to the receiver antenna and ground posts, and the receiver tuned to the "Modulator's" signal, exactly as if it were a station. The volume is adjusted by the receiver volume control.

Several sales opportunities for the "Radio Modulator" may be suggested to the wide-awake serviceman—viz: Home entertainment; Emergency public address work; Comparison of quality in different radio receivers; Simultaneous check of entire receiver from antenna to speaker; For small audition studios; For public-address work in small clubs; In high-quality, home recording.

The "Modulator" lists at $33.50, with the usual discounts to dealers and servicemen.

A Portable Service Laboratory

For the serviceman who can afford the price, Jewell-Weston offers one of the finest portable radio test laboratories this department has yet seen. We refer to their "66" series of units mounted in a multiple carrying case, and illustrated in Figure 2. The complete set comprises five individual instruments—radio set analyzer, tube checker, test oscillator, volt-ohmmeter and capacity

meter. These units can, of course, be obtained separately and where only a partially complete outfit is desired, the oscillator, tube checker and analyzer can be mounted in a smaller carrying case for the

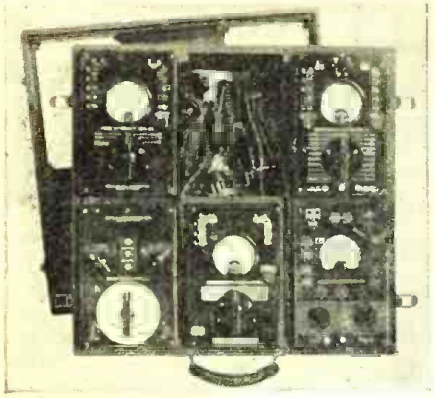


FIGURE 2

analyzer method of diagnosis. Similarly, the oscillator, volt-ohmmeter and capacity meter can be combined for the serviceman preferring the point to point procedure.

Program Circular

Arthur Liebscher, serviceman in Germantown, Philadelphia, circulates the useful piece of literature shown in Figure 3 among his clients and prospective customers. The circular is a four page folder, with the log, as illustrated, on the inside. The front cover carries only the words, "PROGRAMME de RADIO" in a very "Ritzy" type and an oval half-tone in the lower right hand corner of a man, presumably Mr. Liebscher, speaking into a microphone. The rear cover observes that—

"Ten years of radio experience have taught the necessity of associating modern laboratory methods with even the sallest problem, where quality is the first consideration.

"High quality workmanship results in maximum enjoyment of your favorite pro-

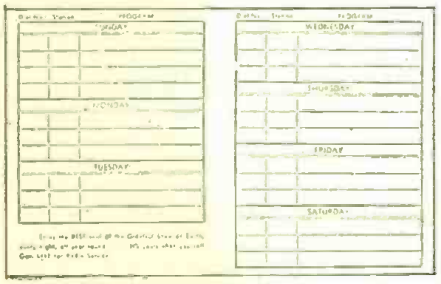


FIGURE 3

gram and this, together with fair prices, means customer confidence and satisfaction."

The circular is conceived and executed in a quiet, aristocratic manner, with attractive type on an excellent grade of buff paper. Opened, the size is four and a half by seven and a half inches.

Wind-Driven Power

The photograph of Figure 4 suggests novel possibilities in the way of rural radio power supply. This wind-driven power plant was built as an experimental installation by Ronald A. McNeil, of Atwater, Saskatchewan, Canada, and is so successful in supplying power requisites some thirty miles from the nearest lines that a permanent and modified installation is now being constructed. The four bladed propellor drives an Autolite 6-8 volt generator through a six to one belt and pulley arrangement. The generator charges two 6-volt batteries in parallel at 20 amperes in a fair wind. Assuming an efficiency of 50 percent, from .75 to 0.1 horse power is available with a 20 to 25 mile-per-hour wind.

The permanent installation will use a 32-volt generator, charging storage "B" batteries, and will be driven by a more efficient airplane style propellor.

RADIO NEWS *P. A. System on the Job*

Norman H. Speight of Toronto, Canada, whose motto is "My installations speak for themselves", says a good word for the RADIO NEWS public-address amplifier described in several articles by our Mr. Dorf. He sends

FIGURE 4

us the photo of Figure 5 and writes: "To say that I am delighted with it, is to put it mildly." We take it that this amplifier, which was used on Mr. Speight's first P. A.

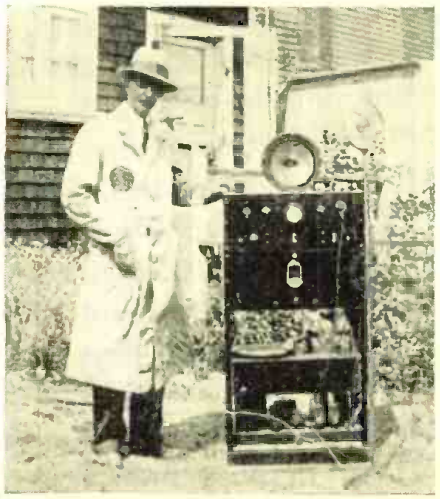


FIGURE 5

job, is in part responsible for the sales argument on his letterhead which states—"Sound Equipment Rented for Political Meetings, Entertainment, Picnics, Advertising, etc., at Reasonable Rates".

High-Powered Portable P. A. System

Speaking of P. A. equipment, one of the neatest portable jobs we have yet seen is turned out by the United Sound Engineer-

(*Continued on page* 317)

Radio Physics Course

LESSON 23—ELECTROMAGNETIC INDUCTION

This series deals with the study of the physical aspects of radio phenomena. It contains information of particular value to physics teachers and students in high schools and colleges. The text material aids teachers in laying out current class assignments

By Alfred A. Ghirardi*

WE have seen that when a coil is moved in a magnetic field—or the field is moved in the coil—an e. m. f. is induced in the coil, and that the direction of the induced e. m. f. and current depends upon the direction of the motion; the direction of the induced current always being such that it tends to stop the motion or cause producing it. This principle is used in the electric generator shown in simple form in Figure 1. Here, a simple loop of wire A-B-C-D is arranged to be mechanically rotated on a shaft between the poles N and S of two powerful electromagnets. We will assume that the magnetic field between the poles is uniform, as shown, that is, of the same strength throughout. The two ends of the coil are connected to two collector rings (of brass or copper), F and G respectively (sometimes called slip-rings), insulated from each other and from the shaft. They are arranged to rotate with it. The two stationary copper or carbon brushes H and J make a wiping contact with these rotating collector rings to lead the current to the external circuit, consisting in this case of a lamp K. This arrangement of parts not including the external circuit, constitutes the simplest form of alternating current generator.

Let us assume the coil to start from the vertical position (A) of Figure 1 and to rotate at a uniform speed in a clockwise direction as shown. At this position the induced e. m. f. is zero because the coil sides A-B and C-D are moving parallel to the lines of force. Therefore in a given small angular movement at this position there will be very few lines of force unlinking with the loop A-B-C-D and hence very little e. m. f. is induced.

After pasing the vertical position, lines of force begin to unlink with the loop at an increasing rate and the induced e. m. f. gets stronger and stronger. The direction of the current is shown by the arrows in (B) This is found by using the right-hand rule and remembering from Lenz's law that the magnetic poles produced by the current in the coil are such as to tend to stop the rotation, that is, an S pole is produced at the top of the coil and a N pole at the bottom. This south pole is forcibly rotated toward the south pole of the field by the applied mechanical power, and the N pole of the coil is also rotated toward the N pole of the field against the force of repulsion. At the horizontal position (B) the coil has maximum e. m. f. induced in it, because during a small angular movement from this position the maximum number of lines of force are unlinked, since coil sides A-B and C-D are moving at right angles to the lines of force.

As the coil continues on to the vertical position of (C) the e.m.f. is still in the same direction but diminishes in value again. At the vertical position the e. m. f. is zero.

As it continues past this, the induced e. m. f. and current change in direction, as shown by the arrows in (D), since the poles of the coil must now reverse in order to keep opposing the motion of rotation. The e. m. f. increases in strength, and becomes maximum when the coil is horizontal as shown.

Continuing the rotation another 90 degrees brings the coil back to its original starting position and condition of (A). The e. m. f. decreases to zero again. As the rotation is continued, the above conditions repeat themselves over and over.

In one complete revolution of the coil there are two positions (A) and (C) at which there is no induced voltage and hence no current in the external circuit and two (B) and (D) in which the voltage is at maximum value, although in opposite directions. At intermediate positions, the voltage has intermediate values. A complete revolution of the coil takes in 360 degrees of the rotation. Since the rotating coil moves in a circle, we can mark the position of the coil as so many degrees from the starting point (A) which is considered as 0 degrees. Thus (B) is the 90° position, (C) is the 180° position, etc.

We may plot the voltage induced in the coil at every instant, against the degrees through which the coil has rotated from the zero position (A). This is shown in Figure 1. When the current is flowing in one direction we call it *positive*, and lay off the voltage values vertically *above* the zero line O-O. When it is flowing in the opposite direction, we call it *negative* and lay off the voltage values vertically *below* the zero line O-O. If the conductor moves at a uniform rate, the induced voltage can be plotted against the "time in seconds" instead.

The curve thus obtained, is called a "sine-curve", because the induced voltage at any instant, in the ideal generator just described, is proportional to the trigonometric natural sine function of the angle of rotation of the coil from the zero position. In an actual generator, the curve is not a true sine curve because the field flux is not exactly uniform. Also, in an actual generator the armature coils are wound on a circular iron core to reduce the magnetic reluctance of the space between the field poles. This makes the magnetic field and the induced voltage very much stronger.

The curve shows that at first the e. m. f. increases rapidly (O to L), then less rapidly until it reaches its maximum value M when the coil reaches the 900 degree position. At the maximum value, the rate of change is least. Then it decreases slowly at first to N, and then more rapidly to zero at P. Then the e. m. f. reverses in direction and begins to increase in value in that direction to Q, and to maximum at R. Then it decreases to S,

Generating an alternating e.m.f. in a loop of wire rotated in a magnetic field

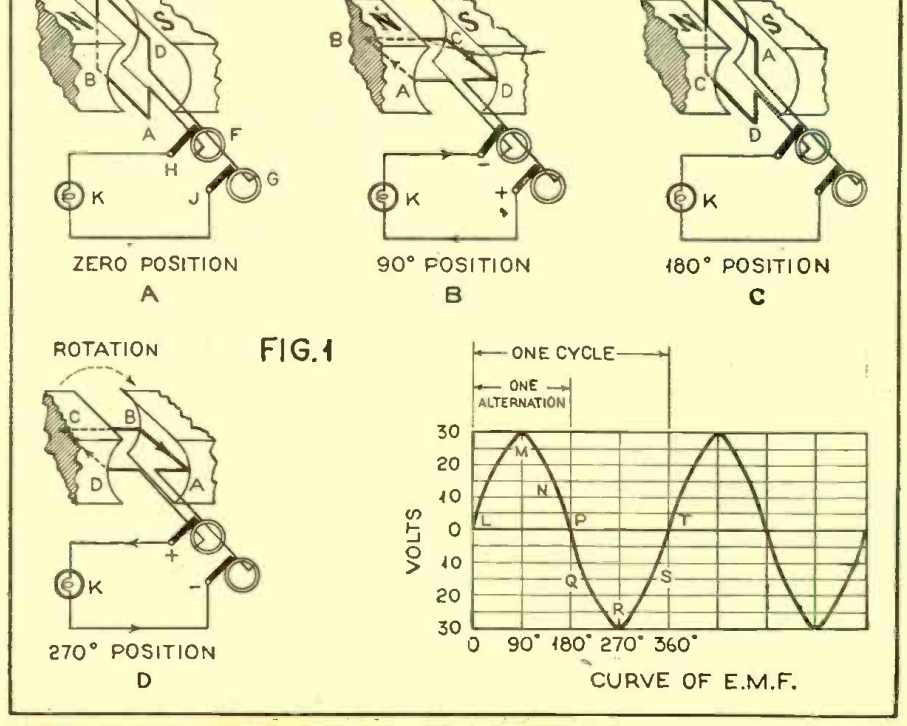


FIG. 1

* Radio Technical Pub. Co. Publishers, Radio Physics Course.

and completes one cycle at T. The e. m. f.'s in the negative direction are represented by drawing them below the O-O axis line.

A complete wave of changes of the e. m. f. or current from zero to maximum in one direction, then down to zero and to maximum in the opposite direction and back to zero again is called one *cycle*. At the end of a cycle the coil is at the same electrical position or condition as at the beginning. It then starts to repeat the same thing all over again. If it continues to rotate, it repeats the cycle once for each rotation (for a 2 pole generator). The time required for a complete cycle is called a *period*. One-half cycle is called an alternation. The number of cycles produced each second is called the *frequency*. It is evident that for a 2 pole generator as shown, the frequency is equal simply to the number of revolutions per second. In order to produce the ordinary commercial lighting frequency of 60 cycles per second without rotating the armature at excessive speeds, commercial a.c. generators (commonly called alternators) as a rule have a larger number of poles than two. One cycle is produced by a coil passing a pair of poles. Therefore in one rotation as many cycles will be produced as there are pairs of poles or,

$$f = \frac{\text{No. of poles}}{2} \times \frac{\text{Speed in R. P. M.}}{60}$$

In the ordinary commercial lighting circuit the frequency is usually 60 cycles per second, although in some localities the frequency is 25 cycles and in others still different frequencies are employed. In a 60 cycle current there are 60×2 or 120 alternations per second. Special alternators for generating a-c voltages at frequencies up to 20,000 cycles per second are used in long-wave radio transmitting stations. As it is not practical to generate e. m. f.'s of frequencies much higher than this with alternators of the type described, vacuum tube oscillators or generators are used for generating the e. m. f.'s of the higher frequencies required in radio work.

Commercial a.c. generators have a stationary armature consisting of many coils in series in order to make the individual e. m. f.'s generated in each coil additive so as to produce a large total e.m.f. The field poles are usually rotated. They consist of heavy iron cores covered with wire through which a *direct* current is sent to maintain a strong unidirectional magnetic field. The direct field current is furnished by a separate small d.c. generator called an *exciter*, or by a separate small d.c. winding, commutator, and brushes built right on the main armature.

It is seen that an alternating current is really a current that flows first in one direction, through the circuit and then reverses and flows in the opposite direction. The e. m. f. forces the free electrons through the circuit first in one direction, and then they all reverse and flow in the opposite direction usually many times a second. Not only are the electrons reversing in direction, but the rate at which they are flowing also varies throughout each cycle. As we shall see later, this gives rise to many effects in a.c. circuits and apparatus which are not encountered in direct-current circuits.

A Signal Generator

(*Continued from page 274*)

be seen that, if it is desired to obtain the highest gain possible, the signal generator becomes a valuable adjunct, not only in obtaining this high gain, but also in actually measuring the gain.

Selectivity

Selectivity is defined as the frequency band that a set will allow through for a given r.f. carrier. A well-designed set will have a selectivity of kilocycles on either side of the resonance point of a signal. Moreover, at 5000 cycles away from resonance, the set should be almost as sensitive to the radio signal as it is at resonance in order to provide the desirable "flat-top" characteristic. If the selectivity of a radio set is too high—that is, if at less than 5000 cycles away from resonance the set tends to become insensitive to the radio signal—the latter will be distorted. On the other hand, if more than 5000 cycles on either side of the resonance point is permitted through, two radio stations on adjacent broadcast channels are likely to interfere with one another.

The method of procedure for measuring selectivity is simple. A milliammeter is connected into the detector plate circuit of the set. The radio set and generator are then adjusted to a predetermined frequency and the current in the plate milliammeter is observed. Then with the attenuation and modulation of the generator held constant and also the frequency setting of the receiver held constant, further readings are taken as the frequency of the signal generator is varied up to 5 kilocycles either side of the assumed resonance point. If the plate milliammeter holds substantially constant up to 5 kilocycles on either side of resonance and then readings fall sharply, the set has good "flat-top" selectivity characteristics and good selectivity. In the same manner peaked and broad selectivity can also be observed. If a vernier dial capable of being read to one-tenth dial division is employed, as many as 8 to 10 points can be potted for selectivity measurements.

Measuring Detector Efficiency

It is very often of interest, especially in receiver design work, to test the efficiency of various means of detection.

The signal generator, receiver and output meter are set up exactly the same as they are in the sensitivity test (Figure 3). Efficiency of detection is determined as follows: The frequency and r.f. attenuation of the generator and the frequency of the receiver are held constant. The modulation is then varied to produce definite percentages of say 10, 20, 30, 40 and 50. Corresponding readings are then observed in the output meter for each step. For perfect detection the readings in the output meter should increase in exact linear progression with the increase in percentage modulation.

Harmonics are available down to 5 meters and the intensity of these harmonics can be attenuated down to the lowest signal that the most sensitive set can detect. This can serve as an excellent method of comparison of the relative sensitiveness of two short-wave receivers. Although the exact value of the strength of these harmonics is not known, it is safe to assume that they follow the law of harmonics generated by a linear detector (the double diode being a linear detector) and as such will have the following ratio of amplitudes:

Frequency	*Amplitude*
Broadcast frequency	= 1/1 × 3
Double broadcast frequency	= 1/3 × 5
Triple broadcast frequency	= 1/5 × 7
Quadruple broadcast frequency	= 1/7 × 9
The Nth multiple of the broadcast frequency	= $1/4n^2-1$

All these signals are modulated exactly as the broadcast frequency is modulated.

Other Tests

Aside from the few tests described in this article, this signal generator may be employed for dozens of other tests which should prove immensely interesting to the more advanced experimenter.

The signal generator today is the standard unit employed to solve the most perplexing problems of the radio receiver.

What's New in Radio

A department devoted to the description of the latest developments in radio equipment. Radio servicemen, experimenters, dealers and set builders will find these items of service in conducting their work

By The Technical Staff

Vacuum Tubes

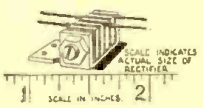
Description—This manufacturer announces a complete line of radio vacuum tubes which includes all the new –50 series type, automotive type, mercury-vapor rectifier series, voltage doubler rectifier, the new pentagrid converter, duplex-diode pentode and all the new power tubes. These American

vacuum tubes are made under RCA license and all tubes are triple tested by the oscillator, receiver and meter methods. The manufacturer calls attention to the fact that the tubes are guaranteed for six months (except breakage and burnouts). The tubes are packed in attractively designed two-color cartons.

Maker—American Radio Tube Co., 53 W. 17th St., New York City.

Meter Rectifier

Description—This tiny rectifier with the appropriate resistances for the range desired, will convert any d.c. milliammeter into an a.c. voltmeter. The popular 0-1 milliammeter lends itself most readily for this purpose. The life of the Taurex rectifier, when operating under normal conditions, is infinite. It



measures ⅜ inch by ¼ inch. The rectifier consists of four sets of copper-oxide discs arranged in the same manner as the four arms of a Wheatstone Bridge circuit, the measuring instrument, a milliammeter in this case being substituted in place of the usual galvanometer. This new rectifier should appeal to the radio experimenter, technician and serviceman.

Maker—Leo Taussig, 32-45 37th St., Long Island City, N. Y.

Power Line Cord with Resistor for Universal Sets

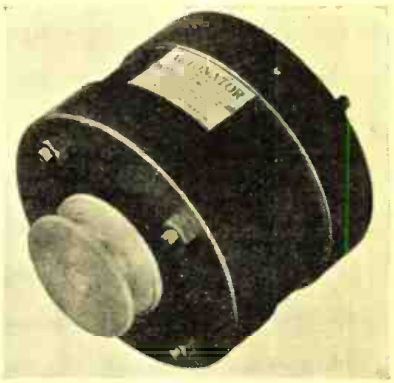
Description—The new Ohmite "Cordohm" line cord resistor replaces the internal voltage dropping resistor employed in the universal a.c.-d.c. type radio receiver. It is a two-conductor power line cable, but includes a

third element to reduce the line voltage to the required voltage for the tube filaments. The new cord resistors are available in the following standard values: 135, 160 and 290 ohms.

Maker—Ohmite Mfg. Co., 636 N. Albany Ave., Chicago, Ill.

Fan-Belt-Driven Generator

Description—The new Autonator is a power device operating by the motor-car fan belt to produce 110 volts, 60 cycles, alternating current. It is easily installed, has no brushes, collector rings, commutator or wire-wound armature to service and requires no drain from the auto battery. Provision is made for regulation of voltage at all speeds. There are six models in the following power ratings: 50, 100, 150, 250, 350 and 500 watts. This power supply has nu-

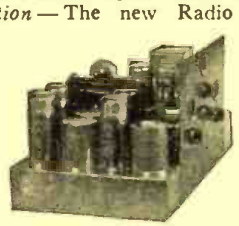


merous applications, for instance, in operating radio sets, public-address systems, neon signs and electric lights in sound trucks, pleasure cars, buses, etc.

Maker—Autonator Laboratories, Inc., 8440 So. Chicago Ave., Chicago, Ill.

Short-Wave "Laboratory Built" Superheterodyne Receiver

Description—The new Radio Research



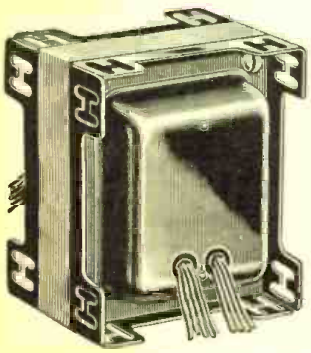
Labs. model RRL-7B-X short-wave receiver is a custom-built eight-tube superheterodyne circuit featuring dual manual volume and

sensitivity controls, automatic volume control, beat-frequency oscillator for c.w. reception, band spread on all frequencies, newest type tubes and a wave-band switching arrangement. The high gain i.f. transformers operate at 465 kc. and the receiver makes use of a 10-inch dynamic type speaker. The vacuum tubes employed are as follows: –56's for both oscillators, –58's for the first detector and i.f. stages, a –55 for the combined second detector and first audio and a –2A5 type tube for the power output stage. The chassis measures 16 inches long by 10 inches wide by 9 inches high.

Maker—Radio Research Laboratories, 2017 California Ave., Ft. Wayne, Ind.

Transformers

Description—Announcement is made of the new line of General multi-tap universal replacement power transformers. The series



comprise four units which have various taps so designed that they can be used singly or in combinations adapting them to practically every commercial radio receiver made. The transformers are designed with a universal type of mounting and they are fully shielded. This company also makes multi-tap universal output transformers and a complete line of replacement audio interstage transformers.

Maker—General Transformer Corp., 500 S. Troop St., Chicago, Ill.

New Type Horn

Description—This new Macy horn has been designed to cover a wide area and while it is particularly adaptable to sound truck equipment, it is also applicable for airport and all manner of outdoor public address installations. The horn is exponentially

shaped, is 54 inches in length and the bell of the horn measures 23 inches in height and 50 inches in width. An aluminum detachable throat is provided for the attachment of the unit. The horn is of weatherproof construction and in the photograph it is illustrated with the new Macy horn standard. This new bracket standard permits the horn to be swung throughout a complete circle and tilted at any desired angle.

Maker—Macy Engineering Co., 1451—39th Street, Brooklyn, N. Y.

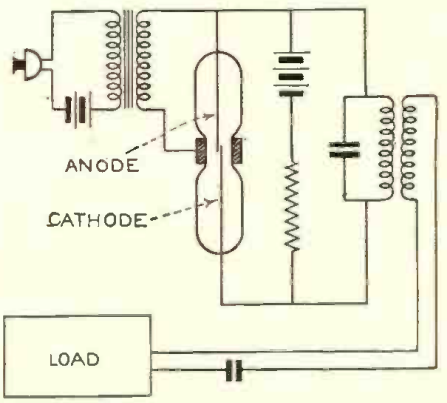
Latest Radio Patents

A description of the outstanding 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

By Ben J. Chromy*

1,898,486. MODULATION SYSTEM. AUGUST HUND, West Orange, N. J., assignor to Wired Radio, Inc., New York, N. Y., a Corporation of Delaware. Filed Nov. 2, 1931. Serial No. 572,551. 2 Claims.

2. A modulation system comprising, means for producing high-frequency oscillations including a gaseous discharge tube provided with a cold cathode and anode and an exterior control electrode, a plurality of condensers serially connected with respect to



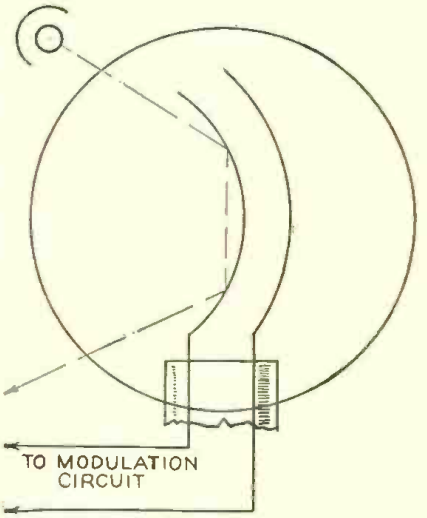
each other and to said cathode and anode, a source of ionizing potential and a series resistance therefore connected in parallel to said plurality of condensers and to said cathode and anode, a load circuit including an inductance connected in parallel with one of said plurality of condensers, a source of modulating potentials, an input circuit comprising an inductance connecting said source of modulating potentials to said exterior control electrode and said anode.

1,897,337. TUNING ELEMENT. THEODORE JOHNSON SCOFIELD, Jackson, Mich., assignor to The Sparks-Withington Company, a Corporation of Ohio. Filed Oct. 30, 1929. Serial No. 403,526. 3 Claims.

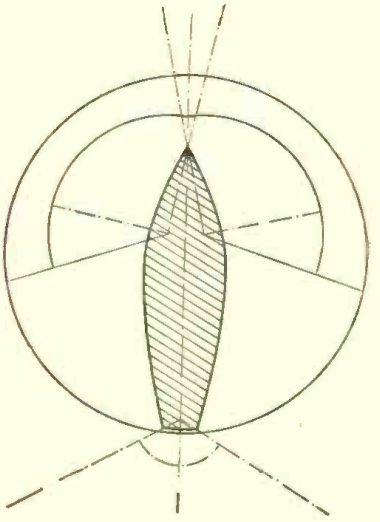
1. In radio units, a metal frame member, a shield member attached to said frame consisting of a different metal adapted to produce with said metal frame an electrolytic couple of predetermined electromotive force and a sheet of still different metal integrally joined to one of said members and contacting with the other of said members, the metal of said sheet adapted to produce with said other member an electrolytic couple of materially less electromotive force whereby electrolytic action between said parts is reduced.

1,894,462. LUMINOUS ENERGY CONTROL. CHESTER L. DAVIS, Washington, D. C., assignor to Wired Radio, Inc., New York, N. Y., a Corporation of Delaware. Filed Apr. 25, 1929. Serial No. 358,107. 3 Claims.

1. A modulating reflector for luminous energy comprising a pair of glow discharge electrodes disposed in an ionizing atmosphere, a modulation circuit for controlling the luminosity of the glow discharge from said electrodes, means for directing light rays upon said glow discharge electrodes and shaped surfaces on said electrodes for deflecting the rays therefrom to a predetermined focal joint, the reflected energy being proportional in intensity to the ionization of the atmosphere adjacent said electrodes.



1,898,831. ARRANGEMENT FOR INDICATING THE POSITION OF VESSELS. WALTER HAHNEMANN, Berlin-Marienfelde, Germany, assignor to C. Lorenz Aktiengesellschaft, Berlin-Tempelhof, Germany. Filed Jan. 6, 1930, Serial No. 418,743, and in Germany Jan. 24, 1929. 6 Claims.



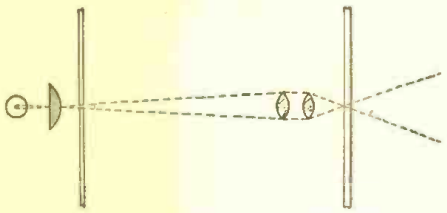
1. In an arrangement for indicating the position of ships, the combination of a short-

* Patent Attorney, Washington, D. C.

wave wireless transmitter and a wireless receiver mounted one above the other on a ship, and an electromagnetic screen formed by metallic surfaces of the ship's structure separating the transmitter and the receiver.

1,898,040. PRODUCTION OF SOUND AND SOUND PICTURE RECORD. BYRON E. ELDRED, New York, N. Y., assignor to Radio Corporation of America, a Corporation of Delaware. Filed Sept. 15, 1931. Serial No. 562,900. 5 Claims.

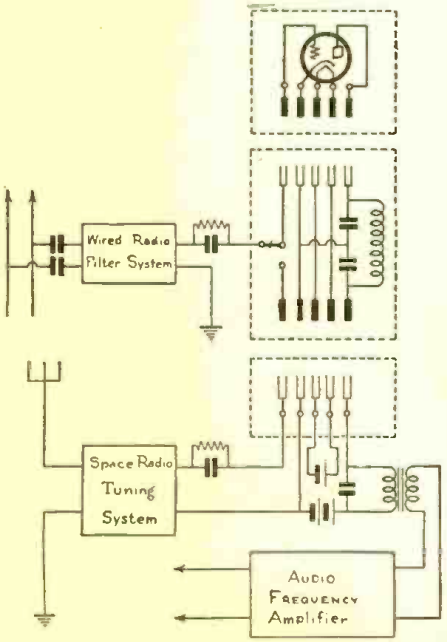
1. The method of reducing ground noise during reproduction of sound from a photo-



graphic record located in an emulsion supported on a base which includes covering said emulsion with a protective layer of a thickness which is of appreciable magnitude as compared to the objective focal length of the lens system through which light is applied to said record.

1,892,696. MEANS FOR RECEIVING WIRED RADIO SIGNALS ON SPACE RADIO RECEIVERS. ROBERT D. DUNCAN, Jr., East Orange, N. J., assignor to Wired Radio, Inc., New York, N. Y., a Corporation of Delaware. Filed June 3, 1931. Serial No. 541,770. 3 Claims.

1. A radio receiving system, comprising a space radio energy collecting system, a wired radio energy collecting system, a detector tube, a supporting socket for said detector tube, an audio-frequency amplifier opera-



tively connected to said socket, an adapter interposed between said detector tube and said socket, a single-pole two-position switch in said adapter for connecting said detector tube to said space radio energy collecting system or said wired radio energy collecting system and a filter system included in said adapter for excluding super-audible frequencies from said amplifier.

Another Report from Nova Scotia

Mr. Merrall H. F. Young of Lunenburg, N. S., sends in the following list of Best Bets: W3XAL, FYA, W8XK, DJD, EAQ, CT1AA, GSC, W1XAZ, DJA, W2XAF, YV1BC.

?QRD?

A column devoted to the commercial operator and his activities

Conducted by GY

JUST a bunch of the boys whooping it up in the clubrooms of the A.R.T.A. (American Radio Telegraphists Association). This chap Haddock is just taking the reins over in his capable hands and making organization spirit crackle and sparkle. Shooting mail out, making up prospectus for new members, rewriting bulletins and keeping delegates all over the country advised of the progress being made is sure a man-sized job. And what a break the outfit is getting with the help of a secretary (without pay) who is the sine qua non of efficiency. She is none other than the Mrs. Hoyt S. Haddock. Between the two of them, the place is a beehive of activity and the results shown since they have taken things over proves their ability. This column *sponsors them wholeheartedly* and wishes them long life and success because of their unselfish efforts in the interests of the radio operating profession.

For the security of life at sea, all ships should be made to carry an auxiliary radio aboard. The French have already inaugurated this system in their vessels by passing a law requiring two radio shacks on all passenger liners. The reason for this came to the forefront by the sinking of the City Service *Petro*, a short time ago. The explosion 'midships tore away the cables to the shack, thereby putting the generator out of commission. Luckily for the crew, they were in the shipping lanes, as otherwise another ship would have been added to those which have gone down to the sea and never left a trace as to what had happened to them. If a small battery job had been aboard, the "op" George Stano, could easily have sent out an SOS and brought succor, so much sooner than waiting from 0900 to 2200 before the rescue was effected. Georgie is now a firm believer that he was saved for a hanging.

Radio receives another feather to put in its cap through the praise it has received from Mr. F. R. Guggenheim, the noted philanthropist. He made a statement that if it hadn't been for the radio he would not be telling it to the world now. His yacht went on fire off the Long Island coast and it was the radio which brought the airplanes to the rescue. We take this opportunity of thanking the chappie. We'll be recognized yet, what!

Ah, shades of Pirate Morgan and his clique! Freddy Gritzner on the *S.S. Salvor* is sure an important figure in the activities of the rescue of the gold, silver and other junk that is believed to still be on the *S.S. Merida* which was sunk off Norfolk in 1911. He has been kept busy wiring for help from the Coast Guard to come out and settle the dispute which has arisen between the newcomers and his skipper. The new operators just came on the scene. The other version is "finders keepers," but these new salvagers don't believe that, or so they told Captain Bowdoin of the *Salvor*. Heavy verbal threats were shouted back and forth between the rivals and for a time it seemed that the well-dressed salvager would wear cutlasses and pikes, but the Coast Guard elbowed in and now peace reigns. With Freddy's high blood pressure and broken arches, we can't image how he stands all the excitement.

A code has been sent to the NRA, by the A.R.T.A., in response to the Presidential request for all industries to submit one. It contains such provisions as a decided increase in salaries, proper designation as to the rating of a radio "op" aboard ship, better living conditions, etc. It also takes into consideration the plight of the other branches of the profession, broadcasting and airways, which have been neglected because of lack of organization. Minimum salaries to be paid range from $125 to $200 per month, according to the class of vessel. Fixed station "ops" to receive $200 to $250 per month. Maximum working hours on fixed stations, 36 hours per week and 8 hours per day on mobile outfits. It includes such things as the allowance for vacations, purchase of sufficient apparatus for efficient operation of outfits, etc. Now the question is, What will the shipping companies have to say about it? Will they agree with these articles for the betterment for all concerned? Well, we shall see!

By looking through the mail this month we note that brother Bliss is on the *Tachira* strutting his stuff down the East Coast. . . . That T. C. Ault is on the *S.S. Santa Maria*, trying to keep his eyes open long enough to say hello to the gang. . . . Covak is on the *C. A. Canfield*, and Downing is parading up and down the quarterdeck of the *Louis Luckenback*. Here's one from old H. C. Chetham, who is still holding down the billet up there in police radio of Salem, Mass. More controversy has passed over his head than through a chorus girl's, but he still goes about his business. Good luck, OM. . . . Brother Amsterdam tells the one about the time that he lost his bunk because he requisitioned too much stuff for a new billet. The "op" before him had carried on well enough with the stuff that was there. . . . J. M. Hallie wants to know whyinell we don't tell Jack Schauffler that he wants to hear from him. . . . Sorry, JM, old fellow, but we are having a hard time keeping tags on ourselves. We'll give him a buzz, though.

Well, now that the boys are being organized and the code has been shipped to the moguls down in Washington, things will soon be popping for the whole radio gang. If it is run properly, with due regard and understanding for the viewpoints of the shipping interests and the owners of the other radio business activities, there is no doubt but that real action will be started soon with radio schools doing a land-office business to supply the demand. It does seem that for an art which takes years of hard study to master that it should not be recognized for its real worth. Men are looked down upon because of a few "ops" who do not appreciate what that spark sign means or because of the immense egotism displayed by the youngsters who do not know when the happy medium is reached in dealing with their fellow shipmates. In the words of President Roosevelt, with due respect to him, "If you want better conditions you can have them," but only by helping yourselves and playing the game as it should be played. By working properly, by being men, by demanding respect because of having respect for yourselves and by living clean. The shipping companies will take various things into consideration, but we believe that an equitable agreement can be reached. It cannot be one-sided and it cannot be made to appear that all the wrongs have been on only one side. By stepping to the front, part way, you will be met. The A.R.T.A. now seems to be in the proper hands and with co-operation will

be able to lead the profession out of its present state of indifference and low-voiced mutterings to a better understanding which will be of mutual advantage. Conditions, which in the past have been anything but agreeable, will improve to an extent that even this columnist believes will satisfy the most intolerant persons. So, here's hoping that the future brings calm seas and plenty of shipping and with a reminder that "The Lord helps those who help themselves, but Heaven help those who get caught helping themselves." We sez 73. . . ge . . . GY.

P. A. Systems

(*Continued from page 272*)

Sources of Signal

The input signals to the main amplifiers are as a rule taken from one or all of the following sources, microphones, phonograph pick-up, radio receiver or "line."

Microphones generally used in public-address systems are of the type known as double-button carbon microphones. A microphone of this nature consists of a diaphragm which is suspended at its edges and free to vibrate. On the front and back of this diaphragm are carbon cups or "buttons." These carbon cups are packed quite full of carbon granules. As sound waves impinge upon the diaphragm, it is set into vibration. These vibrations are communicated through physical contact to the carbon granules which change their resistance in exact relationship to the vibrations of the diaphragm. If a microphone is properly connected to the primary of a transformer and a source of potential to establish a current through the microphone, the current through the primary of the transformer is varied proportionately with the resistance of the granules. Thus a voltage is established across the primary which in turn will be available across the secondary for amplification. See Figure 6.

Another type of microphone which has recently come into use where extremely high quality is desired is the condenser microphone.. The condenser microphone varies somewhat from the carbon microphone inasmuch as it has no buttons or carbon granules, but rather a rigid plate in close proximity to the vibrating diaphragm, the two plates forming an electrostatic condenser. If a potential is applied between these two plates, sound waves impinging on the diaphragm will cause it to vibrate, thus changing the capacity of the condenser. This change in capacity will establish a voltage across a resistance in series with the condenser, which will be available for amplification. As the level obtained from such a circuit is extremely low, being as a rule about —70 db., a pre-amplifier of one or two stages is usually built into the case that carries the microphone head. As a matter of fact, when we speak of the condenser microphone, we usually mean the complete unit consisting of the head and this amplifier. The output from the amplifier is usually in the nature of 200 or 500 ohms.

Phonograph pick-ups are made in impedances from 200 ohms to several thousand ohms. If a low-impedance pick-up is used, it should be worked into a transformer that matches its impedance. If a high-impedance pick-up is used, a transformer is rarely necessary or desirable. As a rule, better quality will be obtained from low-impedance pick-ups working into the transformer than will be obtained from high-impedance ones.

In the following article the author intends to deal further with sources of signal for public-address systems. The information contained in these articles has been gathered over a period of some two years of his work with Electrad, Inc., where, as engineer in charge of sound installations, he has had the opportunity to observe the practical as well as the theoretical side of sound amplification.

A S.-W. Super

(*Continued from page* 280)

Refer to Figure 2 and put 2-volt flash lamps in the transmission line as shown at F, F. Make a coil 3 inches in diameter and put on about ten turns spaced ⅛ inch. Inside the tube slip a cylinder of copper fly screening that has a ⅛-inch slit running lengthwise and extends out of the tube at least 3 inches on each end. Inside of this, slips the oscillator wave coil P of an oscillating frequency meter or "driver." You can make up this oscillator in an hour from parts you have in the junk pile. Any of the ordinary self-oscillating circuits will do, such as Figure 3, for example.

Adjust its coil L so that with condenser C it will tune from 20 to 40 meters. After you have this made (and your coil L must be such a size that you can slip it inside the fly screen cylinder shield previously described, put it inside said shield and ground the shield.

Put a 600-ohm resistor at Z in the antenna. Now turn on the oscillator, and as you run over the scale with the condenser C the flash lamps will probably vary in brilliancy or the milliampere meter needle will jump up and down. Try changing the resistor Z to more or less than 600 ohms until you find a value that, as the condenser tunes over the scale, the lamps stay uniformly lighted or nearly so.

That's all there is to that.

A pick-up coil is now slipped into the split shield. This connects to the tuned input circuit of your receiver. The wire screen avoids electrostatic coupling so that only electromagnetic coupling is effective.

Two antenna arrays are constructed like this, and the "A" or antenna array parts should be at least 1000 feet apart and preferably 2000 feet.

Of course, one array can be used alone with all its directional advantages, but there can be no diversity effect with only one antenna.

When two arrays are used, they should be coupled to the input stage of the receiver as shown in Figures 4 and 7.

Now let's leave antennas and theory for awhile and come back to the actual design of the special receiver we are building.

Naturally, when we make the i.f. amplifier tunable over a range of 1087 kc. to 2174 ks., we have sacrificed what has always been considered the prime advantage of the superheterodyne, namely, its two or three-stage if. amplifier working at a low frequency, with very high gain and fixed tune.

However, the extremely high gain and excessive selectivity has more frequently than not been the cause of horrible side-band cutting with the resultant of nothing but low-frequency music.

It must be remembered that the government licenses permit and the high-grade short-wave broadcasters *use* a 20 kc. audio band.

So don't let's sacrifice this wonderful range by having 5 or 6 kc. selectivity in the receiver. We want all the musical notes and their important harmonics up to 10,000 cycles. The high-class short-wave broadcaster knows these higher frequencies are of vital importance and he transmits them, so don't throw them away.

The National MB32 broadcast tuner is an example of a fine engineering job in a multi-stage t.r.f. unit. This set has been taken and slightly remodeled to use the newer -58 type tubes in the r.f. stages and the -56 triode for its detector, which will be the second detector in our superheterodyne combination. Some cutting down of the gang condensers and a few coil turns removed brought its range down to cover 1087 kc. to 2174 kc., and still keeping all its good qualities and band-pass features; 20 kc. band-pass selectivity is maintained at 1500 kc.

We are thus furnished with a fine four-stage, very completely shielded intermediate-frequency amplifier, which is tunable.

The short-wave rebroadcast receiver which I am describing, considered as a complete whole, may be classified as to its parts or sections as follows:

Section A—Antenna arrays and coupling to receiver
Section B—Push-pull two-stage t.r.f. signal amplifier with push-pull first detector
Section C—Crystal-controlled oscillator and harmonic amplifier
Section D—Tunable i.r.f. four-stage amplifier and second detector
Section E—Automatic signal-level regular (a.v.c.)
Section F—Two power supplies, F1 and F2
Section G—Power-line noise and radio-frequency filters

Figure 4 shows the complete circuit of the entire receiver with all the interconnections of the various sections as enumerated above.

So that we will know just what we are doing and the whys, let us study the push-pull t.r.f. input amplifier and its detector. Three National split-stator variable condensers of 100 mmfd. capacity each half of section are required. Two small Hammarlund single type padding condensers are used to couple the second r.f. stage to the detector stage. Use the type that has about 70 mmfd. maximum capacity. Later on the best adjustment of these two condensers will be found to be near 50 mfd. All the .0001 mfd. fixed coupling condensers should be high-grade mica and copper molded in bakelite such as Acme, Parvolt or Dublifier. The cathode resistors are 500-ohm, wire-wound and variable. The grid leaks should be Lynch etallized or of equally good quality. Use Isolantite National six-prong sockets for the tubes as well as the coil forms. Use the new Hammarlund triple-grid tube shields and their 250 mh. r.f. chokes. By-pass condensers should be of good quality and the voltage ratings shown.

The first stage plate coil L2 is made up as follows: All forms are National 1½-inch diameter of R39 material and six-prong bases. Use No. 18 enameled copper wire for the windings and space the turns to fill 1⅞ inch of the length of the coil form.

Important Note: Bring out the end turns to any two symmetrically placed prongs of the base on the side toward the plate terminals of the -58 tubes. Now of necessity the top turns of L2 and L3 will have a longer lead to the base, so when you connect to the plate terminals, allow a corresponding extra 1⅞-inch wire from the lowest turn of the coil to its plate terminal. Bend this extra 1⅞ inch up in a nice easy curve. Follow this procedure in the other coil wiring also. These little niceties in watching details will help keep the circuit nicely symmetrical and balanced so that the electrical centers of the coils will actually be where planned and each tube will work equally with its companion. Watch this same point in all the connections to the variable condensers, plate chokes and coupling condensers.

The following Table III shows the coil data for L, L1, L2 and L3:

TABLE III

Diameter of all coils 1½ inches

	L	L1	L2	L3
20 meters....	4 turns	8 turns	8 turns	7 turns
30 meters....	5 turns	10 turns	10 turns	9 turns
50 meters....	8 turns	17 turns	17 turns	16 turns

Coil L1 deserves special consideration. The secondary of this coil has no center tap, as it finds its own electrical center by the completely balanced nature of the grid input circuit and its symmetrically associated parts and wiring. As it carries an electrostatic grounded shield between the input primaries and the secondary, it must be carefully made.

Take a National coil form made of mate-

rial called R39, cut off with a hacksaw the bottom part that contains the prongs, and also cut off the top flange. This leaves a cylinder 1½ inches in diameter and about 2 inches long. Next cut 2 pieces of ¼-inch bakelite 2½ inches long by 2 inches wide and drill or cut a hole 1½ inches in diameter as in Figure 5. Now cut another piece 2 inches square and fasten this to the bottom of the two pieces of Figure 5 as shown put together in Figure 6.

Now take the bottom of the original R39 coil form that has the prongs and drill a 7/16-inch hole in the center and a corresponding hole in the center of the 2 × 2 bottom piece of Figure 5. Mount with a suitable machine screw and nut. Then slip the R39 cylindrical piece into the 1½-inch holes of the two end pieces and you will have what is shown at Figure 7. A little glue or shellac will hold the cylinder tight in its end pieces. Next make a nice split cylinder of copper 16-inch mesh fly screen that will just slip tight inside the R39 cylinder. The slit in the screen should be ⅛ inch open and all edges should be nicely trimmed so as not to have any frayed edges or loose ends of wires. This screen will have a wire soldered to it and to one of the prongs of the base which will go to ground and the screen should extend 1 inch at each end of the coil form. Coils L are to be slipped inside of the copper screen as far as a point just even with the outside of the bakelite end pieces. This gives about the right coupling.

The little coils I are best made up of double-silk-covered wire with two flexible leads about 4 inches long with little telephone tip terminals on each end. After the coil form L1 is in its socket, these coils L are shoved in with the tip of the finger and their tip terminals plugged into the tip-jacks which are mounted on small strips of bakelite on the left side of this first-stage shield can.

As said before, either one or two antennas may be used.

If only one ordinary antenna is used, there is no merit in using the electrostatic screen, so if you decide definitely at the start only to use your regular antenna, you can dispense with this shield and wind the coil L on same form as coil L1, which may be a regular form R39, and none of the extra rig described in Figures 5, 6 and 7.

A 1934 Model Laboratory Super

(*Continued from page 288*)

not affect the fidelity unfavorably, which is still flat from 50 to 4000 cycles to 5 decibels.

Another change which results in improving the signal to noise ratio is the use of the tuned r.f. stage on both broadcast and short waves. This is a development made possible by research work done by the writer in the past year which has resulted in the ability to accurately track the tuned r.f. stage with the first detector and oscillator circuits. The additional gain of this stage cuts down oscillator hiss and also reduces image interference found on short waves.

A separate antenna coupling coil is used for each of the wave length ranges, thus permitting the use of a tuned or transposed antenna or leadin system when desired.

Still another point of improvement lies in the arrangement of circuit constants to permit the 12,000 k.c. short wave band mostly occupied by foreign stations to fall at the low tuning capacity end of one tuning range. This "low C" circuit gives better signal strength than does a "high C" circuit, making for more consistent and satisfactory reception of 12000 k.c. and 9500 k.c. band foreign stations.

Radio In Education

(*Continued from page* 266)

assembly was the suggestion by Levering Tyson, the council's director, urging consideration of the possibility and advisability of forming a "National Radio Institute," entirely apart from any organization now in the educational broadcasting field but anticipating the co-operation of all, with the sole purpose of raising funds for devising and producing, under its auspices, programs of generally accepted excellence.

Mr. Tyson's suggested "institute" would cover such subjects as public health, literature, science, art, home economics, agriculture, government, history, economics, labor and international relations. Programs would be designed for both school and adult audiences.

"Let me assure," Mr. Tyson said, "that its management would be vested in fifteen governors, men and women from all parts of the country who are nationally recognized for their ability and public spirit; for example: Newton D. Baker, Herbert Hoover, Jane Addams, Alfred E. Smith, Norman Thomas; and that a staff of administrative assistants for all necessary purposes would be engaged."

He further suggested the possibility of the formation of a staff of program producers who would have the point of view of the general public in addition to the knowledge of techniques. He spoke of the possible co-operation of networks and small and large individual stations in order to obtain daytime hours for schoolroom listeners and evening hours for adult audiences. He pictured a capable research staff to make the programs of maximum effectiveness and usefulness to the widest possible audience.

"Of course, the question of finances is of paramount importance," Mr. Tyson declared. "If plans could be thoroughly laid by a competent group, if the expenses of the preliminaries were met by private contribution, and if the public could be made thoroughly aware of the high purpose of the whole enterprise, your director is confident that funds to support such programs for school and adult audiences would be forthcoming. There are forty-eight states in the American Union. It doesn't seem unreasonable to expect that for programs of the type described an average of $50,000 per state per annum could be raised eventually, provided, of course, that the character of the enterprise was unassailable.

"Let us assume that $25,000 on an average per state were secured. This would provide approximately $1,000,000 a year for a series of programs which your director submits would equal if not surpass anything the centralized educational broadcasting systems in Europe have produced."

Mr. Tyson's report dealt with many aspects of his plan and brought out some possible objections. He pointed out that it is not the function of the National Advisory Council to turn itself into a program production enterprise, but expressed his belief that the council may well do what it can to start the wheels turning for the formation eventually of an organization along the lines of the "institute" suggested in his report.

He expressed the belief that nothing would do more to precipitate the whole problem of educational broadcasting than a concerted attempt to form such an organization under properly constituted auspices which could not be assailed by anyone.

The assembly was addressed by many persons prominent in broadcasting and educational circles. The speakers included Professor Herman S. Hettinger, of the University of Pennsylvania; Frank A. Arnold, former director of development of the National Broadcasting Company; Katherine Ludington, of the National League of Women Voters; Hector Charlesworth, chairman of the Canadian Radio Broadcasting Commission; Lloyd Espenchied, one of the American delegates to the recent International Radio Conference; C. M. Jansky, Jr., well-known engineer; Harold Lafount, of the Federal Radio Commission; Mrs. Sidonie Gruenberg, director of the Child Study Association, and Felix Morley, of Brookings Institution.

Mr. Lafount, of the Federal Radio Commission, asserted that economic conditions have necessitated less expensive, but not necessarily poorer programs.

"Educational programs," he said, "could, and I believe in the near future will, be broadcast by the Government itself over a few powerful short-wave stations and rebroadcast by existing stations. This would not interfere with local educational programs, and would provide all broadcasters with the finest possible sustaining programs. The whole nation would be taught by one teacher instead of hundreds, and would be thinking together on one subject of national importance. Personally, I believe such a plan would be more effective than a standing army. I shall not undertake a description of this proposed plan, other than to say it would be very flexible and inexpensive.

"I do not consider this a step towards Government ownership or operation of radio broadcasting stations. The Government's activities would be confined to the transmission and wholesale distribution of educational material and discussions of subjects of national importance to all the stations in the United States, and not to the maintenance of any particular station."

Robert A. Millikan is president of the National Advisory Council on Radio in Education. Noran H. Davis is chairman of the board of directors.

Aside from the numerous broadcasts on the air that are presented under the label of "education," there are numerous everyday programs that are educational as well as entertaining. News broadcasts, interviews with prominent personalities, food talks, Government agriculture talks and many other programs have high educational value.

Magnetostriction

(*Continued from page* 276)

it is easily possible, by magnetostriction oscillators, to reach and maintain lower frequencies for the generation of waves which are longer than those reached in standard quartz-stabilized oscillators. For higher frequencies smaller coils with less inductance and shorter rods must naturally be used.

The original circuit of Dr. Pierce was designed primarily for scientific investigations and for the generation of super-audible sounds and oscillations.

Another experimentator, to whom radio is very much indebted in other fields, used the magnetostrictive effect for the production of sound in another way. This was the late Reginald A. Fessenden.[3] In this construction, a schematic drawing of which is shown in Figure 7, use is made of the effect of magnetostriction to induce *sound in a piano without touching the keys of the piano.*

A coil, L, is wound around the piano string, S, without touching the latter. The ends of the coil are attached to the oscillator. If sufficient current is sent through the oscillator so that the natural frequency of the string is reached, oscillations are generated in this string, as expressed in his claim No. 17, namely: "A sound producing device comprised of a piano sound board, a plurality of magnetostriction wires stretched across the sound board, and means for energizing the same."

By changing the pull of this string, and

adjusting the self-induction of the coil, L, the natural frequency of the string can be brought into resonance with a radio tube oscillator used to generate the operating energy.

[1]G. W. Pierce, Proc. Am. Acad. Arts and Sci. *63*, 1, 1928.
[2]United States Patent 1,113,149.
[3]United States Patent 1,854,025.

Cathode Ray Tubes

(*Continued from page 270*)

discharge devices, etc., are easily and directly obtained without resorting to the usual, tedious point by point method of plotting.

As a final example of cathode-ray utilization most radio engineers believe that the home television receivers of the future will employ cathode ray tubes. By providing electrical means of making the spot of light scan the entire screen repeatedly in a series of lines, and at the same time varying the intensity of the light according to the output of a television receiver, television images may be received with a perfection depending chiefly on the associated apparatus, without any mechanical moving parts.

In a later article, the more interesting uses of cathode ray tubes will be explained in detail, so that any interested reader may carry out the work with the assistance of the information to be given. As mentioned before, other articles of this series will explain in detail how to construct the associated apparatus necessary to operate a cathode ray tube, and how to use such a tube in the reception of television.

The DX Corner

(*Continued from page 284*)

ception of the nearer stations in the United States and Europe consistently good. The best of all and the most remarkable is DJC. I have heard stations in Porto Rico, Mexico, France, Great Britain, Spain and Italy. My set is a 3-tube affair used with 'phones. It is battery operated and uses one –32 tube and two –30 tubes. I have also heard police broadcasts, ship-to-shore, airplane, transatlantic telephone and amateur stations."

Report from Kearney, Nebraska

Mr. Floyd Roberts of Kearney, Nebraska, reports that using an Apex 3-tube converter ahead of a 7-tube receiver his Best Bets are VK3ME, GSB, EAQ, HBL, PHI, XDA, XETE as well as most of the stations in the United States and Canada.

A Report from England

Mr. Alan Barber of Bisphan, Blackpool, Lancashire, England, reports that in one evening he recently heard stations: W2XAF, FYA, DJD, DJB, HBL, DJA, HBP, RV59, OXY, W8XK, 12RO, EAQ, GSB, GSF as the best short-wave stations in his locality. He has heard the following American stations on the long waves: KDKA, WTIC, WGY, WJZ, WABC, WPG, WCAU. His receiver is a home-built 3-tube battery operated set.

Best Bets in New Jersey

Mr. Francis Fekel of the Short Wave League, Vineland, New Jersey, states that using a 2-tube home-built set he receives the following stations best: W8XK, DJB, GBU, DBS, W2XE, W1XAL. DJD. GSD, VE9JR, FYA, YVQ, LSX, EAQ, TI4NRH, CT1AA, HBL, W3XAU, W1XAZ, DJA, W2XAF, GSB, VK3ME, VK2ME, HBP, W3XL, YV1BC, W3XAL, W9XF, VE9GW, W9XAA, W8XAL, W3XAU, GSA, DJC, VE9DR.

He has received a card or a letter of verification from all of the above stations.

Best Bets for Oregon

Mr. Glenn E. Dubbe lists the following Best Bets for Oregon: VK2ME, VK3ME, J1AA, DJD, FYA, EAQ, GSA, GSE, I2RO.

A Report from California

Mr. Melvin Hill of San Francisco, California, reports that he is entering the International Short-Wave DX Contest and sends in information regarding the transmission of XETE. He mentions that J1AA may be heard on 38.07 meters from 10 p. m. to 12 midnight. Station PLE, Bandoeng, on 15.92 meters he reports hearing from 12:30 p. m. on. He also reports EAJ25, Barcelona, Spain, on 50 meters on Saturdays from 9 to 11 a. m. All times are E. S. T. He uses a Scott de Luxe all-wave receiver.

Reception in British Guiana

E. S. Christiani, Jr., of Georgetown, British Guiana, sends in the following list of Best Bets for his location using a Philco model 43H receiver: GSA, GSB, GSC, GSD, CSF, W8XK, W2XAF, W1XAD, W3XAL, RABAT, FYA, VK2ME, DJA, DJB, DJC, DJD, CT1AA, I2RO, HVJ, TI4NRH, HBP, PHI, GSG, RV59, WEA, WEF, YV1BC, W3XAU.

A Ohio Report

C. H. Skatzes of Delaware, Ohio, sends in the following as his monthly report: "Reception during the past two weeks has been very good. The English and Latin Americans roar in like locals. DJD has been heard from 3 to 5:30 p. m. They give a time signal at 4:20 p. m. followed by the news. This is followed by an announcement in four languages, two of them being English and Spanish. DJB on 19.73 signs off at 4:30 p. m.

"One feature of I2RO's transmission distinguishable from all other Europeans is the long bursts of applause between selections. The station seems to favor operatic performances.

"XETE rolls in every night between the hours of 6 and 11 p. m. The German stations work two stations on the air at the same time. DJB-DJD, DJD-DJA, DJA-DJC work together in pairs. GSA is not heard. I have not picked them up for months. GSE and GSB come in QSA-5.

"VE9JR broadcasts market news frequently during the day. PHI and EAQ were well received this month. PHI is heard often between 7 and 8 a. m. All times are E. S. T."

Best Bets in Atlanta

The following stations were mentioned as Best Bets by C. H. Armstrong of Atlanta, Georgia, in his monthly report: DJD, GSD, FYA, I2RO, W8XK, W2XE, GSB, XETE, W3XAL, W8XAL, W9XAA, W2XAF, W3XL, DJC, VE9GW, EAQ, HJ3ABF, YV1BC, PRADO, HJ1ABB, VK2ME, WEF, LSX, WEA, XAM, XDA, PHI, CT1AA, DJA, DJB, GSC, GSE, GSG, GSF, HJB, HJ4ABB, TI4NRH, CNR, RABAT, HBL, HJ2ABA, TGW, VE9CS.

Another Report from British Guiana

Mr. J. A. V. Bourne of Georgetown, Demerara, British Guiana, reports that on an RCA Victor console model R75, he has picked up the following stations: W2XAF, W8XK, WEF, W8XAL, GSB, GSD, W1XAZ, I2RO. He uses a 30 foot outdoor aerial about 30 feet high.

Monthly Report from Winston

Mr. C. H. Long of Winston, Missouri, reports DJB strongly received, GSF fairly well but not as good as formerly. These

stations are best received at about 9 a. m. FYA strongly received between 10 and 11 a. m. 12RO, DJD and FYA continue well received during the afternoons. GSD is also heard quite well. EAQ is best about 6 p. m. XETE is now coming in strong with occasional announcements in English. Interference between W1XAZ and VK2ME has ceased. GSB still continues strong. VE9GW received with remarkable strength on afternoon transmissions but at night it is naturally stronger. VE9GA is strong during daylight.

Readers Who Helped Log Stations for This Month's Report

We are indebted to the following readers of RADIO NEWS who sent in reports of reception this month: R. G. Summers, Buffalo, N. Y.; George R. Heil, Corona, Long Island, N. Y.; J. F. Satterthwaite, Toledo, O.; Al Ratzlaff, North Sacramento, Cal.; E. J. Ellwood, San Pedro, Cal.; N. B. Phillipson, Reading, Pa.; R. F. Hinck, Fort Sill, Okla.; Jack Bews, Revelstoke, B. C., Can.; W. H. Boatman, Atoka, Okla.; G. S. Murray, Leonardo, N. J.; G. O. Hedges, Brunswick, Md.; W. K. Laycock, Baton Rouge, La.; C. R. Anderson, Mason City, Ia.; A. C. Curtis, Roberts, Mont.; W. R. Champion, Portland, Ore.; H. S. B. Binns, Talara, Peru; D. W. Parsons, Roanoke, Va.; R. C. White, Dallas, Tex.; C. H. Armstrong, Atlanta, Ga.; Melvin Hill, San Francisco, Cal.; G. E. Dubbe, Freewater, Ore.; Francis Fekel, Vineland, N. J.; Alan Barber, Bispham, Blackpool, Lancashire, England; Floyd A. Roberts, Kearney, Nebr.; W. P. Cutter, St. George's West, Bermuda; Edward C. Lips, Pittsburgh, Pa.; C. E. Hurlburt, Middle Haddam, Conn.; C. McCormick, Johannesburg, S. Africa; Willard Buettner, Cincinnati, O.; A. B. Snyder, Los Angeles, Cal.; E. Arthur Conklin, Norwich, N. Y.; Pelayo Garcia, Santurce, P. R.; C. H. Long, Winston, Mo.; J. A. V. Bourne, Georgetown, Demerara, British Guiana; C. H. Skatzes, Delaware, O.; E. S. Christiani, Jr., Charlestown, Georgetown, British Guiana.

The Editors acknowledge with thanks the assistance of public-spirited readers who have thus co-operated to make these columns so successful and helpful. Let us urge our readers, one and all, to continue, in even a larger way, to send in these reports. We would be grateful if every reader who hears even a single station would send it in to us with just the data as to its wavelength, the time which it was heard, etc. Of course, we would prefer to get more information, including the Best Bets in each listener's locality, as well as definite logs of stations, their wavelengths and times of transmission. Readers will also help by stating what type of receiver they use in logging these stations.

Backstage

(*Continued from page 295*)

gram. The "Ginger" of the program, Virgina Baker, is twenty-two and a native Philadelphian. At the age of eleven, she was earning money as a singer and acrobatic dancer. She turned to vaudeville for a while and two years ago made her WCAU début.

THEY call him the singing cop. He's not a policeman now, but he did put in some time as one of New York's "finest." Phil Regan, Columbia's young tenor, is the person we're discussing. His first audition at CBS was a failure, due to mike-fright. But he merited a second chance and came through with a contract. It's just a little over a year since he made his radio début with Abe Lyman. Later he was featured for a full season with Guy Lombardo's Orchestra, George Burns and Gracie Allen on

the Robert Burns Panatela program. Now he's on sustaining spots. He was born in Brooklyn twenty-five years ago. Phil became a policeman and just when it seemed that he was settling down to a civic service career, someone advised him to follow a singing vocation. He trained his voice and took his radio audition. He won a stellar commercial booking in remarkably short time.

AN unusual type of variety program was recently launched over the NBC under the sponsorship of the Buick Motor Car Company. The series, featuring a wide array of radio headliners, is presented on Monday nights. Gustave Haenschen's Orchestra and the Ohman and Arden two-piano team supply the instrumental background to the program. Conrad Thibault, baritone, and Arlene Jackson, soprano, furnish the vocal solos. The Songsmiths, a male quartet, and the Nightingales, a girl trio, are heard in special harmony arrangements. Arthur Boran, humorist and impersonator, has the leading comedy rôle. Graham McNamee officiates at the microphone, but an effort has been made to minimize announcements. The continuity was arranged so that each act would move smoothly into another.

VERA VAN, Columbia's newest singing star, acquired her network affiliation after considerable local broadcasting on the West Coast. Vera was born in Marion, Ohio, and spent her girlhood in California. She was a professional dancer at the age of seven. During an illness, when she could not dance, Vera studied voice and was convinced that a bright future awaited her in singing. She was signed by Station KFI, Los Angeles, and later appeared over KMTR, of the same city. The Los Angeles outlet of the CBS, KHJ, soon signed her up. Her radio work on the West Coast soon led to an invitation to come East for a thrice-a-week program on CBS.

WILLARD ROBISON, radio's "evangelist of rhythm," recently switched his broadcasting affiliations to the CBS after a period with NBC. Columbia is featuring him on Sundays in an afternoon program known as "Syncopated Sermons," and on Thursday nights conducting his noted Deep River Orchestra. His Sunday program co-features David Ross, the announcer, who reads a continuity composed entirely of poetry. Willard Robison brings a colorful background to his radio programs. He was born in a small Missouri town known as Shelbina. A few months of piano study

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. All questions will be answered by ail 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 NWS 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.

NOVEMBER, 1933

Technical Information Coupon
RADIO NEWS Laboratory
222 W. 39th Street
New York, N. Y.
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.

☐ 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.....

under a local teacher constitutes his entire academic training. Later, Robison played piano in a nickelodeon, trouped in small-time vaudeville, entertained in dance halls of the oil boom days and starred in medicine and old tab shows. When Robison organ-

WILLARD ROBISON

ized his original Deep River Orchestra, he established a unique spot for himself in music circles. Negro spiritual and folk tunes of the South have been his inspiration since childhood.

The Service Bench

(*Continued from page* 301)

ing Company of St. Paul, Minn., and is shown in Figure 6. Two 2A3 tubes in push

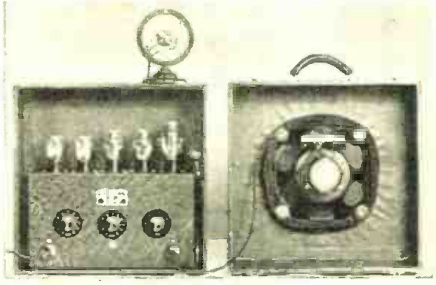


FIGURE 6

pull deliver 15 watts of Class A output with less than 2.5% haronic distortion.

A Short-Circuit Turn Indicator

The detection of short-circuited turns is usually beyond the sensitivity of resistance

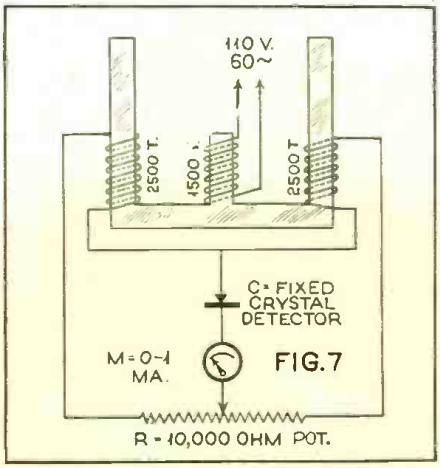


FIG. 7

measurements, and is a problem which often confronts the serviceman. Tom Martel, of

Germantown, Pa., sends us the following data on a short-circuited-turn detecting device:

"The circuit (Figure 7) is that of a Wheatstone bridge, two arms of the bridge being made up of resistance and two of inductance. The indicator is a 0.1-milliam-

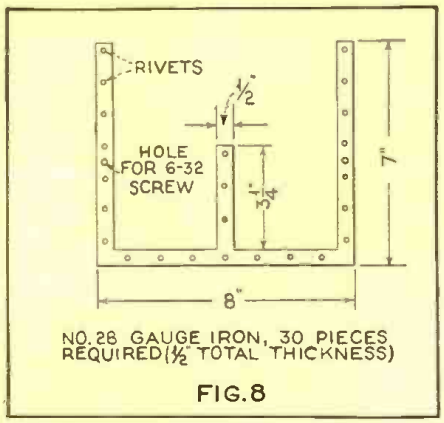


FIG. 8

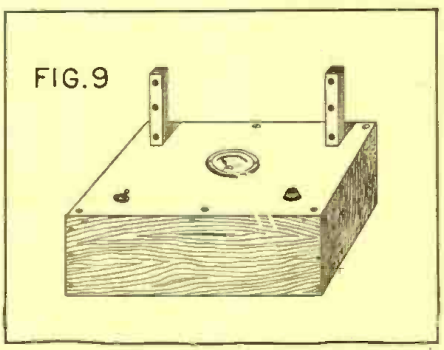
pere meter in series with a crystal detector or a small single-wave, copper-oxide rectifier. The 10,000-ohm potentiometer supplies the resistance arms and also acts as a zero adjustment to balance out any difference between the two inductive arms.

"The core of the device is made of No. 28 gauge lamination iron cut to the dimensions shown in Figure 8. These laminations are stacked and riveted together.

"After the core has been assembled, wrap each leg with two turns of heavy cardboard, 3-inches wide. Impregnate the cardboard with shellac and when dry remove from core and use as winding forms. If the constructor has a lathe his winding will be simplified, as the cardboard forms may be slipped over a piece of wood and fastened in the lathe chuck. Wind two of the forms with 2500 turns of No. 32 DCC wire and the other with 1500 turns of the same wire. These windings need not be made with extreme care. However, try to keep the windings symetrical in respect to each other so that the inductance of the two similar coils will be nearly the same.

"When the coils have been completed place them on their respective legs of the core, the two larger coils on the outside legs and the smaller one on the center leg. Constructional details are suggested in Figure 9. When connecting the rectifier bear in mind that the copper plate is positive and should make contact with the positive side of the meter.

"After the wiring has been completed connect the center coil to a 110-volt, 60-cycle line. The meter will probably show a deflection but this can be balanced out by use of the potentiometer. To check a coil, slide it over one of the protruding core legs. If the meter gives an indication the coil has a shorted turn in it somewhere. A shorted turn causes a change of flux in the core over



which it is placed thereby changing the inductance of the coil directly underneath which unbalances the bridge and allows current to flow through the meter circuit."

Emergency Mike Repairs

"My partner and I operate a mobile public-address system for street advertising, sporting events, meetings, etc. We are using a condenser microphone, similar to the one described in RADIO NEWS several months ago, made from a discarded speaker unit. On one occasion, just before going on the street with some advertising, the diaphragm of the mike was accidentally damaged as we attempted to stretch it. Something had to be done about it immediately! We purchased a 5-cent Hershey almond bar, and carefully unwrapped the candy, taking great care not to damage the tinfoil. When it was removed, we scraped the tinfoil to remove

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the last of the candy, placed it between the pages of a magazine and pounded it with our fists to flatten it. This done, we replaced the old diaphragm with the tinfoil and carefully stretched it. We found that the tinfoil gave very excellent results and put us 'on the street' within twenty minutes from the time we first discovered our trouble."

Clarence J. Anderson,
Burlington, Kansas.

S O S

A radio serviceman of Glendale, Long Island, writes that his toughest problem is the detection of intermittent "opens" in condensers and resistors. The *Service Bench* has already published quite a bit of data on this subject, but our correspondent is asking for further dope from other servicemen on "Symptoms and Cures for Intermittent Opening of Blocking, By-pass, Filter Condensers and Resistors." As he points out, "if we could detect the intermittently open condenser by direct test, rather than hit and miss methods, the time required on many service jobs would be cut considerably."

THIS MONTH'S SERVICE SHOP

The C. H. Ramm Company believes in mottoes and good equipment. Their first motto is "The Pathfinders of Trouble", and their shop equipment, shown in this month's heading, consists of a 1000 cycle hummer, 600 volts break-down condenser test, Jewell ohmmeter, capacity meter, test panel, Weston oscillator and a continuity meter. All of which contributes to speed, accuracy and their second motto which states, "We Check and Double Check Your Radios!"

ALL IN THE DAY'S WORK

Use immediately crops up for the short-circuited turn indicator described in this month's *Service Bench*. Charles F. McNulty, Clearfield, Pa., writes:

"Within the past few weeks I have had several sets in the shop which had been struck by lightning. The antenna coils checked okay on a resistance meter, but on close inspection it was found that two or more turns had fused together."

Mr. McNulty continues: "A short time back a Bosch model 5 personal radio was brought into the shop. The tone was badly distorted and at first I suspected the audio system. However, after an hour of close checking, the trouble was found to be caused by a filter condenser that had melted loose and dropped down to the chassis, shorting the bias resistor to the power tube."

A Common Source of Noise

"I was called upon to service a Scott A.C. 10 receiver and ran into a peculiar condition. The bronze name plate and escutcheon would run hot after the receiver had been turned on for some time. Everything tested okay, but reception was accompanied by considerable noise on all dial settings. Inspection of the toggle switch disclosed that it was badly burned and charred. A new switch cleared up the difficulty."

Ray E. Everly,
Newton, Ill.

Vibration and Tube Life

Harry D. Hooton, of the Radio Service Company, Beech Hill, West Va., sheds light on an unusual case of tube demise.

"A few weeks ago I serviced a midget set using a single -45 as an output tube. The

owner complained that he was troubled with excessive 60 cycle hum and that he found it necessary to replace the power tube quite often because of burn-outs.

"Naturally, I expected to find an excessive filament voltage, since the tubes were burning out, but everything checked okay. I noticed there seemed to be a tremendous amount of vibration, especially when the volume was set at maximum, so I checked over the audio transformers and the power supply. The trouble was soon located and proved to be a loose lamination in the power transformer, moving in unison with the 60 cycle current. Since this transformer was mounted close by the –45 output tube, the vibration literally 'shook the filament to pieces'."

Motorboating

In the delicately-balanced, high-gain circuits of today, even a minor variation in voltage constants may be enough to set up motorboating. Stewart J. Robinson, of Sacramento, California, checks up on this trouble in the Westinghouse WR-15 and the R. C. A. 78 and the R. C. A. 11.

"Motorboating in these sets is generally due to oscillation in the preselector or first detector circuits, which may be caused by an open cathode bypass condenser or the fact that the rotating plates of the tuning condenser are not grounded by the forked springs—the latter condition occurring when the springs become dirty. Cleaning the contacts with sandpaper and bending to provide greater tension will relieve this latter trouble. Of course motorboating in any set employing automatic volume control may often be traced to open condensers in the a.v.c. tube circuit or cathode condensers in circuits affected by the automatic volume control. And occasionally, in the models under consideration, motorboating results from incorrect alignment." (Probably over-correct alignment!—*The Service Editor.*)

Pity the Poor Fuse

The ordinary bowl-type heater element ranks a prominent place in the service kit of E. J. Alexander, St. Louis, Mo. In cases where repeated fuse blow-outs suggest power supply trouble, he hooks this heater element in series with the power line. It will usually pass enough current to operate the set, and, if a short-circuit or near short-circuit exists, the fuse will not blow. Also, the degree to which the heater element glows is fairly indicative of the short-circuited condition.

Best Oklahoma Reception

Mr. Robert Woods of Sand Springs, Oklahoma, sends in the following list as received there most reliably: XETE, W3XAL, HJ4ABB, W2XE, W8XK, EAQ, W3XAU, VK3ME, YV1BC, W9XF, VE9GW, FYA, W2XAF.

Best Bets from Iowa

Dr. A. E. Braley of the State University of Iowa, College of Medicine, writes us giving the Best Bets for his location: XETE, FYA, GSF, DJB, W8XK, W2XE, W3XAL, HVJ, I2RO, DJD, GSE, GSD, CT3AQ, EAQ, VK2M, VK3ME, PRADO, HBL, OXY, DJC, HJ1ABB, HJ2ABA. Dr. Braley uses a home-made, two-tube a.c. receiver, consisting of a type –35 detector and one stage of resistance-coupled amplification. Built the whole set in about three months, winding the power transformers himself from parts he had laying around the house for years. He says the receiver cost him 40c in cash. Its looks are only fair, compared to other short-wave sets in town, but he claims to have several times more stations than most of the other receivers.

PRECISION H. F. PARTS

for Amateur, Experimenter and Constructor

AC SW58 RF TUNER

To those who prefer TRF, the ACSW-58 offers extremely low background noise and high usable sensitivity, together with unequalled flexibility and ease of control. The thoroughly engineered circuit employs five tubes with push-pull output. A D.C. model, Type SW-34, is also available.

AIR-DIELECTRIC SHIELDED PADDING CONDENSER

Almost as small as a walnut, the NATIONAL Air-Dielectric Padding Condenser is designed to replace the inefficient mica condensers commonly used. Isolantite insulated, and thoroughly shielded, it occupies a space 1¼ inches in diameter and 1¼ inch high. It is described on Page 15 of the General Catalog No. 220.

PRECISION TYPE N SHORT WAVE DIAL

One phrase, "Precision High Frequency Dial," describes the character and purpose of this thoroughly engineered product. "Precision," because of its accuracy makes tuning easy and calibration authoritative, and "High Frequency" because every detail has been designed to fit it for this most difficult service. Thoroughbred in appearance as well as action, it will improve the appearance of your receiver as much as it will improve the accuracy of your wavemeter.

FRONT-OF-PANEL-CHANGE COIL FORMS AN, SOCKETS

Bring your short-wave receiver up to date with coils wound on NATIONAL Regular and Band Spread Coil-Forms with grounded and shielded cast-metal handles, and built-in air-dielectric padding condensers—as used in FB-7 and FB-X Receivers. These forms are made to fit the NATIONAL special 6-prong front-of-panel coil-socket with aluminum shield and external terminal strip.

COIL & TUBE SOCKETS

These new NATIONAL Isolantite sockets, designed specifically for short-wave service, will reduce losses at this point to a minimum. Made with convenient prong-guiding channel, and in 4, 5, 6 and 7-prong styles.

RF CHOKES

TYPE R100 RF CHOKE

And completing the NATIONAL line of High Performance R.F. Chokes, the type R-100 is particularly effective for short-wave receivers. Rating: 125 milliamperes, 2½ millihenries, 50 ohms D.C. resistance.

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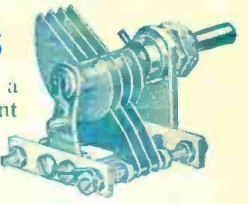

NATIONAL makes a full line of 52 different models of short-wave and ultra-short wave variable condensers. All midgets have Isolantite Stator insulation, no shorted turns, constant impedance rotor-connections to eliminate crackle and noise, mechanical rigidity and electrical stability. Fully listed in Catalog No. 220.

STANDARD R-39 FORMS

These forms are made of R-39, the special high-efficiency dielectric for short-wave work. Reduces losses—will not deteriorate. Made in 4, 5 and 6-prong models. Fit NATIONAL sockets.

FB-7 SHORT-WAVE SUPER

When you see and operate the FB-7 you will understand why this seven-tube short-wave superheterodyne receiver has become so popular not only with the experienced amateurs, for whom it was designed—but with short-wave broadcast listeners everywhere. Two stages of high-gain air-dielectric tuned I.F. amplification (six tuned circuits) give very high sensitivity and selectivity. A class A Pentode audio output assures ample volume and quality. Full range 9 to 200 meters. Our catalog gives all the features—many of them exclusive—of this outstanding receiver.

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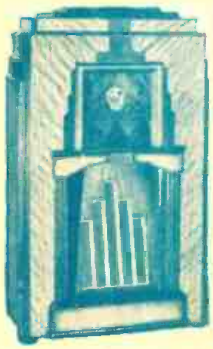

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