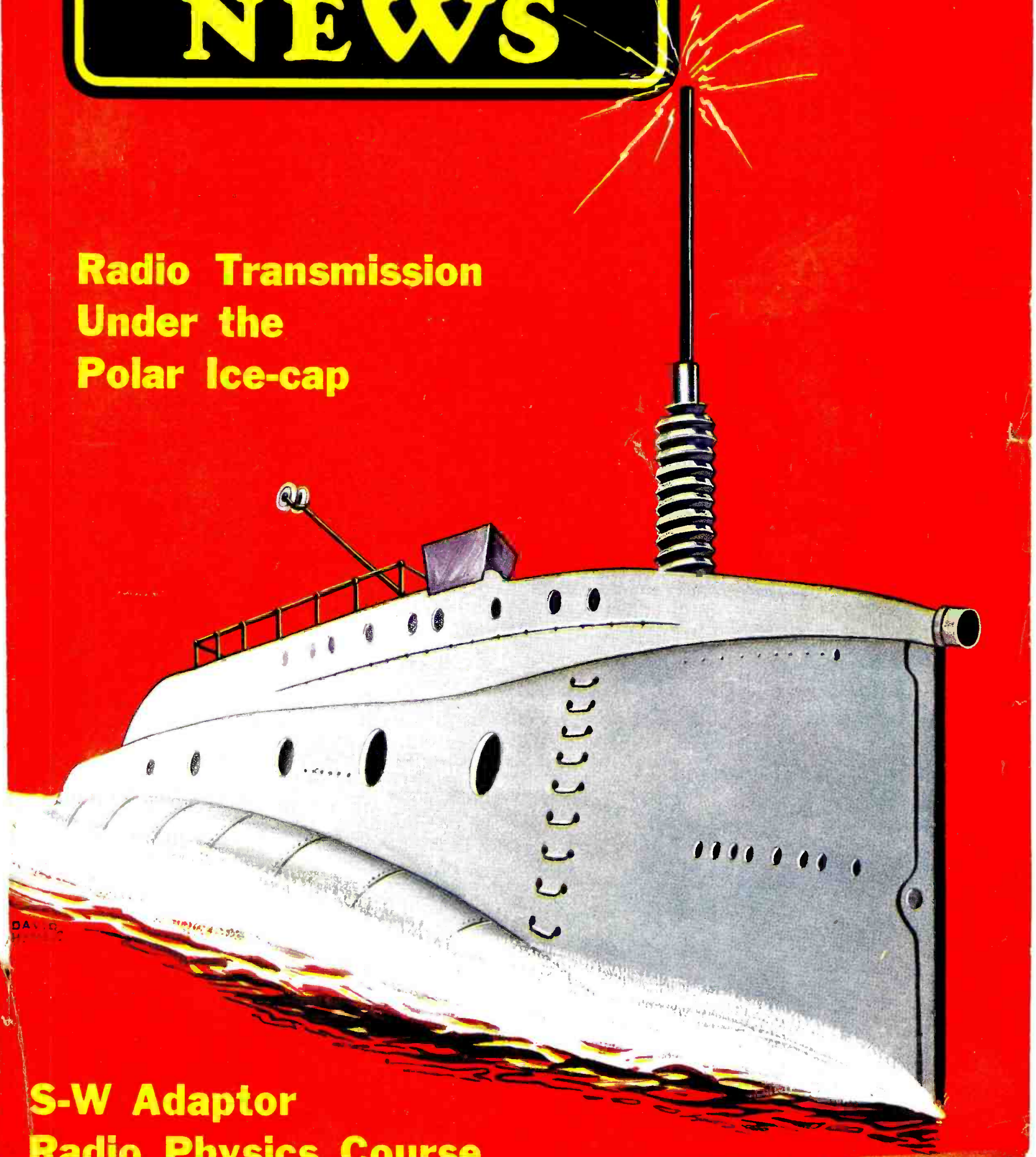
RADIO NEWS PRIZE RECEIVER

RADIO NEWS

SEPTEMBER
25 Cents



Radio Transmission
Under the
Polar Ice-cap

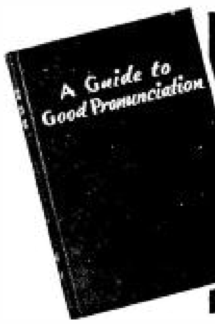
S-W Adaptor
Radio Physics Course

Grammar At a Glance

A new and unique method for simplifying English grammar and giving you an easy understanding of its essentials. The same demonstration sentence, with slight variations, is used throughout to illustrate the eight parts of speech and their correct use. A practical self-testing system is included. It is an amazingly simple and effective method and will surprise you with its ease and simplicity. At last English grammar is made easy.

Common Errors In English Corrected

The authors have tabulated the errors in English that are most likely to trip you up. They point out the error and explain the correct form. You will be delighted to see what great progress you can make in polishing up your speech and writing with this book, and how easily you can save yourself from the embarrassing bad English that mars your speech and handicaps you in all your associations.

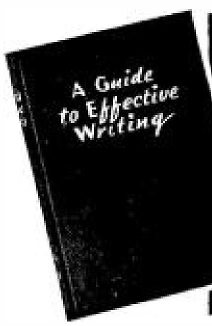


A Guide to Good Pronunciation

Thousands of the words most frequently mispronounced are listed here with correct pronunciations. For each word a guide to correct pronunciation in the form of simple words with the same sounds is given to make it easier than ever before to learn good pronunciation. An hour with this book will probably correct dozens of mispronunciations of which you are now unconscious but which hurt you with others.

The Ready Vocabulary Builder

A remarkably helpful book with over six thousand synonyms and antonyms. They are presented with examples of use so that you grasp fully the distinctions in meaning and the correct use of each word. This book will rapidly build your vocabulary and give your speech and writing more power, color, exactness. It will give you that valuable ability to use the right word in the right place.



A Guide to Effective Writing

Quick and useful information on every form of writing—business, social, literary. We are all writers in one way or another and we all need facility in writing. The knowledge of what makes writing effective, that is so plainly and thoroughly explained here, will prove of enormous dollars and cents value to you whenever you undertake the task of writing anything.

A Guide to Effective Speaking

A veritable encyclopaedia of facts on all the practical problems of speaking, formal or informal, business or social. No one who understands the basic principles of speaking explained clearly here need feel any hesitation or embarrassment when called upon to express his ideas in a conference or interview, on a platform or at the speaker's table, in a social group, or anywhere else.

Good English
Opens the Way To Good Fortune

It is the man who can express himself well—whose mastery of English enables him to present his ideas effectively—who captures the richest prizes in any line of work or any social circle. To be able to speak well, write well, converse well, present your ideas forcefully in conference or interview, is to put yourself in a position where opportunities come to you—and can be seized. Slip-shod English is a fatal handicap. It prevents many a man with real ability from winning the success he should have. Too often the capable business man, the talented mechanic, the well-trained professional man, is outstripped because he cannot do justice to himself by expressing himself well to others and sees a man of smaller ability forge ahead of him. Beware of shabby speech and writing. Give your real ability its proper chance.

Here's Your Good English Tool Chest

A new way to clear up your English troubles—to make you a master of good English—is offered in the most practical and usable series of handy volumes ever prepared. Here are six Rapid Guides to Good English that will appeal immediately to the practical person who doesn't want school-room exercises or long-drawn-out discussions, but clear, brief, easily grasped facts about the correct use of English.

A New and Sensible Method For the Practical Man

It is not difficult to master good English if its study is undertaken with common sense. There has been a real need for this common-sense explanation of the subject—for a series of *Rapid Guides to Good English* that would meet the demands of daily life and give to busy people a quick, simple, usable survey of the essentials of correct usage. That need has now been met by this series of six convenient handbooks that give you all the facts you need to be a master of English. This series is neither too childish for practical value, nor too advanced for easy understanding. You are not warned against "I seen" and "You is," nor are you bored with technical abstractions. The series is intelligently planned to be intensely usable for practical people.

A Course of Study A Handbook for Reference

This new series of six *Rapid Guides to Good English* has been prepared by a group of three practical, widely experienced instructors: P. T. Ward, Instructor in Business English at Columbia University and Lecturer in Business Correspondence, Metropolitan Life Insurance Co.; C. B. Anderson, Instructor in English, Columbia University; A. W. Riley, Lecturer in English, Columbia University. They have divided the whole subject of good English into its six natural classifications, and explained each of the six in a volume that is 100% usable. See the descriptions of the individual volumes to the left. The series as a whole has been related and unified. It represents the most valuable exposition of good English for the practical man that we, as publishers, have ever seen.

Examine Them All FREE

Each one of the six books is based upon a definite, new, practical idea worked out to make the subject clear, its treatment useful, its mastery easy. You will see this immediately for yourself when you examine the books. So we want to put them into your hands for FREE EXAMINATION without obligation or expense to you. If you agree, when you see them, that they are the most helpful books on the subject you have ever seen, keep them, make a first payment of $1.95, and three monthly payments of $2.00—a total of only $7.95. If you do not want them, send them back and owe nothing. Don't let others have a better chance than you have. Give yourself the mastery of English that is essential to success.

MAIL THIS COUPON

D. Van Nostrand Co., 250 Fourth Ave., New York.

Send me for free examination the six Rapid Guides to Good English. Within ten days I will either return them to you or make an initial payment of $1.95 and three monthly payments thereafter of $2.00—a total of $7.95. (5% discount for cash with order. Same return privilege.) (R.N. 9-31)

Name..

Street and Number...

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

Business Connection...

Reference...

VOLUME XIII — September, 1931 — NUMBER 3

CONTENTS

(*Cover Design by David Hymes*)

DEPARTMENTS

Published Monthly by Teck Publishing Corporation, *Dunellen, N. J.*

OFFICERS

Lee Ellmaker, *President*
Warren P. Jeffery, *Vice President*
William Thompson, *Treasurer*
Wesley F. Pape, *Secretary*

EDITORIAL AND EXECUTIVE OFFICES
350 HUDSON STREET, NEW YORK CITY, N. Y.

Entered as second class matter at the Post Office at Dunellen, N. J., under the act of March 3, 1879.

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.

The Editor—to *You*

THE modern progressive serviceman is steadily and surely becoming one of the most important figures in the radio field. He has proved his worth, not only to many millions of set owners in keeping their radio apparatus in fine working condition and in advising them how to get the most out of radio broadcasting, but, also, as a good-will emissary for the industry at large—RADIO NEWS is very much interested in the welfare of these hard-working young men who are doing so much for radio. Our editorial staff is constantly at work investigating and solving their problems, helping them not only to educate themselves in radio technique but also contributing towards their business training, their methods of servicing and telling them how to augment their own business in an economical, profitable way that will be of mutual advantage both to them and their clients.

* * *

IN THIS way is being born a new type of serviceman. We might call him a "service-salesman." He is quickly learning how to run his business, his radio hospital, in an efficient, courteous and profitable way. He is giving good service; he is at your beck and call night and day whenever your set goes wrong—just before a World Series game, a prize fight, or the reception of world fliers. He is ready to advise you expertly on radio matters, whether it be how to tune your set properly, or what set to buy to suit your needs best.

* * *

RADIO dealers are also very much interested in his work, for they themselves must rely on the serviceman not only to install and put in proper operating condition all of the radio apparatus they sell for home use, they must also rely on the serviceman for practically their complete sale of replacement tubes, batteries, volume controls, burned-out resistors, power packs and condensers. "A mighty man is he," although he seldom has time to spend under any spreading chestnut tree—he is busy at his work day and night. The modern serviceman works hard; he is conscientious and reliable.

* * *

HERE are excerpts from a few letters from servicemen who appreciate the efforts "our own" magazine is making to help them in their service work:

"I think RADIO NEWS *is the best magazine ever published for the serviceman and radiotrician and I read it from cover to cover."* Norman Miller, Hebron, Nebraska.

"I take this opportunity in congratulating you for the help your magazine lends us servicemen." A. L. Gomez, Guadalupe, Mexico.

"I am a subscriber to RADIO NEWS *and have files as far back as April,* 1926. *I would not take ten times the subscription price and be without them."* S. S. Fluhart, Fluhart Radio Laboratories, Seattle, Washington.

"RADIO NEWS *is getting better and more valuable every month to me in my work."* Richard Wagner, Greenwich Village Radio and Phonograph Company, New York City.

"There might be other radio magazines in the United States, but there is only one RADIO NEWS. *I must say that the material presented in one month's issue of your magazine is worth more to the radio man than a five-year subscription would cost. I appreciate your articles for the serviceman and hope you will continue to help us in our many problems."* James W. Knecht, West Salisbury, Pa.

"I have nearly every copy of RADIO NEWS *since the days of the 'Electrical Experimenter.' It is getting better all the time."* Raymond L. Howell, Electric Shop, Oswego, New York.

"I have been a reader of your splendid magazine for years and I want to say right here that it is the best in its field. The things I like best are your fine service and short-wave articles." L. C. Glascow, Manager, Radio Service Department, Shamrock, Texas.

"You have a great magazine and I like it better than any I have ever read." Backs Radio Service, Chicago, Illinois.

"I wish to thank you for the many helpful articles in RADIO NEWS." Harry R. Robinson, Serviceman, Shaumavan, Sask., Canada.

* * *

THE editor is also receiving many letters from radio experimenters with television. It is evident from these that our readers are enthusiastic about what they have been able to "see" over the ether.

Richard W. Walker of Washington, Pa., writes: *"I have just completed the television receiver in your July number and it certainly does work fine. I went by your plans exactly. It was just like reading a book."*

* * *

Speaking about short-wave reception, two more letters received by the editor show that real results are being obtained on receivers described in RADIO NEWS.

"I have just read your article, 'Stepping Out for World-Wide Reception.' *I obtained a new Scott set on April 18th and on the afternoon of the 24th I was listening to the same program you were receiving from G5SW, Chelmsford, England. Have also had 12RO, Rome, several times."* L. L. Haughn.

It is interesting to note that Mr. Haughn was receiving the same spoken program that our Technical Editor recorded on a phonograph in our own laboratories, part of which was transcribed in the July issue.

* * *

And then, from the other side of the pond, a reader in England states: *"I see that a good deal of space is devoted in* RADIO NEWS *to the reception of European short-wave stations. You may be sure that this enthusiasm for DX reception is reciprocated here. As I write I am listening to the music of W2XAD. The receiver I use is a copy of the Cornet described some time ago in* RADIO NEWS, *with a pentode in the last stage. On some nights I have to detune for fear of waking the neighbors. Here are a few high spots in WGY's program: the mimic air battle over New York, the relay from the 'Empress of Britain' and a recent relay from Rome. Strange to say, this last item was received better from America than I could get it from Rome direct."*

* * *

RADIO engineers, technicians, and experimenters have become so accustomed to thinking of the vacuum tube in terms of circuits and voltages that they lose sight of the fact that the tube is an electronic device. Emil Reisman contributes in this issue an interesting and instructive article on how the electrons activate a vacuum tube.

* * *

ONE of the continual worries in the mind of a radio engineer is the fear that he may be getting into a rut; that he is not keeping up with the art in general. Ralph Glover tells how to keep up to date with radio and how to do it systematically so that it does not become a burden to keep the necessary information at your fingertips.

* * *

MCMURDO SILVER continues his series of articles on the design of modern receiving sets, with a contribution describing a superheterodyne employing an ultra-selective amplifier and a compensating audio system to replace the high frequencies in their correct relative strengths. This might be considered a modification of the Stenode system without, however, using a crystal filter.

* * *

THOMAS ELWAY tells us something of the psychology of listening-in and discusses how-to and how-not-to do it in order to get the best results.

* * *

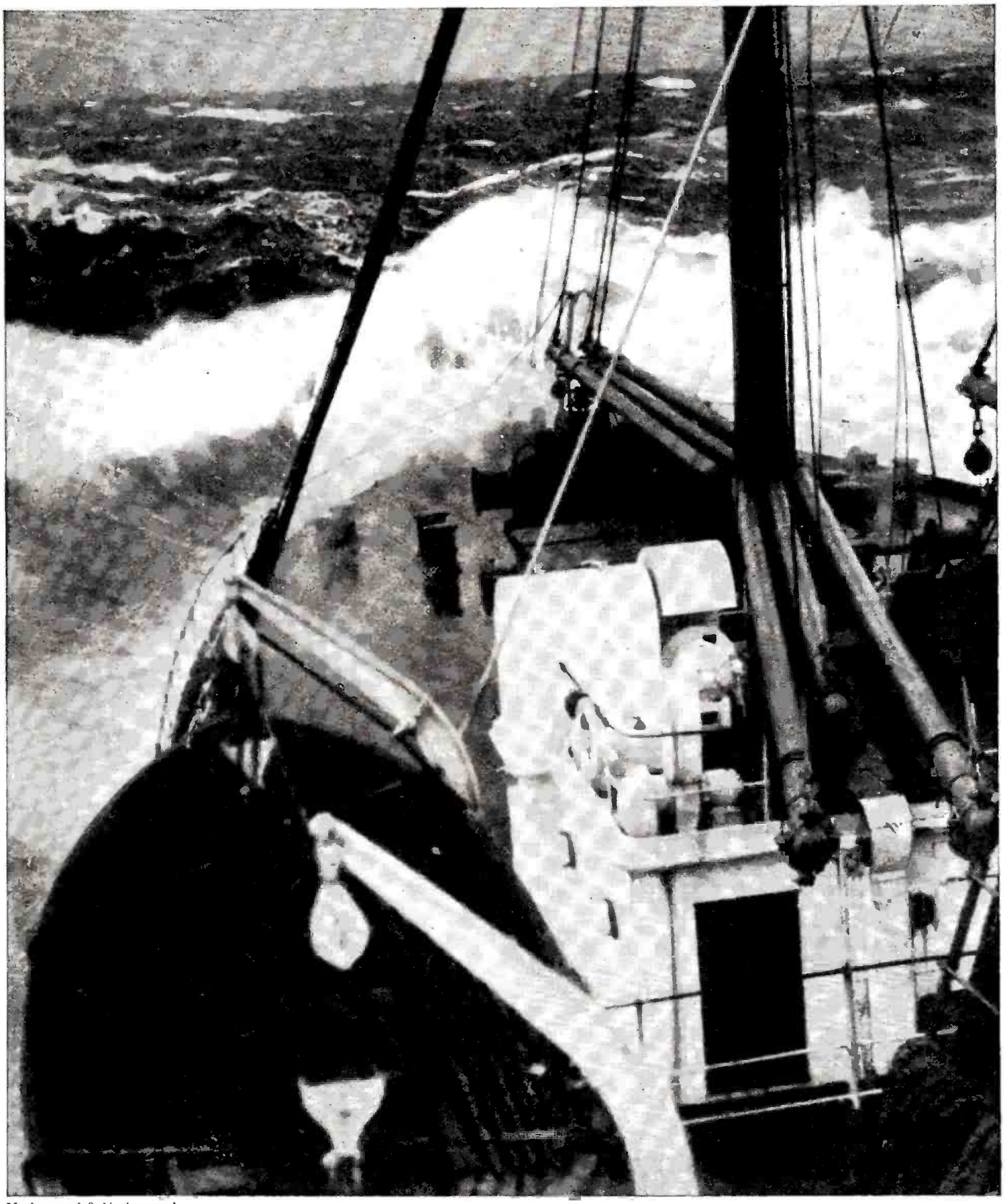
THE editor invites our readers, after they have read the remaining articles on radio transmission in out-of-the-way places, the field of radio in education, amateur radio transmission, new broadcasting ideas, television, voltage divider design, and our helpful departments, to write to us on how they liked them and what additional subjects they would be interested in.

"Radio broadcasting to-day ranks as one of the most important factors in raising the level of general knowledge of the mass of the people. In years to come the invention of the radio will be recognized along with Gutenberg's invention of movable types as an outstanding step forward in education. The steady stream of information, in the form of noteworthy lectures, addresses, and talks by experts that it pours forth day and night is bound to have a marked effect in broadening and heightening our civilization.

"The work that RADIO NEWS *is doing in providing teachers and students of physics with up-to-the-minute information about new technical developments and applications of radio is in my opinion of distinct educational value."*

E. J. Kilduff

Chairman, Dept. General Courses, and Assistant Dean, School of Commerce, Accounts and Finance, New York University



Underwood & Underwood

Seeing the World as a Radio Man

The life of an operator at sea is often packed with adventure and unusual experiences. It broadens the outlook of the individual and at the same time offers many opportunities for study during "off" periods. This is attested by the number of executives of large radio enterprises who made their start as radio operators on shipboard.

"SPARKS" Sails the Seven Seas

A most unusual and intimate chronicle of one man's experiences tracing back over twenty-two years of radio. It is not one of these "intimate interviews" of a world-famous figure, but the story of a man who has lived and enjoyed life

By Fred Victor Griffin

I WAS sitting by my radio tonight. I unwittingly turned the dial to the extreme and presently a buzzing of a ship's wireless floated through. Most times I would have been annoyed, but tonight I was in a thoughtful mood and I found myself reading the message being transmitted by a ship at sea. Then—the old days came back to me and I'm passing them on to you—perhaps you will be interested—so many people listen to their radios, not knowing how much it has meant in the lives of some of their fellow men, in the pioneering of this great science which has brought joyful entertainment to the homes of the multitude.

"HELLO, Tommy!"

"Hello, Bill! By Jove, old top, haven't seen you for ten years, and how's that jolly, fat-headed brother of yours getting along?"

To which my brother replied that I was not even heading the tide, but was merely anchored in the sea of unemployed, which was at high tide in jolly old London, don't yer know, at that particular period, which is just about twenty-two years ago.

Tommy, on hearing this, decided to take a friendly interest in my affairs by suggesting that my late Indian cable experience would be of great value in wireless, which was then beginning to come into general shipping and commercial use.

As vacancies were opening in many countries, one of which was British Columbia wherein a friend had recently made a great success in the government service, it was suggested that it might shake up both my mind and body by traveling in this direction.

Thus the news of meeting with an old friend brought home by my brother, coupled with the suggestion that it would do me a lot of good to try out British Columbia, having had no success in London, and thusly also did it come to pass that, after due consideration by all members of the family, and with the intense arousing of my interest in the outside world, that in April, twenty-two years ago, I landed in Victoria, British Columbia, knowing no one, knowing nothing, but hoping for the best in the general direction of a position in the Government wireless service.

I join the Eskimos and adopt the native dress of the Arctic

My interview with the Government Superintendent ended, to my great delight, in my being installed in the Government wireless station in that salubrious little spot known to all Victoria folk as Gonzales Hill, where my time was spent being initiated into the wonders of wireless and its general complications.

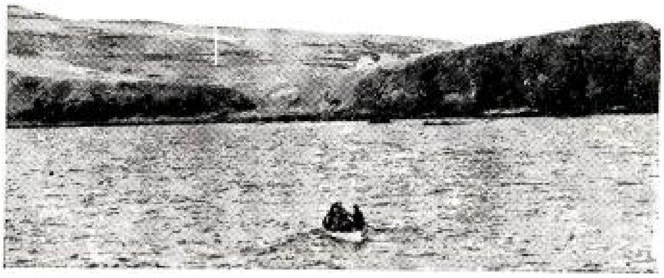
This was the beginning of my career in the wireless world, and I felt extremely happy in the good fortune which Fate had bestowed upon me, until a few weeks later when I had a call from the city office, where my presence was desired by the Superintendent, the result of the conversation with whom found me no longer a Government employee.

It was just this, my dear friends in the Old Country had kindly included in their parting words of advice prior to my sailing across the Atlantic, the fact that the great, wide, wild and open western country of Canada was a place wherein all could be thoroughly independent, there being plenty of easy wealth and a long list of promising positions—not jobs, mind you, but real positions—making it possible to look carelessly into the boss's face and tell him to go to blazes.

It was this kindly advice which I followed on being informed that I was destined for Triangle Island, a small lighthouse and wireless station out in the open Pacific about forty-five miles to the northwest of Vancouver Island, where the final communications were then made with the trans-Pacific ships traveling the northern great circle route to Japan, by the Aleutian Peninsula and its broken archipelago of smaller islands. I was told to go to this island by the next revenue cutter, and in reply I told someone else to go somewhere else, so that instead of traveling by revenue cutter out into the Pacific, I traveled by foot out into the streets of Victoria.

Oh, no! I did not find the numerous positions or even

Japan has some glorious temples. Here's a typical one of Kamakura



United States Naval Radio Station at Unalga, Unimak Pass, in the Aleutian Peninsula, Alaska

Ever been shipwrecked? Here's an uncomfortable position—Japanese fisherman on bottom of boat after typhoon in the Inland Sea of Japan

What! No motor car? No, sir, not on your life, while there's rickshaw comfort and means of locomotion that can't go wrong. A snap from Yokohama

mere jobs, and there were no ten-dollar bills lying around the streets, so when the landlady showed me the way out, and the pawnbroker had taken his fullest interest in my belongings, I found the bed which my lack of experience in the world had made for me—it was a distinctly hard one, consisting of a plank and some straw carefully arranged in a corner of the shipping wharf where I calculated the wind would be least.

However, I guess it was healthy for those who like it, but it spoils the crease in one's pants so much and increased the crease in my food depository to such an extent that I reluctantly became one of those beastly odd-job farm laborers. However, not too much of this for me, so I soon decided to make a name for myself, and two months after I had joined the ranch at Mount Tolmie, which is situated just outside of Victoria, I found myself in Seattle, after a stowaway voyage, and enrolled on the articles of a noble little fishing steamer as wireless operator and bound for the fishing grounds off the Queen Charlotte Islands to the northwest of the British Columbian coast, and bounding Queen Charlotte Sound, the terror of the tourist traveling the inside passage route to Alaska, for it is the first stretch of the open Pacific in their trip.

Wireless, Baiting and Cooking

This was an excellent job, for I had much opportunity of studying languages—Swedish, Norwegian, German, Russian, Dutch—good, bad and indifferent, the skipper and myself being the only English-speaking people aboard—but the interest of fishing somewhat spoiled my study of wireless, and, anyhow, there was only one message to transmit every two weeks, and I found a very remunerative occupation in baiting gear at a dollar a skate, which, after some practice, took just over an hour to accomplish. Later, also I took on the catering to the fishermen by becoming assistant cook and bottle washer at a dollar and a half a day, so that, between the wireless, baiting and cooking, in about three months I soon had several hundred dollars in my pocket and decided to try out a passenger vessel.

On returning to Seattle, I reported as usual to the chief, requesting that another victim be sent to the fishing steamer, as I had had my bite and it was up to another operator to be the fish and be baited for a few months of halibut hauling.

My request went through, and a few days later I was bound for the Aleutian Islands with a staff of cannery workers on a glorified steam schooner, which was only seaworthy on one side—however, with an ample supply of canvas and tar, the other side was also made seaworthy, and with the aid of continuous performance on the ship's pumps, we managed to weather the storm across the Gulf of Alaska and arrived at the dreary, barren spot known as King Cove, the cannery station being the only break on the monotonous scenery. This was about opposite to Kodiak Island and on the mainland of the Aleutian Peninsula, the rock barrier between the Gulf and the Bering Sea. We landed all our passengers here and then proceeded to another such station known as Sand Point, a short journey away, and in a few days were once more headed south for Seattle and the States, after about a two-months' voyage.

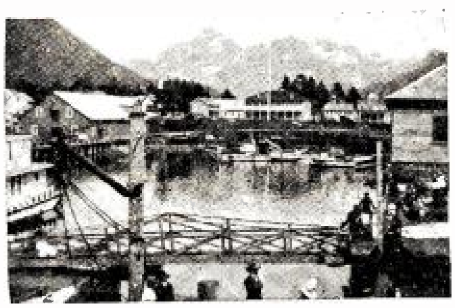
My next trip took me farther north into the Bering Sea to St. Michael's and Nome, also to the main points in Norton Sound, and later on various vessels I was enabled to see most every point of interest in Alaska from Skagway, where I traveled with the tourist parties along the old Klondike trail to White Pass, to Excursion Inlet, Sitka, the old Russian capital of Alaska, and all the southwest, also to the southeastern town of Ketchikan, by way of Juneau and the beautiful Wrangle Narrows.

Bound for Nome

Once again I was in Seattle, and by now, having the wanderlust thoroughly eaten in me, I decided to try the sunny south and travel to California, which I did by way of Portland, Oregon, and through the mountains and all their magnificent scenery on to Shasta, and finally in San Francisco, where I lost no time in applying for another wireless job, with which to refresh my eyes with scenery of still another world. But—I was doomed to disappointment, for the only vacancy at that time was on another trip north, from whence I had recently come, but this time it was considerably farther, in fact, right into the Northern Arctic Regions, the land of the midnight sun, of the Aurora Borealis, and snow and ice, of the long summer, and the longer winter. Three weeks later I was in Nome once again, the center of the great gold rushes of earlier days of which we have all read so many thrilling stories.

A few days in Nome, and we heaved anchor and set out on a trading trip beyond the Bering Sea into the Arctic Ocean, and on our way out of Nome we signaled a farewell to the Steffanson Expedition going in for their final supplies before setting out on their trip to become acquainted with the blond Eskimos. Why, goodness only knows, for I've seen many an enticing blond in Seattle, without having to go to the Arctic. We met up a little later south of Point Barrow, and that was their last sight of humanity until, I believe, about two years later, when they returned to civilization.

I could give many interesting anecdotes of this wonderful trip we had in the "Land of the Unknown," but there are many other parts of the world to be mentioned in the short chapter of radio wanderlust. (*Continued on page 232*)



Above. There's glorious mountain scenery in Alaska. Here's the background of Sitka, Southwestern Alaska

Right. A peculiar rock formation known as Castle Point, on the Aleutian Peninsula

Seven Rules for Radio Appreciation

This article is intended primarily for those who value the artistic and æsthetic in radio programs. It includes a scientific discussion of the factors involved in obtaining the greatest realism in modern radio reproduction

By Thomas Elway

A FEW weeks ago a chance-met group of New Yorkers including a musician, a psychologist, a radio engineer and an expert in acoustics happened to fall into conversation about the best way to listen to radio. It is not enough, everyone agreed, merely to own a good radio receiver and to tune in a good broadcasting station. The listener who would get the greatest possible enjoyment out of a broadcast symphony or other program of distinction has duties, too. He must put himself in the situation and in the frame of mind to be most receptive, just as must a concert goer or a patron of the theatre if he is to get the most out of these enjoyments.

By no means are all of the rules for listening best to radio certain. Radio psychology is still a new art. But the seven rules printed on this page may be taken, I think, as a sure beginning.

Every one of these rules has a reason. Some of these are merely common sense; some are based upon acoustic science, including facts newly learned about the complicated responses of the human ear to different types of sound; some touch on the newest discoveries of the psychology of senses.

One of these last, for example, is the rule that lighting in the room where radio is heard should be dim. Back of this lie the facts about the mixture of senses.

Mixture of the Senses

Five years ago, when acoustic engineers first began studying the exact character of noise in cities, they discovered, much to their surprise, that the noise inside the New York City subways, when measured on delicate electric instruments, turned out to be really less in physical intensity than the noise in many of the busy city streets. Nevertheless, virtually all human ears agreed in considering the subway noise substantially louder than the street noise.

The explanation of this paradox, the engineers finally decided, is that the subway is lighted much more dimly than the street. Why should this affect the ear's judgment of noise? That is precisely what the psychologists mean by the mixture of the senses; really the effect of one set of sense impulses on the perception of another set.

There is a small instrument called an æsthesiometer, the duty of which is to determine just how delicate is the sense of touch in the human skin. A small sharp point is pressed against the skin with a very slight but known pressure. The psychologist increases this pressure gradually until the point can just be felt. That is a measure of one variety of touch sensation.

The interesting thing is that this sensitivity of touch is found not to be a constant thing. If the person concerned is intent on something else, the delicacy of the touch sense greatly decreases. What is still more significant, this delicacy of touch decreases when the person concerned is listening to noise, when he is in a brightly lighted room or when any other sense is being stimulated strongly. Applying this to the paradox of the subway, the answer seems to be that dim light, when the eye sense is stimulated less strongly than normal, tends to exaggerate the responses of other senses. Noise in relatively dimly lighted places like the subway sounds louder. Doubtless the skin senses would be slightly exaggerated also, so that a suit of flannel underwear, for example, probably would feel less uncomfortable in brilliantly lit places like out of doors in daytime than it would be in dimly lit places like the subway or a church.

Effects Occur in the Brain

These effects occur, the psychologists agree, not in the sense organs themselves, like eyes or ears, but in the brain. Dr. Frederick Tilney of New York City, among the most distinguished of American neurologists, once reported to the Galton Society studies of the sense impressions of Helen Keller and some other blind or otherwise handicapped individuals. It is the usual impression, everyone knows, that blind persons acquire more sensitive hearing and that persons both blind and deaf, like Helen Keller, acquire an exaggerated delicacy of touch. This is the so-called "law of compensation."

Dr. Tilney found that this law is a myth. Miss Keller's sense of touch is no more delicate than that of the ordinary person. Similarly, Professor Pierre Villey, of the University of Caen, in France, reported not long ago to the French Academy of Sciences, direct tests of the ears and touch senses of blind individuals. No increase in the delicacy of either sense could be

The Seven Rules

ACTUALLY these rules are by no means as silly as they sound at first reading, as the reader will discover in reading the article.

1. Choose a room of fairly large size with plenty of rugs, curtains or books and with few flat, unbroken wall spaces.
2. Have this room dimly lighted, with no actual lamp, not even the pilot lamp of the receiver, visible to any listener.
3. Adjust the receiver to moderate volume; if the announcer's words are just understandable in the far corners of the room, that usually is about right.
4. Sit directly in front of the loud speaker, usually at a distance of from five to ten feet.
5. Choose a comfortable chair and wear comfortable clothes.
6. Keep quiet; shut the windows on noisy streets and avoid conversation.
7. Avoid interruptions; adjust the tuning and volume controls once and for all and let them alone until the program is over.

The furnishings, lighting, wall and floor coverings and the obvious general comfort of this room all lend themselves to real radio appreciation

detected. Nevertheless, Dr. Tilney and Professor Villey agree with everyone else that blind or blind-deaf individuals actually do perceive things better by touch than do ordinary persons. The difference, however, resides in the brain and not in the senses. By better training, more attention or some other psychological change the brain is able to understand touch messages from persons who are both blind and deaf and hearing messages in people who are blind only more completely and certainly than would be the case with normal individuals.

Importance of Proper Lighting

Precisely the same thing happens, psychologists believe, when the normal brain is freed from the messages of one or more of the senses. Persons experienced in appreciating music are likely to listen to a musician or orchestra with eyes closed. Thinkers who wish to exercise every power of their brains prefer quiet rooms. Experienced microscopists find that they can see tiny details under their microscopes more perfectly if there are no distractions of noise, bodily discomfort or surrounding bright light.

That is the reason why the psychologists insist that one of the rules for proper listening to radio is that light in the surroundings should be reasonably dim. It is particularly important, these psychologists insist, that listeners who wish to get the best out of that exercise should seat themselves so that no bright light at all shines into their eyes. Even the small lamps used to illuminate dials on many modern radio receivers probably are psychologically bad, since this little spot of bright light serves to stimulate the eye sense of the listener and probably to depress, in at least some slight degree, the perfection of the listener's sense of hearing.

Exactly the same psychological theory underlies the theory against discomfort. The brains of normal human beings receive continually from the myriads of nerves on the surface of the body successions of sense impulses due to the touch of clothes, the contact of the body with chairs, the existence of shoes or collars or other articles which are unduly tight, and so on. The touch sense, furthermore, is by no means a simple one. At least three distinct and different senses exist in the skin; the superficial touch sense, the so-called deep pressure sense and the sense of heat and cold. Some psychologists would enlarge the list of skin senses to six or more instead of three.

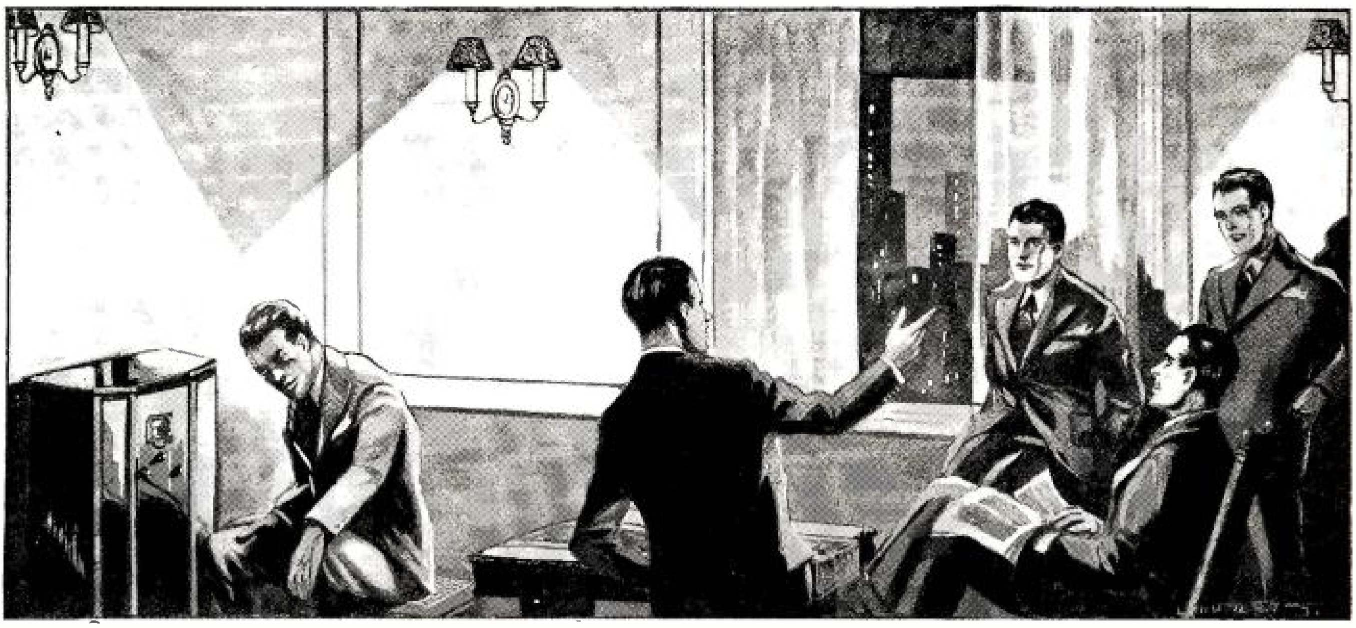
Ordinarily all of the myriad impulses from these skin senses are ignored by the brain. They never reach the level of consciousness unless something goes seriously wrong—for example, a shoe is painfully tight, a scratchy suit of underwear, and so on. Nevertheless, there can be no doubt that these skin sensations do have their effects on the brain action. One can be slightly uncomfortable even if that discomfort is unnoted. And even these slight discomforts operate, it is probable, to decrease in some degree the possibility of mental concentration and the perfection with which some other sense, like that of hearing, is able to operate.

It has even been maintained that similar sensations from the internal organs of the body, again a set of sensations not ordinarily perceived consciously, may have great effect on the operation of the mind. One form of insanity has been traced, for example, to a too acute perception of these internal sensations so that the brain pays too much attention to these things which normally should be ignored. Undoubtedly extreme instances of internal perception, like pain, indigestion, and so on, interfere with other operations of the mind and with the other senses. No one would expect to enjoy a radio program as fully as possible in the midst of an attack of indigestion or toothache. Probably milder internal sensations, not strong enough to reach the level of consciousness, also have their effects.

The Psychology of Dress

It has been suggested on similar reasoning that one reason for the remarkable increase in recent years of the success of women in business has been their adoption of looser and more comfortable clothes. Like everything else requiring real ability, success in business necessitates a considerable degree of mental concentration as well as quick and successful functioning of the senses of sight and hearing. How can one ex-

Not exactly æsthetic, but then this man's taste probably runs to world's series broadcasts rather than Chopin or Bach



These surroundings may be suitable for reception of a fight broadcast but certainly do not favor good reproduction of the more artistic programs

pect, it is urged, that women encased in uncomfortable corsets and wrapped in many layers of heavy and even painful clothing could devote to the business of their jobs the concentrated and perfected attention which success requires?

It is not at all impossible, these facts of psychology suggest, that the white collar which has become a label of a social class is itself a limit on that class's complete success, merely because the ordinarily stiff, white, too-tight collar is a definite annoyance to most people, even though that annoyance becomes accustomed and unnoticed. The mere existence of uncomfortable sense impulses clamoring for admission to the brain may be interfering unconsciously, these theories suggest, with the best functioning of that brain and of the other senses of the body.

Bodily Comfort Essential

It certainly is true that if one wishes to get the most out of any kind of intellectual or esthetic enjoyment, bodily comfort is a necessity. Comfortable chairs for guests who listen to the radio are more important, it is probable, than comfortable chairs for dining rooms or card rooms. Probably the ideal clothes for the highest degree of radio enjoyment are the pajamas now coming so rapidly into fashion. Much more lies back of this movement of fashion than mere desire for change and novelty. The oldest civilized race in the world is the Chinese, and it is not without significance, experts on the psychology of clothes insist, that Chinese people have come to wear loose coats and robes and pajama-like trousers instead of the tighter and more uncomfortable wrappings of Occidental civilization.

Too much "local interference" to permit radio enjoyment. This man might read this present article with considerable advantage

Three others among the seven rules for best listening are based, not on psychology, but on the newly developed science of sound waves. An example is the rule to avoid wide, flat surfaces in the walls of the room where listening is to be done. Such flat, unbroken surfaces, especially if the surface itself is hard like plaster, tend to reflect the sound waves that strike against them, causing echoes. In large rooms like churches or auditoriums, these echoes often perceptible as such would interfere with proper hearing. In small rooms there usually is not sufficient distance to produce a definite echo. Nevertheless, the echo exists and alters in some degree the character of the speech or music as it is heard. Soft hangings in the room, soft carpets or rugs in the room, soft and unbroken articles like ordinary chairs or other furniture or like the books in a bookcase, tend to absorb or break up the sound waves, so that these echo effects are less pronounced. The clothes and faces of listeners do the same. It is found, for example, that an audience in an auditorium has just about as much effect in absorbing sound waves as would a series of feather beds spread over the seats.

It must be noted, however, that complete absorption of sound waves in a room is as bad as too little absorption. This produces the so-called "dead" effect. The human ear is accustomed to hearing a certain amount of mixed up echoing called reverberation. Effort is made nowadays in modern broadcasting stations to include in the material broadcast just that amount of such reverberation which will make the broadest speech or music have the maximum of naturalness. Accordingly, the room in which one listens should have something this same character. It must have neither too much echo nor too little, and since most rooms are likely to have too much, that is the fault chiefly to be watched for.

Position of the Listener

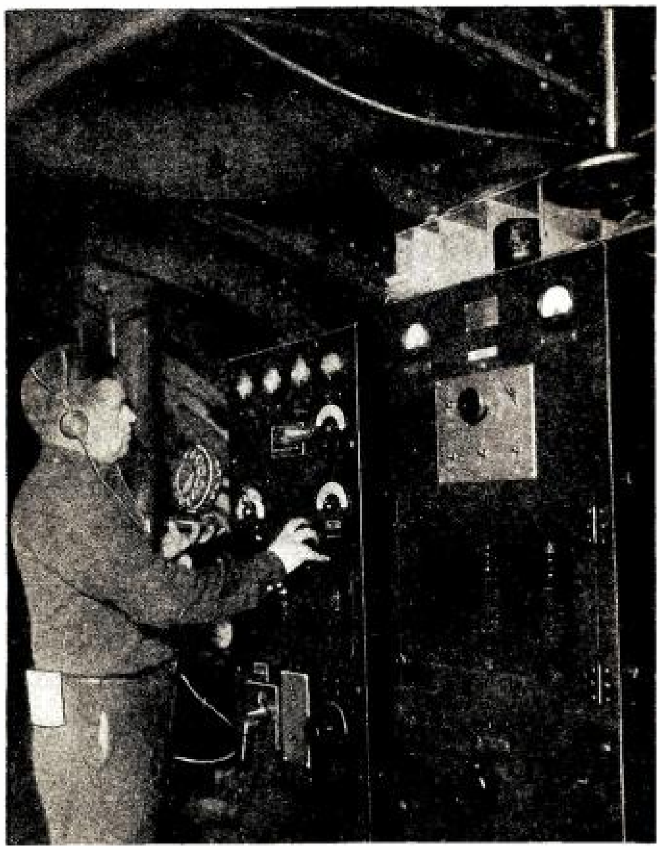
Another of the acoustic rules is the one which specifies the listener's seat directly in front of the loud speaker. The majority of loud speaking devices do not emit the sound waves in a perfect sphere, but send them out, instead, in more or less of a beam or cone. Furthermore, the sounds of different frequencies may thus be coned to different degrees, so that the listener on the fringe of the cone of sound may hear low tones, for example, successfully enough, but may miss the high tones, or vice versa. These are results of what the radio expert recognizes as the directional effect of sound reproducers. The only sure way to avoid them is to sit, so far as possible, directly in front of the loud speaker.

Probably the greatest average sin (*Continued on page* 236)

Radio Transmission

Once more radio heads for the ends of part of the equipment of the Wilkins regions. It is expected to provide a link with civilization—a link in undoubtedly play

By Frederick



The 200-watt transmitter built by G. E. for installation on the *Nautilus*. This transmitter is expected to maintain communication with the United States throughout the expedition

RADIO messages have been sent from airships high in the air, from oases hidden in the centers of the world's great deserts, from isolated mountain peaks, from mines under the earth and submarines beneath the seas and from both of the earth's poles. About the only place that radio messages have not been sent from is beneath the ice sheet of the Arctic Ocean, and this omission is likely to be repaired this summer by the expedition of Sir Hubert Wilkins and the *Nautilus*.

Even before this issue of RADIO NEWS reaches its readers it may be that reports of the Wilkins expedition will have begun to come in over radio channels from underneath the roof of the world.

The Wilkins expedition is perhaps the most important scientific project ever initiated in the Arctic. Arctic explorers traveling by sledge or afoot over the ice are unable to pause long in one locality without danger of exhausting their food. Also, they are usually unable to carry the extensive and weighty apparatus necessary for important scientific measurements. Aircraft exploration, like the flights of Amundsen and Byrd, are necessarily speedy. Circumstances forbid that the craft should land or hover for detailed scientific measurements. Arctic exploration by submarine, if it proves to be practicable at all, will escape these difficulties. Underneath the ice the submarine may pause at will for gravity measurements, for analyses of the sea water or investigation of the sea bottom. At intervals, it is expected, holes will be bored upward through the ice sheet so that the collapsible conning tower may be projected into the air and observers may "land" on the ice surface for magnetic or other scientific observations. The submarine will be large enough, too, to carry really adequate laboratory equipment, electric measuring devices, and what is more important still, radio equipment by which data obtained may be reported currently to waiting scientists in the United States.

The general character of the Wilkins submarine, a former boat of the United States Navy reconditioned especially for the expedition, has been thoroughly described. The chief unusual item of equipment is probably the set of skids fixed to the top of the ship's body, like runners underneath a sled. By means of this structure it is expected that the ship will be able to slide along on the underneath side of the ice sheet, like a fly along a ceiling. A collapsible bowsprit has been provided also, so that accidental collisions with projecting ice or other obstacles will not be fatal. Powerful electric lamps have been provided for lookout purposes, together with strong windows capable of resisting any ordinary force.

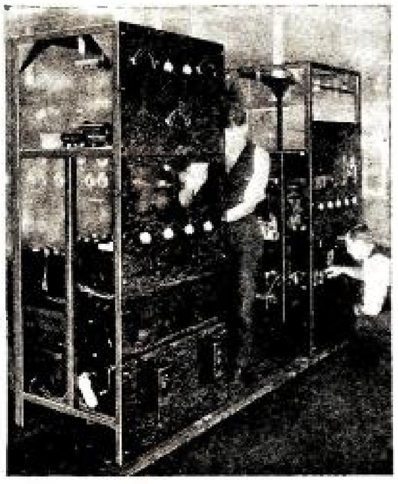
Ice-Boring Mechanism

The ship will be able to remain submerged for at least six days without danger or discomfort to its occupants. Sir Hubert Wilkins expects, however, to find patches of open water every five or ten miles, especially during the summer season when the expedition will take place. In such spots the submarine will be able to come to the surface, thrust out its conning tower through loose ice and obtain fresh supplies of air. If thin ice is encountered but not an actual open space, the ice-boring mechanism on top of the conning tower will come into play and is capable of drilling a hole through thirteen feet of solid ice, large enough for a man to pass.

Even if no thin ice is encountered, the plight of the submarine's crew will not be serious. A second boring mechanism is provided resembling the machines commonly used to drill holes into rock. This second mechanism is capable of drillling two parallel holes each eight inches in diameter through at least one hundred feet of ice. Through one of these holes fresh air can be sucked down to replenish the submarine supply or to provide for the operation of the Diesel engines, needed to recharge exhausted storage batteries. Through the second hole the exhaust gases of the Diesel operation will be discharged.

Unless the ice cover of the Arctic Ocean proves to be continuously more than one hundred feet thick, the submarine will be able, thereafter, to continue its task of exploration indefinitely or until food runs out, although the members of the crew will not be able to get out onto the ice surface unless ice less than thirteen feet thick is encountered. Since virtually all Arctic experts believe that the ice cover of the north Polar Ocean is prevailingly thin in summer, it is probable that ice surface observations will be possible together with others.

The scientific observations to be undertaken include magnetic measurements,

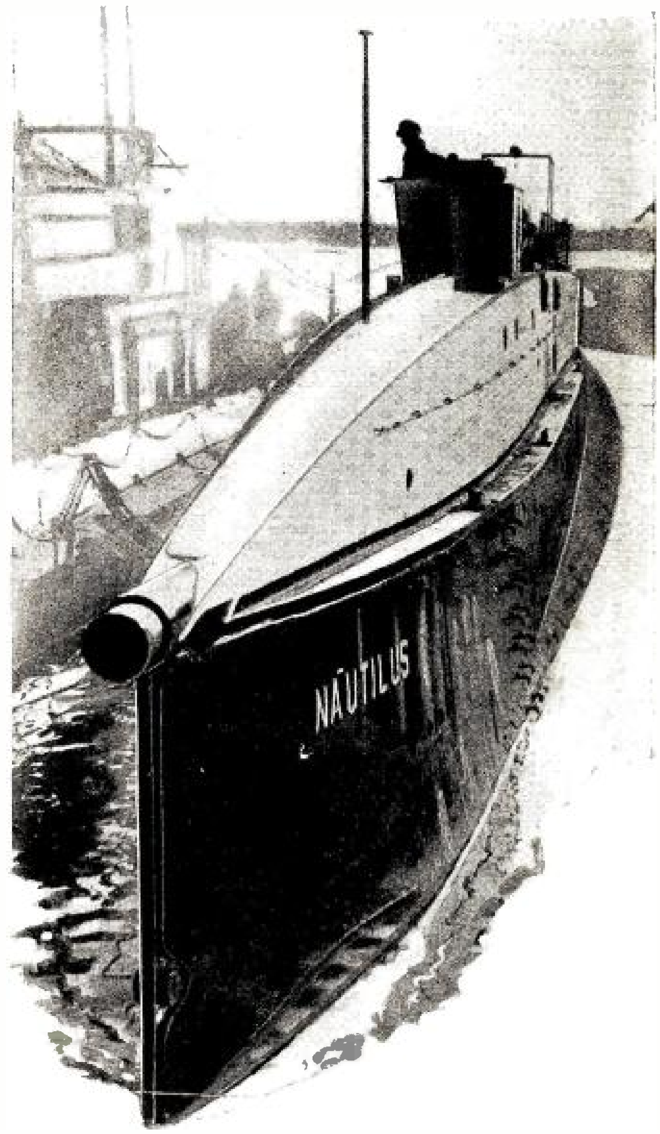


In the DeForest Radio Company's plant at Passaic, N. J., are to be seen the two units of the 1-kilowatt, crystal controlled short-wave transmitter to be used to contact the *Nautilus*

Under *the* Polar Ice Cap

the earth, this time as an indispensable submarine expedition to the polar continuous two-way communication which American amateur stations will an important rôle

Siemens



observations of gravity and many similar items as well as mere exploration. A number of magnetic observations already have been made in the polar regions, not only by the aerial expeditions, but by expeditions like that of the *Fram*. It has seldom been possible, however, to measure the intensity of gravity underneath the polar ice, since the apparatus for this purpose cannot be used in airships and is transportable by land with difficulty. In a submarine, however, almost ideal conditions exist for such gravity measurements and the results are expected to be of great importance in determining the character of rock which underlies the polar ocean, for comparison with the known rocks existing under other oceans of the world like the Pacific and the Atlantic.

Another series of observations from which scientists look for much valuable information are those on ocean currents. A substantial part of the vast northward flow of warm water in the Gulf Stream enters the Arctic Ocean between Greenland and Norway. Only one important current emerges from the Arctic Ocean, the so-called Labrador Current, which flows southward between Greenland and the North American continent. Somehow or other the northward flowing water of the Gulf Stream must circulate through the Arctic Ocean underneath the ice to provide for the Labrador Current. No oceanographer knows, however, just what happens in the Arctic Ocean when these two currents carry out this exchange.

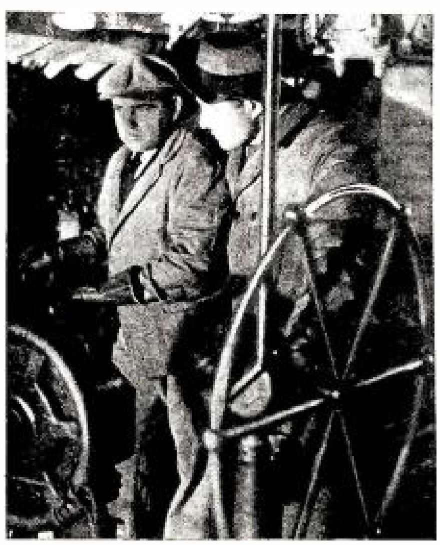
Scientific Value of the Expedition

The existence of this current situation is the reason, incidentally, for the occasional fantastic tales of lost vessels and other ocean débris accumulated through the ages in some unknown Sargasso Sea lost in the polar wastes. It is not impossible that some such débris is swept northward from the Gulf Stream, but that there would be any important accumulation of such lost ships is as little likely for the Arctic as it is for the tropical Sargasso Sea itself.

Nevertheless, living creatures of the ocean, like fish or like the multitude of tiny one-celled plants and animals on which fish live in warmer oceanic climes, undoubtedly are carried northward in enormous numbers by the remnant of the Gulf Stream. Whether or not these creatures survive underneath the Arctic is one of the great problems of oceanic biology. It is expected, also, that biological evidence will be obtained by the coming expedition through examination of samples from the sea bottom.

One of the devices which the *Nautilus* will carry is a tube arrangement which can be dropped from the ship so that it will penetrate the ocean bottom a few inches or feet. This tube then can be hauled up by a wire, carrying inside it a core of the ocean bottom materials, like the core which cooks cut out of dough when they make holes in doughnuts.

Aboard the *Nautilus* will be a small but a well-equipped chemical and biological laboratory. These precious samples of the layers which have accumulated on the bottom of the Arctic Ocean perhaps for hundreds of thousands of years will be sorted out under the microscope and carefully studied. Similar cores obtained from ocean bottoms elsewhere in the world have proved to be important documents in the history of evolution of life on earth. Equally important evidence is expected from the Arctic cores.



(Upper right) The *Nautilus*, showing the skid-like super-structure which will enable it to slide along the under surface of the ice; also the bumper-like bowsprit. (Lower left) Ray Meyers, electrical officer, and Lt. Comm. I. Schlossbach going over the controls of the *Nautilus*

The distinguished British meteorologist, Dr. C. E. P. Brooks, maintains, for example, that at numerous times in past geological eras the Arctic Ocean has not been covered with ice at all but has been clear and open like the other oceans of the world. The evidence for this theory is largely from weather data; not that actual records were kept during these past eras, but because the climatic conditions known to have existed elsewhere on the globe indicate, Dr. Brooks believes, that the Arctic Ocean must have been open at the time and the Arctic climate much warmer.

If such periods of warmer Arctic weather ever (*Continued on page* 250)

Radio News Prize "*Ham*"

The complete description of a super that includes in its design a number of outstanding features, such as: single control, non-regenerative second detector with separate c.w. beat tube, audio filter. It is an excellent job mechanically and cost Mr. Wheat less than $25.00 to build

BEFORE building the Short Wave Superheterodyne described in this article the theoretical and practical designs of existing types of receivers were gone into carefully. Such features as automatic volume control, full a.c. or battery operation, beat-note control, audio filters, single and double tuning references, methods of shielding, head-phone operation in last audio stage, construction cost, etc., were considered.

The result of the survey was the designing of an eight-tube, battery or eliminator-operated superheterodyne using four -22, three -01A and one -71A tubes. Automatic volume control was not incorporated, as it was thought it would complicate matters.

The first input tube is a -22 operating as an untuned first detector which feeds into a -22 first intermediate amplifier stage.

The -01A oscillator tube is inductively coupled to the shield grid of the first detector.

A -22 second intermediate stage is utilized to feed into a non-regenerative -01A second detector.

Heterodyne Beat Tube for C.W.

Regeneration and oscillation for c.w. reception is produced by the use of a separate -01A tube, plate resistance controlled, coupled directly to the grid of the second detector. This method prevents, to a great extent, the interlocking of the two circuits heretofore present and also greatly lessens the hiss usually present when the second detector is oscillating for the reception of c.w.

The output of the non-regenerative second detector feeds into an anti-motorboating device which prevents undue coupling when the receiver is used with a "B" eliminator. It consists mainly of two 100,000-ohm plate resistors in series with a 1-mfd. condenser shunted around one of the resistors.

Audio Filter

The first audio stage is a -22, in the plate circuit of which is the audio filter. This filter is hooked in parallel with a 100,000-ohm plate resistor and a snap switch on the face of the base will shift from one to the other, as for phone or c.w. operation. The filter is made from the secondary of an old Ford spark coil, with the iron core removed, and tuned by a .01 Aerovox tubular fixed condenser. In mounting, this condenser is placed at the lower end of filter, the connecting wires holding it in place. The audio filter is a distinct advantage when receiving c.w., for it removes background murmurs and microphonic noises and decreases interference.

The last stage is a -71A power tube using "C" bias. The output connections are through two small pin jacks, for the speaker, and a Yaxley two-circuit jack for phones. More will be said about this jack and connected potentiometer later.

The intermediate amplifier is peaked at about 190 meters. However, this peak can be shifted up to around 600 meters by using fixed condensers across each equalizing tuning condenser, C2, C3 and C4.

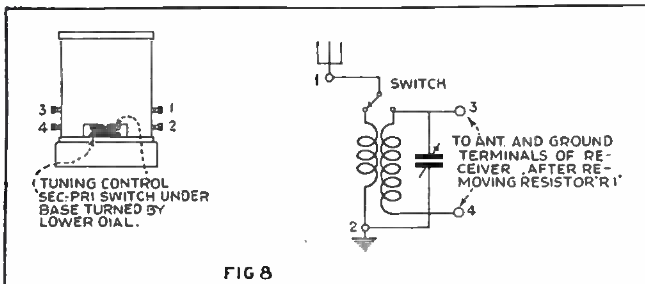


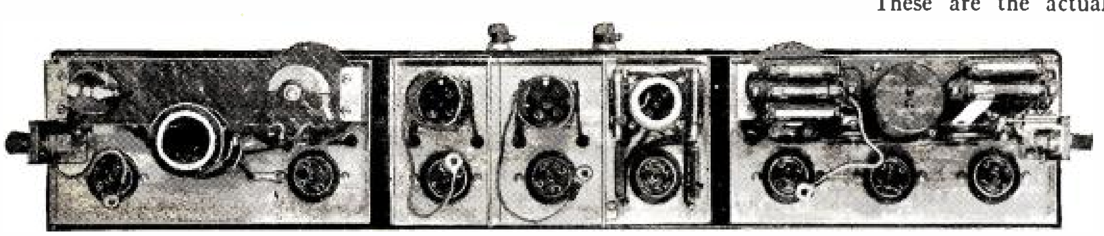
Figure 7. Coils wound on grid leak forms for use in antenna circuit in place of R1, as described in the text

Figure 8. Circuit and suggested design for separate antenna adapter unit for added selectivity. Plug-in coils employed with tuning condenser similar to C2

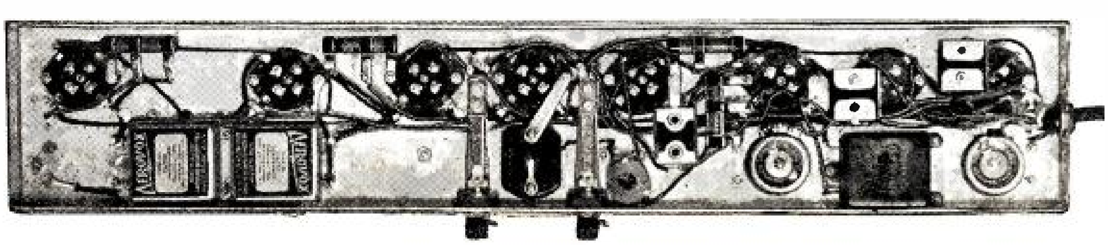
Details of Construction

The base is constructed of 16-gauge or 1/16-inch galvanized sheet iron and measures 24¼ inches × 4⅜ inches × 1 inch when finished, as shown in Figure 2. Would suggest that the 1-inch edge be made slightly wider to allow for trimming down to 1 inch height so as to make lower edges of base level. The corners should be soldered and rounded off with file.

The three-stage shielding cans are made from 22-gauge aluminum and measure 7½ inches × 3¾ inches × 6⅛ inches in height. These are the actual measurements of the



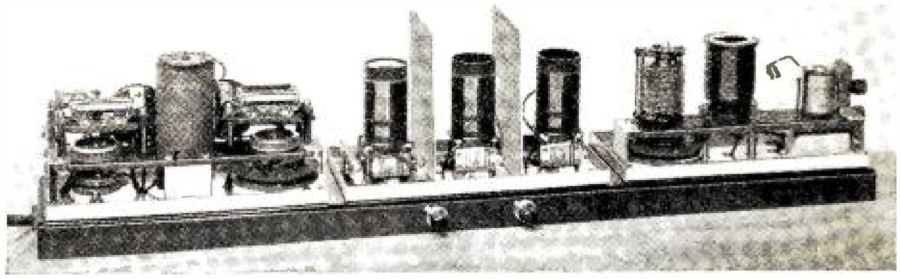
Top view without shields shows neat arrangement of subpanels and parts. Note bunch wound pick-up and heterodyne beat coils mounted inside L1 and L10



The underside view shows a decidedly neat and orderly layout

Receiver

By Wm. G. Wheat



Receiver with shield cans removed to show location of parts. Note partitions between intermediate stages

cans—not the base or cover. The base has a ½-inch lip all around and the lid a ¼-inch lip. The same precaution applies as above—in turning the lips, make them slightly wider, then trim off to desired width.

The interstage partitions are of the same gauge aluminum as the cans and have a ⅜-inch lip folded over for a base.

Any tinner or metal worker can make this metal work up for you at a very reasonable cost if you do not want to tackle it yourself. The openings in the shields are cut as follows: The left, or audio stage, has an opening for the speaker and phone jack which measures 2⅝ × ¾ inch. The opening for the thumb dials measures 1 × 2 inches and is ⅜ inch from right edge of the audio stage shield can. A pointer is fashioned from the metal of the can, as the photo shows. The same sized openings appear in the third or right-hand shield can, as shown in the rear view. The holes and bushings, in the center can, are opposite the set screws on the equalizer condensers which tune the two intermediate and detector stages.

It will be noticed that the receiver is left-handed. This is to accommodate c.w. amateurs who have transmitter and key on the right side of the operating table. However, a right-handed receiver can be constructed by building the units in the opposite direction.

The details of the antenna, ground binding post, phone and pin jacks, insulator strips, as well as the oscillator and audio stage sub-panels and the edgewise dials are shown in the detail drawings.

The .00014 midget vernier variable condenser was constructed from two Pilot condensers of .0001 and .000050 mfd. capacity. Details of construction of this condenser are shown in Figure 5.

The r.f. coils, in the intermediate stages, have ten turns removed from the secondaries and all of the primary turns. New primaries are wound on, using about the same size wire, but having two layers and therefore twice the original number of turns. In other words, after the first layer is wound, cross over to the starting point and wind on the second layer. This increases the impedance as far as is practical.

Be sure and connect the control grid of the -22 tube to the upper end of the secondary and plate to lower end of primary, both secondary and primary windings, of course, being wound in same direction.

The supports for the intermediate coils are 6/32 threaded brass rods, one rod, centered, to each coil.

The equalizer condenser mounting is bent over and clamped up against the bottom of the coil, as shown in the rear view of the set.

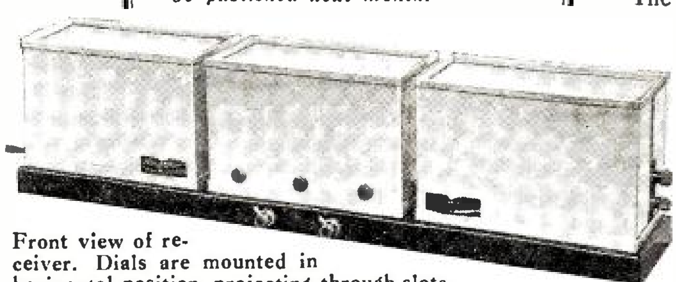
IT is with pleasure that the Editors present here a complete description of the "ham" receiver which was awarded first prize in the RADIO NEWS *competition. This competition was announced in the February issue and included a prize of $50.00 for the best receiver design and one of $50.00 for the best transmitter design. The details of the prize winning transmitter will be published next month.*

The two grid condensers have one end soldered to the grid leak mountings, thereby supporting them.

The heterodyne pick-up coil, inside the oscillator coil, has about twenty-five turns of wire, bunch wound and tied with thread. The number of turns vary, of course, for other wave-length coils.

The feed-back coil, inside the second detector stage coil, also bunch wound, has thirty turns of wire and may be pushed up or down for best operating point.

The anti-motorboating resistance coupling unit has already been described. The center resistor is the grid one and the two outer ones are for the plate (shown over the variable resistor control discs in left-hand shield).



Front view of receiver. Dials are mounted in horizontal position, projecting through slots in shield. Three holes in center shield are for adjusting intermediate stages

Provision for Headphones

To prevent blasting of the head-phones, when operated in the (*Cont'd on page 247*)

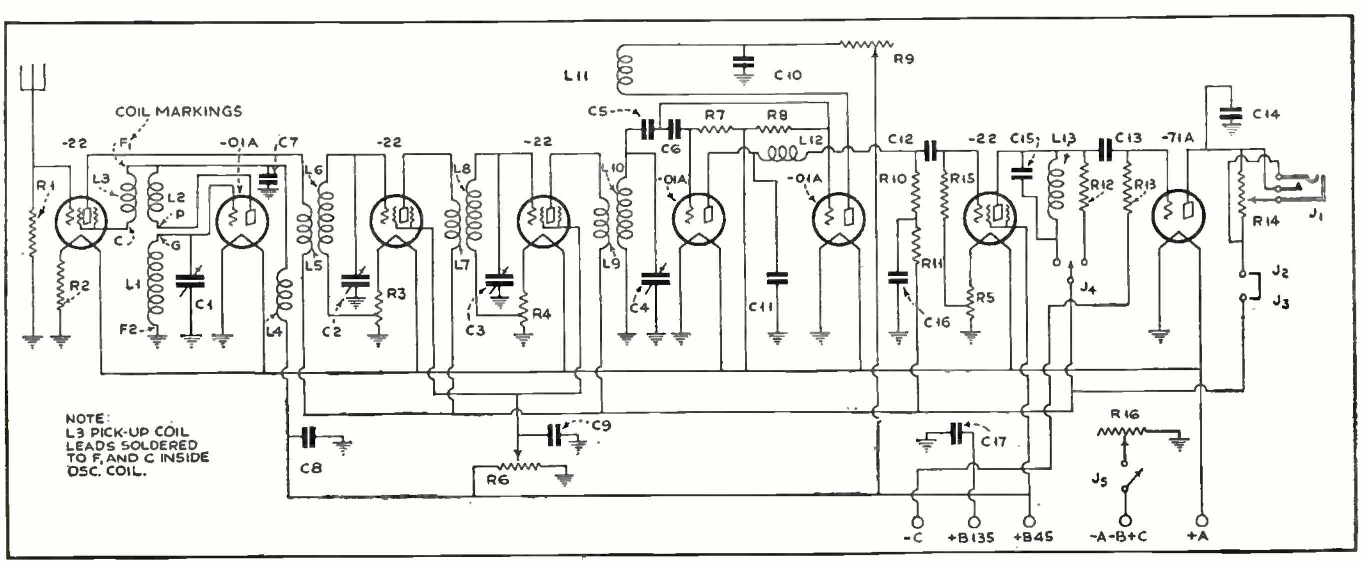


Figure 1. The circuit diagram. See end of text for alternate types of antenna input circuits

The Schoolmaster's

Many have begun to wonder why radio is not playing a more important part in education. Mr. Cummings throws some light on the subject—as do a number of outstanding authorities whose opinions he quotes

THE utilization of radio as an educational medium for both children and adult listeners has long been a major topic of discussion between America's leading educators and broadcasters. Special committees and councils have been sponsored and endowed to effect the development of a stronger bond between the fields of radio and education. Great strides have been made in this work and plans are being formulated to present balanced, scheduled educational programs to the nation's gigantic army of listeners.

Radio's Possibilities as an Educational Force

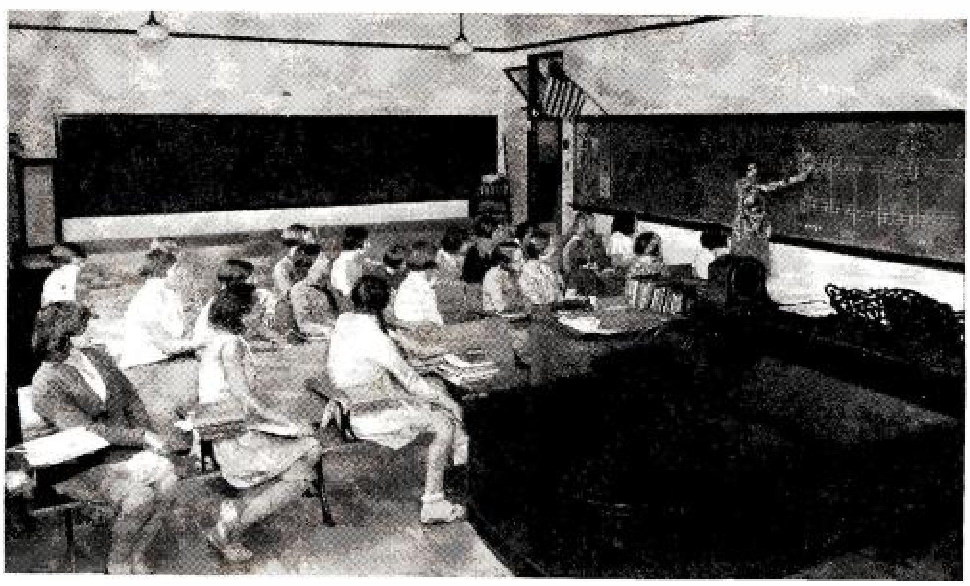
Unlike the classroom and lecture hall, the radio knows no barriers nor limitations. It can reach all homes as well as schoolrooms and is considered by educators as a vital pedagogical force of the future. With television on the verge of popular application, the potential value of radio in education is still further enhanced.

Recognition of radio as an educational force. however, is in itself not sufficient for constructive results. Careful planning is essential to map out complete and effective schedules of educational material that will be acceptable to the broadcasters who are mindful of the entertainment interests of the public. National educational programs must be designed for network presentation and the chain program requirements must be met. Independent stations may be utilized to excellent advantage for programs prepared by municipal and state educational groups.

Achievements have already been made in the use of radio in education. Some of the nation's most brilliant minds have contributed to this development. The pedagogical use of broadcasting has been somewhat hampered by self-forming limitations. Broadcasters deem it unwise to distinguish "educational" programs from "entertainment" programs. Sir John C. W. Reith, director-general of the British Broadcasting Corporation, who recently visited the United States to address the first annual assembly of the National Advisory Council on Radio in Education, agreed with American broadcasters on this angle. He told the writer that the radio audience must itself decide just what programs are and what are not "educational."

Statistics of the National Advisory Council reveal that 10.1 per cent. of the broadcasting stations in the United States are operated by educational interests. Thus, to further this work, the Council was formed on May 12, 1930. Funds for basic organization and maintenance for a minimum period of three years have been assured by John D. Rockefeller, Jr., and the Carnegie Corporation of New York.

The active members of the Council are limited and the roster of this division includes such representative men as Ray Lyman Wilbur, Secretary of the Interior; Julius Klein, Assistant Secretary of Commerce; Frank Baldwin Jewett, President of the Bell Telephone Laboratories; John Erskine, prominent author and president of the Juilliard Musical Foundation; John L. Clifton, State Superintendent of Education in Ohio; and Dr. Robert A. Millikan, of the California Institute of Technology, who is president of the National Advisory Council. Levering Tyson, of the American Association for Adult Education, is director of the Council. The associate membership is unlimited. There are no dues and the only responsibility is a willingness to co-operate assiduously in the Council's program.



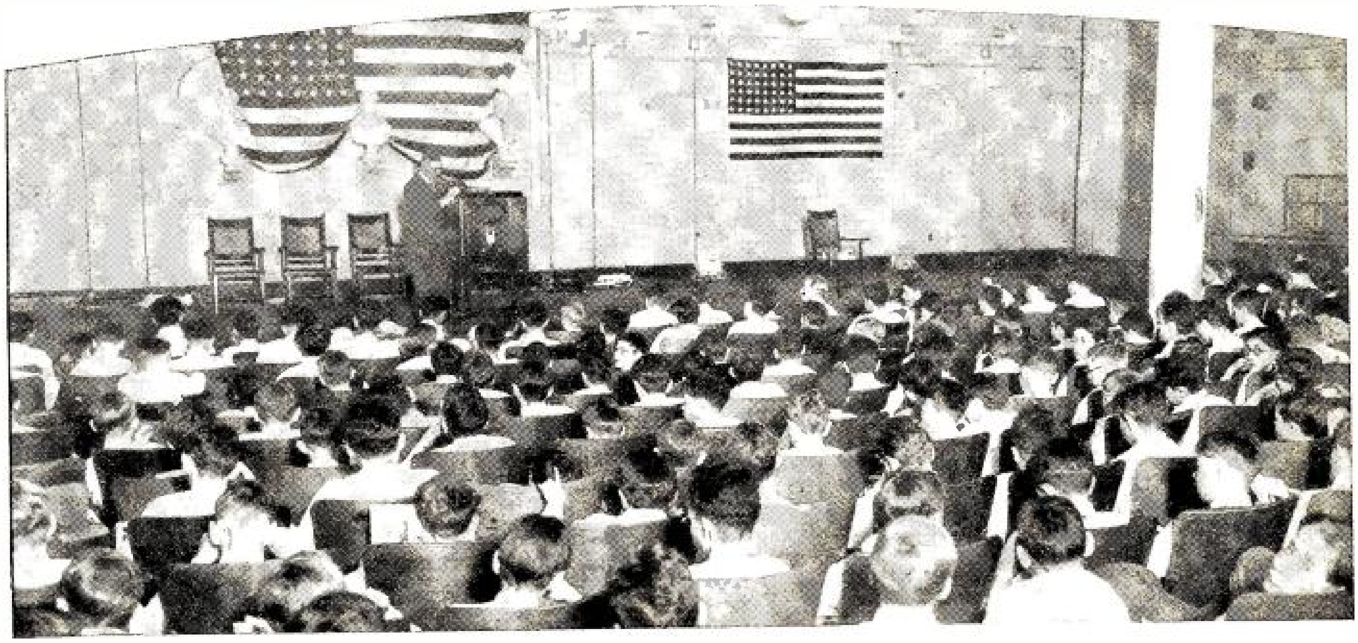
A class employing the Music Appreciation Series of the N. B. C. as a regular part of its music study

A radio-phonograph-amplifier installation typical of the equipment being employed in many modern schools. This installation is in the Oyster Bay High School, Oyster Bay, Long Island

Functional committees have been organized for the following subjects of study: Agriculture, art, astronomy, chemistry, drama and the theatre, economics, engineering, geography, geology, history, home economics, international relations, labor, languages, library co-operation, mathematics, medicine, museum co-operation, parent education and child study, philosophy, physics, political science, psychology, public health, rural education and science.

Radio Voice

By
Merle S.
Cummings



Walter Damrosch, Director of the National Broadcasting Company's Musical Appreciation Series—a broadcast feature which has definitely demonstrated radio's value in the schoolroom

The first program of a series sponsored by the National Advisory Council was recently broadcast over both the National Broadcasting Company and Columbia Broadcasting System networks. President Hoover, speaking from the Cabinet Room in the White House in Washington, introduced Dr. Millikan, the first speaker of the series. Dr. Millikan spoke from a Los Angeles hotel on the subject of "Radio's Past and Future." The utterances of the President and Dr. Millikan were received and amplified in the auditorium of the New School for Social Research in New York, where the first annual assembly of the Council was recently held.

The Unity Afforded by Radio

"The Greek republics," Dr. Millikan told his nation-wide audience, "succeeded so long as they were closely knit city-states; as far-flung empires they disintegrated. The world's first great republic, the United States, has held together for 150 years, but not without proof enough of the difficulties of the task. With every one of its 120,000,000 inhabitants now brought by radio within an easy range of a single voice for the purposes of instruction, entertainment and persuasion, as were the free citizens of Athens when they gathered around the Acropolis to listen to Pericles, the task will certainly be henceforth an easier one. The possibility of letting the whole population of the country, in so far as it desires to do so, listen together not only to the best music the country has to offer, but to the spoken words of the leaders of thought in all phases of our American life, is one that is fraught with unmeasured values for our future."

But here Dr. Millikan sounded a warning. "That possibility, of course," he added, "carries with it also that of the use of radio by the demagogue and the propagandist, but this precise situation is inherent in all democracy, indeed, in every type of variant of the effort to replace the rule of bullets by the rule of ballots where the ballots are possessed by any large or even any appreciable fraction of the population."

Dr. Millikan said that radio is obviously one of the great new unifying and educational forces which can be one of the greatest factors in assuring the success of ballot governments throughout the world.

Dr. Alfred N. Goldsmith, vice-president and general engineer of the Radio Corporation of America, in addressing the Council on the progress of invention in radio broadcasting and the allied arts, emphasized the remark that "education is communication."

"Except for the contract between (*Continued on page* 240)

In all activities the Council co-operates with the Office of Education of the Department of the Interior and with other organizations interested in the application of modern science to education.

The Council recognizes that broadcasting to schools and colleges is one part of the general educational problem, and, without limiting itself to this one activity, is co-operating with other associations for this purpose. Other groups studying radio in education include the National Education Association, the Association of Land Grant Colleges, the National University Extension Association, the Association of College and University Broadcasting Stations, the Association of State University Presidents and the Association of State Superintendents and Directors of Education. There are numerous local groups engaged in developing this type of work. Among the more prominent is the State Department of Education in Ohio, which has just completed the second year of an advanced radio educational system over stations WLW and WEAO.

What Goes On in Your

Radio fans and experimenters are the standpoint of the results they produce ever, know just how these wonders are both interesting

By Emil

WHEN you push the switch of your radio set and sit down in your favorite chair to chuckle over the new misfortunes of Amos and Andy or to listen to choice bits of the music you like best; when you see a movie accompanied by the human voice; when you can lift up your telephone receiver and chat with a friend in London or San Francisco; when an airplane is safely guided through the air from the ground; and when a device measures such an amazingly infinitesimal amount of electric current as to make the mind boggle at the figures, we are making use of the flight of certain extremely small particles through—nothingness.

These small glass tubes or bulbs with which most of us are familiar due to their universal use in radio sets, are but one form of a large family of similar devices—all having their own purpose but working on a similar principle. All vacuum tubes from the tiny "peanut" tube a little over an inch in height to the gigantic 200 kilowatt radio transmitting tube standing almost six feet high depend on their operation, first, on infinitely small particles called electrons, and second, on an empty space provided for the electrons to move through freely. Even the photoelectric cell, the mysterious electric eye, depends upon its operation on the motion of these tiny electrons. Other small tubes containing brilliantly colored glowing gases and which by an ordinary wave of the hand will set into motion tons of machinery depend also on tiny electrons for their operation.

Principle of the Vacuum Tube

The X-ray tube over which humans have always marveled is also another electron and empty space device. Many wonderful devices have been developed, based on the motion of electrons in a space.

The material of the entire universe is composed of intricate combinations of less than a hundred substances called elements. All substances known to man are either elements or combinations of two or more elements. Some of the better known elements are hydrogen, oxygen, aluminum, carbon, copper, gold, iron, and many others. Water, for instance, is formed by the combination of oxygen and hydrogen. When the element oxygen from the air goes into union with the element iron we have rust formed, and then we decide that a new coat of paint is needed to protect the surface. Millions of combinations of the elements are possible.

All of the ninety or so substances called elements are composed of atoms of the particular substance. An atom is the smallest possible particle in which an element can exist. Like the age-old question, "what lies beyond the universe," we may well ask, "what lies beyond the atom?" If we could sufficiently magnify the atom to examine its structure, we would find that all atoms are made up of but two things—a tiny particle known as a proton around which revolve at great speed one or more smaller particles known as electrons. The arrangement and number of electrons around the proton determines the type of atom and thereby the element. We see, therefore, that all matter is composed of elements or combinations of elements, elements are composed of atoms, and atoms are composed of two basic things known as protons and electrons. Between the proton and its electrons is empty space. About twenty-four centuries ago Democritus, a Greek philosopher, said, "in reality there is nothing but atoms and space." Little did he know how near he came to the facts which make up the basis of modern science.

The simplest atom known consists of a proton and one electron. This is the hydrogen atom as illustrated in Figure 1. An atom of oxygen consists of a proton with eight electrons revolving about it. The iron atom has twenty-six electrons revolving about its proton. Radium, one of the heaviest of the elements, consists of a proton with eighty-eight electrons revolving about it. These arrangements of electrons and protons make up a sort of miniature solar system in which the proton is the sun and the electrons are the planets. The magnitudes, of course, are infinitely smaller than can be viewed under any microscope. Something like 250,000 hydrogen atoms placed in a row would have a length of one hundred thousandth of an inch!

Protons and electrons, modern research has shown, are nothing but pure little particles of electricity. They are the "building blocks" of the universe, and all matter is made from them. The proton is a particle of positive electricity, while the electron is a particle of negative electricity. All electrons are exactly alike. It has been calculated that the electron is about one-thirteenth billionth of an inch in diameter!

When the proton has the proper number of electrons revolving about it, the positive charge of the proton and the negative charge of the electrons neutralize each other and we have a stable arrangement. Under certain conditions electrons may leave an atom, and when they do so they are free to go into combination with any nearby atom which has a deficit of electrons.

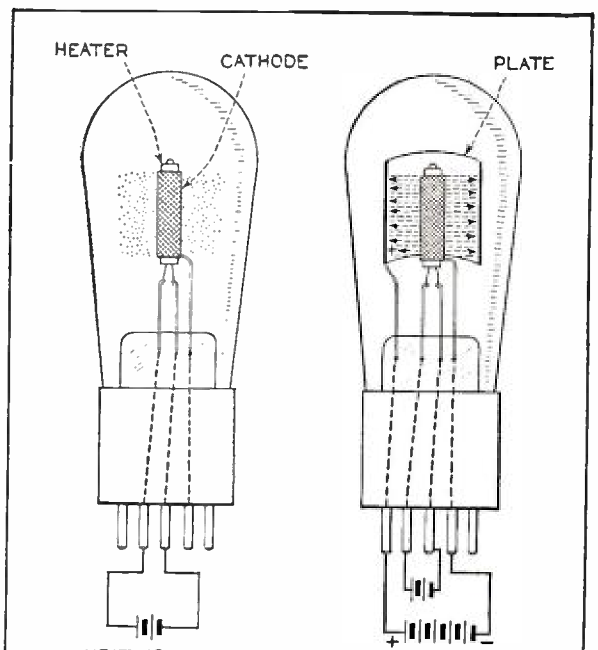


FIG. 2 FIG. 3

Figure 2. When the cathode of a vacuum tube is heated to a high enough temperature electrons are discharged from its surface or boiled off as steam is boiled off from a kettle of boiling water

Figure 3. When the cathode is heated and the plate is positively charged, we have a stream of electrons flowing from the cathode to the plate

Using Electrons

Now that we have had a glimpse of the infinitesimal world of protons and electrons and know of some of their workings, let us see how the ingenuity of man has set these tiny particles or electric charges to work to perform his miracles.

Imagine a machine-gun such as that used in the war. It is aimed at a target at which it is firing. As the bullets strike the target they give up their energy. A slight pressure on the trigger of the gun is sufficient to start a rain of shells toward the target.

The vacuum tube such as is used in your radio set or in

Vacuum Tubes

familiar with vacuum tubes largely from in radio circuits. Many do not, how- performed. For such this article will be and informative

Reisman

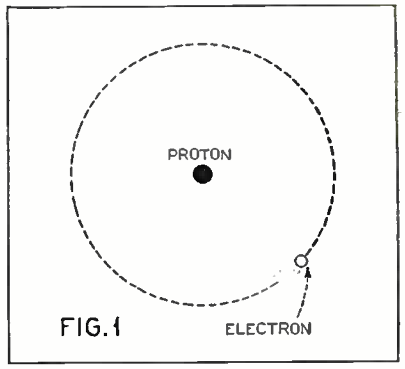


Figure 1. Hydrogen is the simplest element known. An atom of hydrogen consists of a proton around which revolves one electron. The iron atom has twenty-six electrons revolving about its proton

radio broadcasting is a device in which energy can be controlled by the application of a much smaller amount of energy as in the machine-gun. In the vacuum tube we have the machine gun and target on a very small scale. Even the projectiles are there, but this time they are not machine-gun bullets but our tiny electrons.

A vacuum tube consists of a cathode for shooting out electrons, the plate for the electrons to hit, and the grid for controlling the number of electrons reaching the plate. The air is thoroughly pumped out of the tube in order to allow the electrons free passage from the cathode to the plate. If the cathode is surrounded by atmosphere at ordinary pressure an electron could travel but a very short distance from the cathode before it would bump into an atom of one of the gases present in the atmosphere and thus end its flight.

As we previously read, the electrons of an atom are continually revolving about a proton. When the atom is heated to high temperatures the electrons begin to revolve faster and faster until, if the temperature be sufficiently high, an electron is flung off with great velocity. We see, therefore, that when the cathode of the tube is heated to a high enough temperature, electrons are discharged from its surface or boiled off much as steam is boiled off from a kettle of boiling water. Materials, such as thoriated tungsten, or certain metallic oxides, have the property of emitting large numbers of electrons at comparatively low temperatures, therefore, they are generally used for vacuum tube cathodes. The cathode of the vacuum tube, then, is that element in the tube, sometimes in the form of a filament, which is heated in order to discharge electrons from its surface.

The Electron Flow

The plate is a piece of metal surrounding the cathode, and is used to receive the electrons which are emitted from the cathode. When the cathode is heated high above the temperature of its surroundings, millions and millions of tiny negative electrons are discharged into space, as in Figure 2. In order for the plate to draw these electrons to itself it must have a positive charge or a deficiency of electrons. This is accomplished by connecting the positive terminal of a battery or other source of voltage to the plate in order to pull electrons out of it.

We have previously read, that when an electron leaves an atom it is free to go into combination with any near-by atom which has a deficit of electrons. Therefore, when the cathode is heated and the plate is positively charged, we have a stream of electrons flowing from the cathode to the plate as in Figure 3.

Every electron which reaches the plate constitutes a minute electric current, and when a sufficient number of electrons reach the plate we have a measurable current of electricity. This current of electrons or electricity which is shot out of the cathode into the vacuum, reaching the plate, and flowing from the plate through the battery and other apparatus, must be conducted back to the cathode again in order to give back to it its deficiency of electrons. It is this current which is used in so many ways to perform many modern wonders.

Advent of the Grid

We need now in order to complete our vacuum tube, the element for controlling the number of electrons which are allowed to reach the plate. This third element, for which de Forest is famous, is the grid and consists of a wire mesh between the cathode and plate. Every electron which finally reaches the plate must pass through the openings in this wire mesh which we have called the grid.

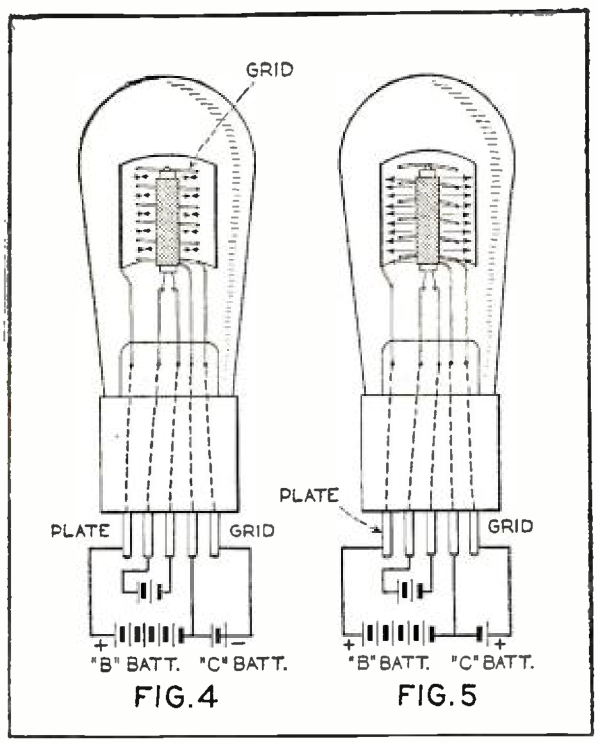


Figure 4. If the grid has a negative charge it will repel any electrons coming near it, and therefore send some or even all of the electrons headed toward the plate back to the cathode, depending on the amount of the negative grid charge

Figure 5. If the grid is positively charged the number of electrons from the cathode reaching the plate will be greatly increased, because the grid then aids the plate in attracting electrons

These tiny electrons speeding across to the plate are easily influenced by the electrical charge on the grid. If the grid has an excess of electrons on it or in other words a negative charge, it will repel any electrons coming near it and therefore send most or even all of the electrons headed toward the plate back to the cathode (Figure 4). The plate current then is decreased. On the other hand, if electrons are taken away from the grid, leaving it positively charged, the number of electrons from the cathode reaching the plate will be greatly increased, because the grid will then aid the plate in attracting electrons. See Figure 5.

The grid in the vacuum tube may be likened to a traffic policeman on a one-way street. When the policeman raises his hand automobile traffic stops; when the grid becomes negative electron traffic stops. When the traffic policeman gives the signal to go, traffic again starts; when the grid becomes positive the stream of electron traffic to the plate is resumed.

We can see, therefore, that since the grid element of a vacuum tube can have such a marked effect on the number of electrons that reach the plate, we can, by varying the grid charge or grid voltage, regulate the plate current in any desired way. As (*Continued on page 234*)

The JUNIOR TRANSMITTER

In this article the author winds up the constructional description of a first-class transmitter and gives complete data on the power supply and adjustment preparatory to "going on the air"

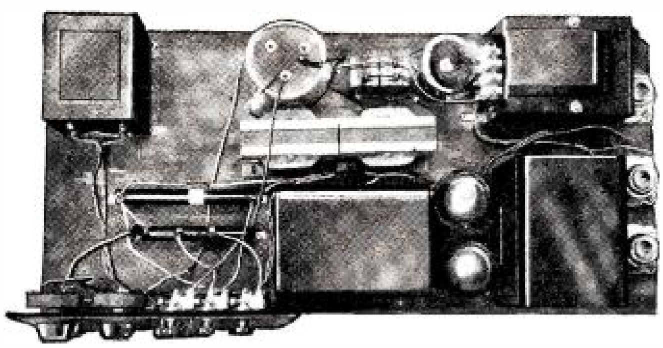
By Don Bennett

PART TWO

WE now proceed with the wiring, the filament circuits first. Twisted rubber covered wire is used for all filaments except the 510's, these being wired with bus bar. Color coding the balance of the wiring helps when shooting trouble. I used green for all grid leads, red for plate, yellow for key and blue for neutralizing leads. Bus bar was used in a few places where leads were short and for the plate leads of the last stage. All bus bar was covered with spaghetti and all wires passing through the sub-panel had an insulating sleeve of spaghetti extending one-half inch on either side of the panel. All leads are run in the shortest path between any two points and pulled tight.

You will notice that there are two sets of 2.5 volts s.c. binding posts. One set supplies the oscillator tube and the other the buffer and intermediate amplifiers. A separate filament transformer is used with two windings, one side for the oscillator and the other for the amplifiers.

The coils for the oscillator and buffer stages are wound on 1½" tubing and mounted as shown in the previous article. The intermediate and power stages are wound on R.E.L. coil forms. The secondary of the intermediate plate tank is wound on a one-inch tube bolted inside the R.E.L. form as shown on the photo. Wind the primary so that it is centered over the secondary coil in order that even distribution of energy is obtained. The coil data is given in a separate table, Figure 7. The turns given are those used in the original transmitter, but they may vary somewhat, depending on the size of tuning condenser, placement inside the shield compartments and other factors. Wind them as given and then make any adjustment necessary.



Top view of power supply, showing layout of all parts

The neutralizing condensers employed just fit in the space available. Slot the end of the condenser shaft so that they can be turned with the adjusting tool (a piece of bakelite rod filed down to a screwdriver point).

The grid condenser of the oscillator tube is mounted on the grid r.f. choke by tapping a hole in the choke. Clips are put on the condenser to take the grid leak.

After you have completed the wiring, check all connections with a battery and voltmeter. Also check all wiring for grounds. Remove the coils when doing this.

The Power Supply

The next step is to build the power supply. While all voltages may be obtained from the original supply by tapping the voltage divider, it is better to have a separate supply, especially if you plan to use phone. This will keep the voltages constant (and the frequency) in your oscillator and buffer circuits and you will not be so apt to have charges of "wobbulation" hurled at you.

The ideal supply for oscillator and buffer stages is B batteries. Four Eveready No. 486 batteries will stand the gaff of continued drain. The intermediate can then be tapped off the old power pack without damage. It will be necessary to have four small 22½ volt blocks similar to the No. 768T for C bias for all the tubes.

However, if you want to get all your supply from the 110-volt lines, you can build the power supply described here. This supply includes the original pack described in the February issue of RADIO NEWS and the additional parts necessary for the lower power stages. Two –81 tubes are used for the high voltage supply, and a Perryman –80M rectifier for the low power. This new mercury vapor tube is used to provide for the addition of doubler stages and the consequent drain. It will pass 300 m.a. at 500 volts, allowing us plenty of margin for additional stages. The complete list of parts is given at the end of the article. The power supply is built on the base of the old Junior transmitter, and although a bit cramped at one end, there is plenty of room for cooling and adjustment. The circuit is shown in Figure 6.

Plenty of Switches

The control panel is made of a piece of 7 by 10 bakelite 3/16 of an inch thick. On it are mounted the variable C bias resistors (potentiometers), the binding posts for connections, and the on-and-off switches. A word as to the switches—when tuning it is advisable to be able to shut off any plate voltage quickly. We have put a switch in each plate

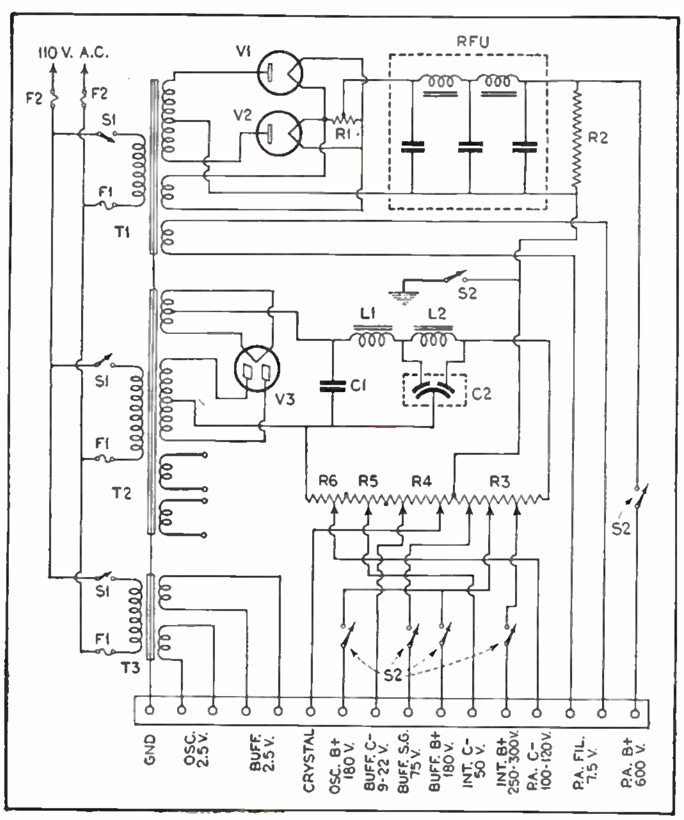
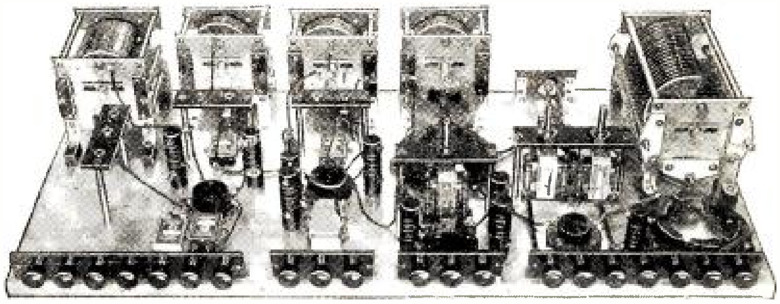


Figure 6. The circuit diagram of the power supply unit which will provide all voltages for the transmitter

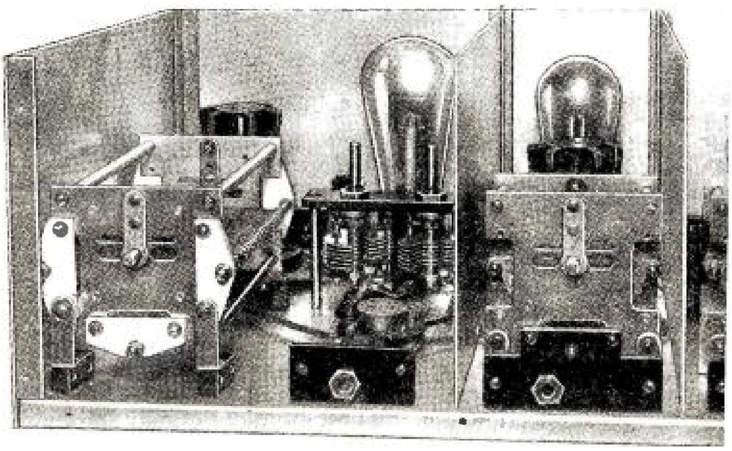
Grows Up



Rear view of transmitter, with cabinet and shield partitions removed

lead for this purpose in addition to the switch in the minus B. This last switch is the one most used as it eliminates the operation of the individual switches when shutting off the transmitter. The sixth switch is for the oscillator tube "C" bias. We are keeping in mind the future addition of crystal control and we can thus simplify the change-over from m.o.p.a. to crystal by being able to apply the bias to the crystal without looking around for a piece of wire.

The power is supplied to the transmitter through a cable made by binding together the individual leads with string. Don't forget to twist the a.c. filament leads before binding them into the form. At the set end these wires may be branched out on a dowel or other light stick, each wire being tied to it adjacent to the binding post on the set. In doing this, you simplify the connections at any time you wish to remove the set for work away from its shelf.



This view shows how milliammeter jacks are fastened to legs of condenser and also shows neutralizing condenser shelf. (Power amplifier stage.)

Going Into Operation

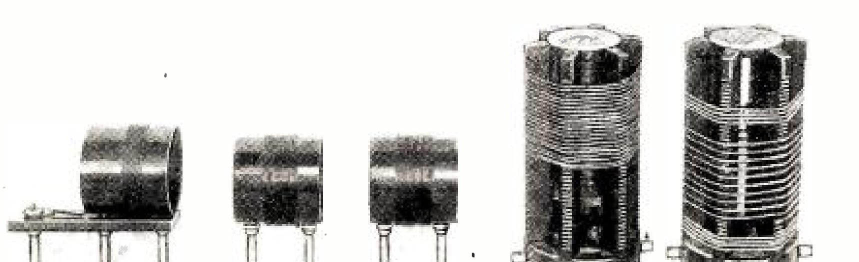
After the power supply is completed and tested, connect it to the transmitters. Throw all switches to the off position, put all tubes and coils in their sockets. Then throw on the switch of the filament transformer. Allow a minute or so for the tubes to warm up and then throw on the -B and the oscillator switches Plug your phones into the monitor and adjust it to the frequency to which you wish to tune the transmitter.

Next tune the oscillator to resonance with the monitor in the same way you tuned the original set. Of course, the O-50 Jewell milliammeter is plugged into the plate jack of the oscillator stage. When the tuning of this stage is completed shift the milliammeter plug to the buffer plate jack, throw the buffer plate switch to the "on" position and tune the stage to resonance. When it is in tune with the oscillator the signal in the monitor will increase in strength. (Of course, you have already adjusted the clip on the voltage divider to 180 volts.) Seventy-five volts is about right for the screen of the -24. Now turn off the oscillator plate switch. The plate current of the buffer tube should fall to zero. If it does not, adjust the potentiometer until it does. This shows that the tube is working at cut-off.

	OSC. GRID	OSC. PLATE	BUFFER	INTER. PRI.	INTER. SEC.	*POWER AMP. PLATE	*ANT. (TOTAL)
80	11	20	20	18	50	18	10
40	5	12	12	10	30	10	8
20	NOT	USED	7	6	15	6	8

ALL COILS WOUND WITH No.18 ENAMELED WIRE.
* HALF ANTENNA COIL WOUND ON EACH SIDE OF PLATE TANK COIL.

Figure 7. The coil winding data and, below, the coils. These are (left to right) the oscillator grid, oscillator plate, buffer plate, intermediate plate (and p.a. grid), and p.a. plate (and antenna) coils



Neutralization

Now turn on the intermediate tube, tune it to resonance as before and adjust it also to cut-off. Next comes the most important step of all—neutralizing. Solder a small loop of wire to a flashlight lamp to serve as an indicator, as shown in Figure 8.

Turn off the intermediate plate voltage but leave the oscillator and buffer working. Put your test loop down over the intermediate coil and tune the condenser until the lamp glows. Then take your neutralizing tool and adjust the neutralizing condenser until the lamp goes out. Readjust the tuning condenser until the lamp glows again and re-neutralize. Continue this until you cannot make the lamp glow. If turning the neutralizing condenser around has no effect on the lamp, you have too few or too many turns in the neutralizing coil. It might be well in making this coil (an extension of the plate tank coil) to dead-end it at seven turns and provide a flexible lead from the base connection. This will also permit changing bands without re-neutralizing by adjusting the coil to get enough r.f. voltage on the other bands and not touching the condenser. Once neutralized, the stage should stay neutralized until you change tubes. As we are neutralizing the tube capacity, putting another tube in service may mean re-neutralizing.

As a check on neutralizing turn on the plate voltage of the intermediate stage. Tune the (Continued on page 249)

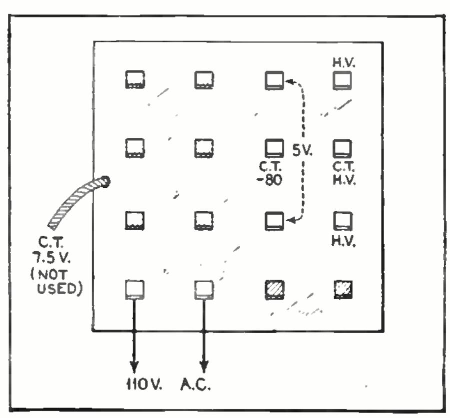


Figure 9. The terminal panel of the high voltage power transformer. The shaded terminals are not used

Using Tuned Audio Circuits

To Compensate Side-Band Cutting Selectivity

Many unique design features are included in this receiver extraordinary—a receiver that is suitable for the ordinary broadcast listener but more particularly for the DX fan who requires unusual sensitivity and selectivity with low background noise levels

By McMurdo Silver*

FOR the past three years it has been the policy of Silver-Marshall, Inc., to offer to the custom set builder and experimenter two distinct classes of broadcast receivers—(1) a design representing a high commercial level of broadcast receiver development and (2) a broadcast receiver design intended primarily for use under the most unfavorable and exacting conditions. The tuner and audio amplifier described in this article are the logical developments of a series of receivers which started with the original 710 Sargent-Rayment receiver, were carried on in the S-M 712 tuner, and last year in the 714 superheterodyne tuner.

An examination of the selectivity curve of the 716-683 combination, operating into a constant (rather than a varying) load impedance, would indicate that side-band attenuation has been carried to a very considerable extreme in the r.f. portion of the receiver, this being completely overcome and corrected by an even higher order of side-band compensation in the audio amplifier and loud speaker circuit.

The 716 tuner is really intended for operation directly in the operating rooms of broadcast stations or in locations within a fraction of a mile or so of very powerful broadcast stations. In consequence, the features of image-frequency selectivity, as well as adjacent channel selectivity and freedom from cross talk or cross modulation have been developed to a high order. In addition to the advanced type of superheterodyne engineering, the receiver also utilizes the latest developments in straight t.r.f. receiver design.

Examining Figure 1, the tuner itself is seen to be assembled upon a formed steel chassis 16½″ long, over mounting flanges, 10½″ deep and 8½″ high, while the audio amplifier and power supply is mounted upon a chassis 12″ long, 10″ deep and 8½″ high over all. For the first time in this series of receivers the control layout of the tuner has been made symmetrical, with the tuning dial and the controls located directly in the center of the chassis so that the tuner can be conveniently mounted upon one shelf of a standard console cabinet where desired, with the audio amplifier on the same or on the speaker shelf of the cabinet, provision being made, as will be mentioned later, to bring the two tone controls of the 683 amplifier directly up to the tuner control locations.

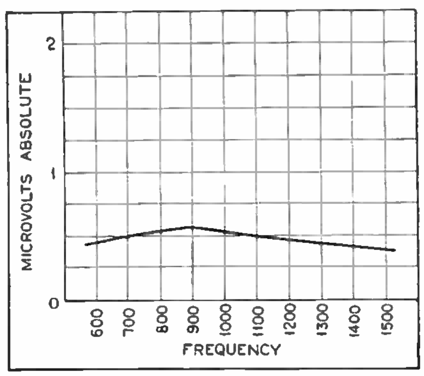


Figure 4. The sensitivity curve of the receiver shows a relatively uniform characteristic varying between .37 microvolts absolute at 1500 kc. and .57 at 900 kc.

The Circuit

Examination of the circuit diagram of Figure 3 shows the assembly to consist essentially of a –51 r.f. amplifier stage, a –24 first detector, –27 oscillator, two –51 dual-tuned i.f. stages, a –27 second (linear power) detector, a –27 first audio stage, a push-pull –47 pentode output stage and an –80 rectifier. As a matter of fact, the first audio tube contributes no gain to the audio amplifier or tuner and is employed, rather, as a necessary element in a totally new tone control system.

A total of four tuned circuits tuned by a four-gang condenser which is housed in the large shield can seen at the right of the chassis in Figure 1 are employed, preceding the first detector. In Figure 3 the left-hand or first tuned circuit is a rejector stage across the antenna and ground which tends to reject all except the wanted signal. Between the antenna system and the r.f. stage is another tuned circuit. The combined effect of these two circuits is considerably better than that of a conventional selector stage and shows, in addition, a considerably higher voltage

*President. Silver-Marshall, Inc.

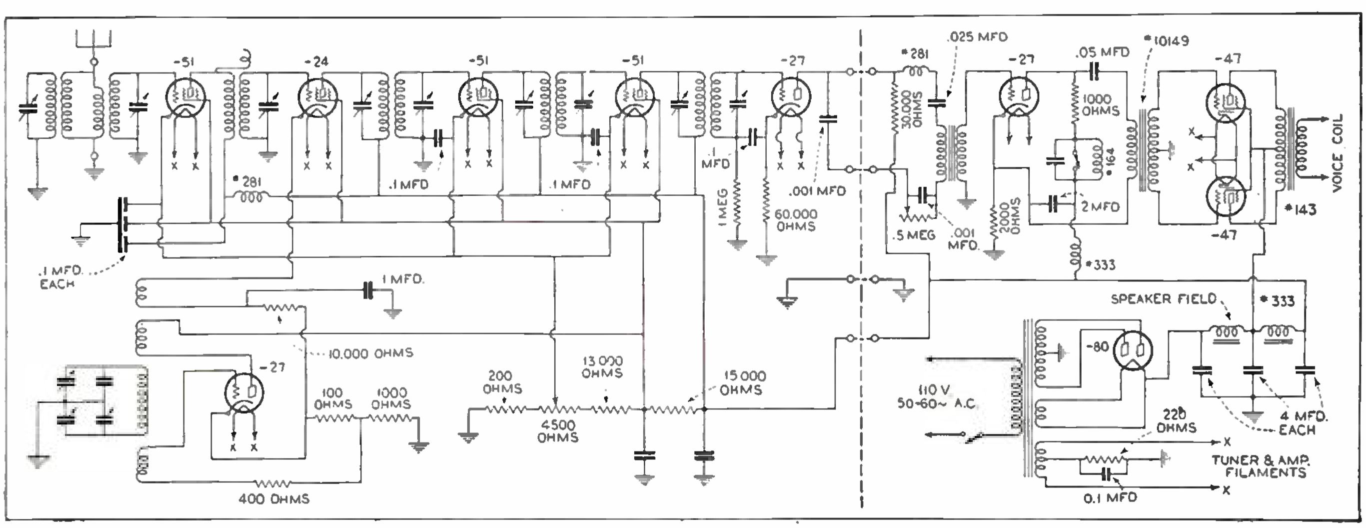


Figure 3. The circuit shows a number of unusual features, important among them being the antenna rejector circuit and the dual tone control

transfer from antenna to r.f. tube, since this system does not show the loss of the average dual selector stage as employed in most r.f. circuits. The use of these two tuned circuits in front of the r.f. tube gives a high order of both adjacent channel and image-frequency selectivity, and coupled with the remote cut-off of the -51 vario-mu tube, a complete freedom from cross talk or cross modulation.

The r.f. tube is coupled into the first detector through a third tuned circuit employing both inductance and capacitative coupling between primary and secondary of the r.f. transformer which results in more uniform gain for all broadcast frequencies. The oscillator utilizes a tank tuning circuit which is substantially disassociated from the oscillator tube so far as frequency stability is concerned, this type of circuit in addition giving practically complete freedom from such variations of circuit alignment as might be occasioned by variations in the characteristics of individual oscillator tubes or variation in line voltage applied to the tuner.

The -24 first detector feeds into two stages of 175 kc. i.f. amplification employing a total of three dual tuned transformers with six tuned circuits. Because of the high order of side-band compensation attained in the audio amplifier, the i.f. amplifier itself has been made considerably sharper than is possible or necessary in conventional superheterodyne design. This assures not only an extremely high order of selectivity, but an unusually good signal-to-noise ratio.

The i.f. amplifier is followed by a -27 second linear power detector which, in accordance with the best superheterodyne technique, has its plate by-pass condenser mounted directly upon the tube socket to prevent i.f. harmonic feed-back to the first detector or oscillator.

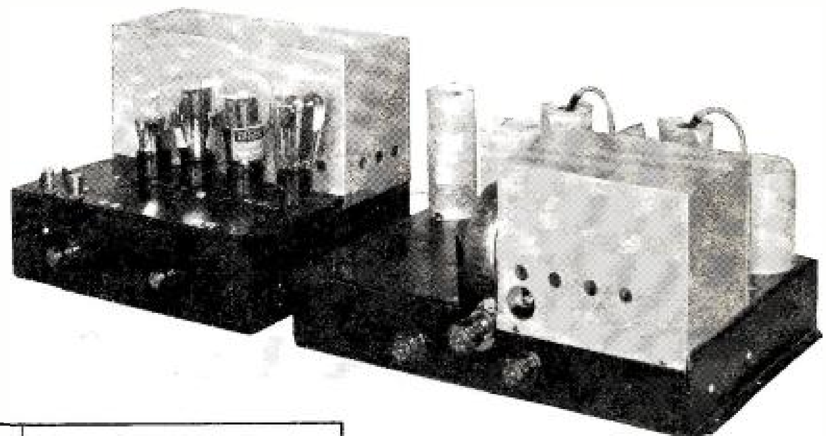


Figure 1. The tuner (right) and power supply-amplifier units follow commercial practices in their physical design

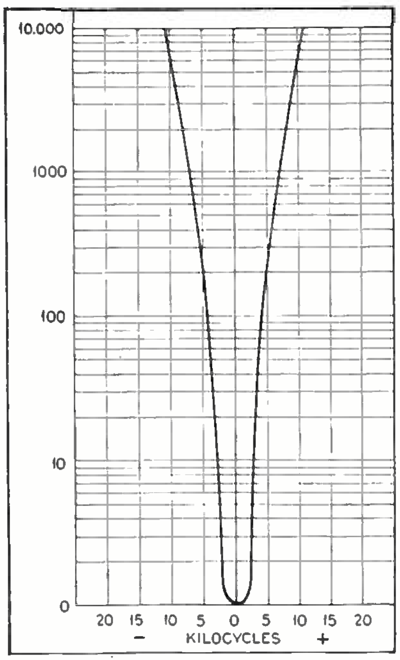


Figure 5. Selectivity at 1000 kc. shows better than 10 kc. width to 200 times down. Resulting attenuation of higher audio frequencies is compensated for in the audio and speaker circuits

Non-Radiating

The r.f. and oscillator coils in the tuner are individually shielded in rectangular aluminum cans, as can be seen from the examination of Figure 2, and as the oscillator condenser and tube are likewise shielded, the possibilities of radiation which would interfere with the reception on neighboring receivers is completely done away with.

The 716 tuner derives all power for its operation from the 683 amplifier which consists of a 10½-ampere supply at 2½ volts a.c. for heaters and 250 volts d.c. for "B" and "C" power. All voltage divider resistors to supply the required grid and screen voltages are included directly in the tuner.

Volume control for the tuner is effected by varying the control grid bias upon the r.f. and both of the i.f. tubes. The first detector grid bias is semi-automatic, the automatic portion being obtained by a drop across the 10,000-ohm fixed resistor in the first detector cathode lead. The fixed portion of the first detector bias is obtained by a drop across resistors in the oscillator cathode lead, the plate current of which, being substantially constant, assures a permanent voltage drop across these resistors.

The oscillator is coupled to the first detector not by means of direct coupling between the coils of each circuit, since this is not practical where they are individually shielded, but by means of a small pick-up coil coupled to the oscillator coil and connected in the first detector cathode lead. The oscillator is so designed that with the 400-ohm resistor shown in its grid circuit, its output is substantially constant for its entire frequency range, which is desired if noise, due to heterodyning action of the oscillator with weak signals, is to be kept down and sensitivity to be kept constant throughout the broadcast band.

Examining the tuner in Figure 1, two things are seen projecting from the rear of the gang condenser housing which serve to shield the r.f. tube, first detector and oscillator from each other. Directly behind this assembly, from right to left, is the first i.f. transformer, first i.f. tube, second i.f. transformer, second i.f. tube, third i.f. transformer and second detector. The blank space to the left of the drum dial on the tuner chassis has been intentionally left for the inclusion of a power supply where it is desired to operate the tuner with an audio amplifier unable to furnish the required power for the operation of the tuner.

The illuminated vernier drum dial is translucent and calibrated directly in kilocycles. The dial pointer has been placed directly behind the translucent scale in a manner such that parolax or variation in dial readings as a result of different angles of vision is completely eliminated, the pointer throwing a distinct and clear shadow directly upon the dial scale. No pointers are necessary, therefore, and the tuner may be operated upon a table without any external cabinet whatsoever, if desired.

In addition to the knob for the tuning dial at the center of the tuner assembly and the volume control directly to the right of this knob, two additional holes symmetrically located are provided on the tuner chassis. These may be utilized for the two-tone (*Continued on page 245*)

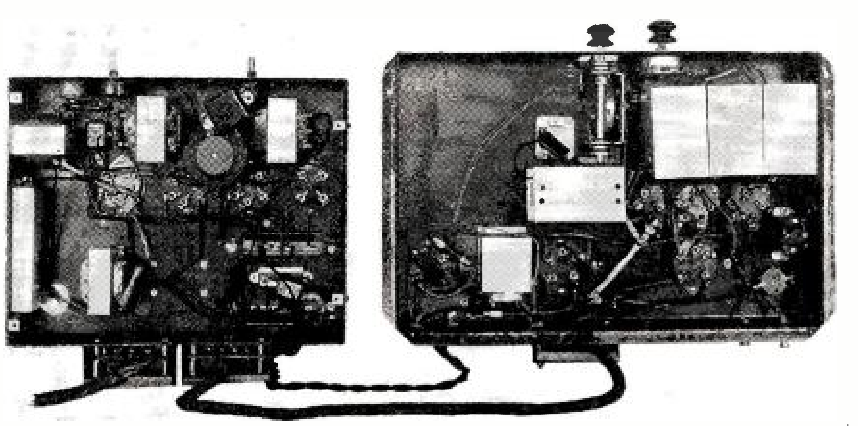


Figure 2. The "below deck" layout is orderly and compact. This model differs from that in Figure 1 in that only two control knobs are included on tuner chassis

Practical

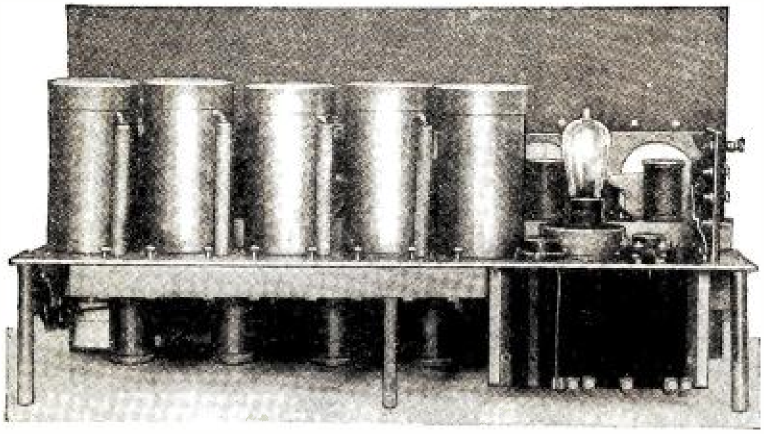


Figure 9. The rear view with the shields removed from the r.f. coils, at the right, and the i.f. coils under the base, at left

NOW let's go back to the receiver and touch on a few points in its design.

As may be noted, it has an extremely complete job of shielding. This has been thoroughly justified, as operation of the set, even when it is connected to a 15-watt power amplifier, shows an uncanny quietness. There is absolutely no sound in the absence of a wave. When the dials come to a point where a wave enters, it pops in, as one might say, out of a clear sky with full and beautiful modulation and no side-band cutting.

All coils used are the highly efficient National coils wound on forms of the new R39 composition. Four of the "Blue" type coils (115 to 200 meters) are used in the intermediate amplifier. Eight Pilot midget variable mica-dielectric condensers are used to tune the plate and grid circuits of these four coils. By referring to Figure 7, which shows a bottom view of the finished receiver with the entire bottom shields removed, these midget condensers are just distinguishable below the brass floor of the receiver and over these intermediate coils. In this particular model of midget condenser the tops were removed and they were mounted directly under the floor. In this floor and directly over the centers of these condensers were drilled holes which were threaded for three-sixteenths, ½-inch round-head brass machine screws. The heads of these screws may be seen in Figures 9, 10 and 11. The grid condensers have one of their terminals mounted by a machine screw direct to the brass floor, as an inspection of the circuit will show that one terminal is grounded. The plate coil condensers are mounted ungrounded. In these condensers there is a small circular disc of bakelite about 1/16 inch thick. It is against these discs that the brass adjusting screws bear, so that by screwing the machine screws up or down one may adjust these condensers and bring all these circuits into resonance from the outside when all the shields are in place. These shields are about three and one-half inches square and four and one-quarter inches in depth. A heavy iron "U" clamp holds all four shields firmly in position so that any handling of the set later cannot throw out of tuned adjustment the intermediate amplifier.

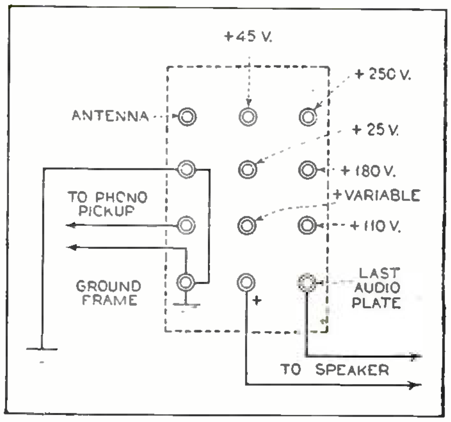


Figure 12. The terminal board, which is located at the rear left-hand corner of the chassis and provides for all connections to amplier and power-pack

In case one might wish later on to try some quite different intermediate frequency, other coils may be inserted in place of the present ones which are tuned now to 1740 kc.

The floor of the chassis is a piece of ⅛-inch sheet brass 25 inches long and 12 inches wide.

All of the tube shields with the exception of the oscillator tube are cylinders with top caps 3¼ inches in diameter and 6" in height.

The tuned radio-frequency stages and the oscillator unit are in rectangular shields about 4½ inches wide each, and 7 inches long from front to back, and 6 inches high.

At the right, looking from front, and back of the two meters, is a small shield completely enclosing four miniature Eveready No. 751 dry cells, which are used for the control grid bias of the volume control tube.

Parts Specifications

All the shields are made of 1/32-inch sheet brass.

All of the coils mount in the special six-prong National sockets.

The variable condensers are the Cardwell taper or wedge-shaped plate type. The five-plate model works out the best.

The bottom milliammeter, a Weston 2¼-inch type, has a scale of 0 to 1.5 milliamperes and is in the plate circuit of the oscillator tube. I have found that in this set the best value here is one milliampere.

The top milliammeter, of the same type, has a scale of 0 to 15 milliamperes.

The voltage dividers are type 446, made by General Radio Co. They are wound in two sections, one of 15,000 ohms and a 1500-ohm section. One of these, at the left rear, is the voltage divider of the receiver, and a 7500-ohm tap is used on the other in the plate circuit of the automatic volume control tube.

All of the small fixed resistors are manufactrued by the Lynch Company.

By-pass condensers are Flechtheim and Parvolt.

Centralab variable resistors are used in the volume control circuit.

A Frost variable resistor is used in the antenna circuit, as this model has an extremely small capacity coupling between its terminals.

A small model Centralab 500,000-ohm variable resistor is used to couple the oscillator to the control grid of the first detector tube as the

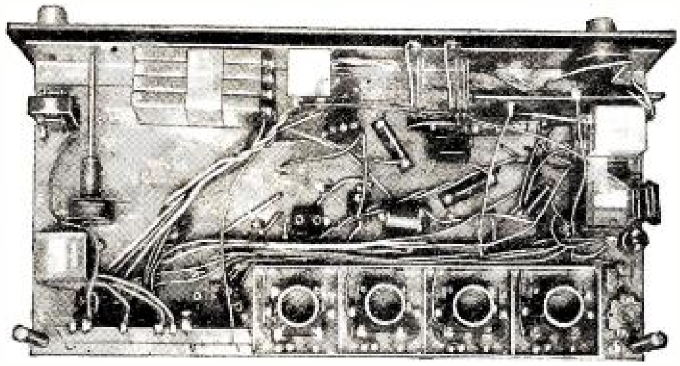


Figure 7. The underneath view of the chassis with the shield removed, showing the i.f. stage coils at the lower right

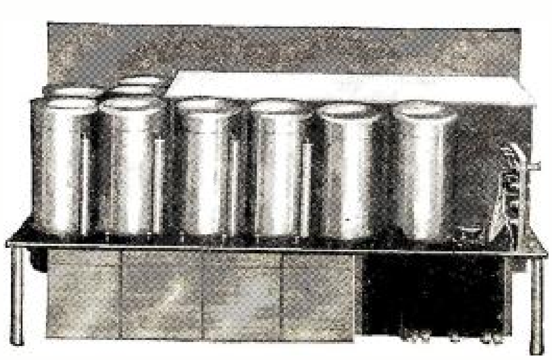


Figure 11. Rear view with all shields in place. This gives an excellent idea of the completeness of the shielding employed

Short-Wave Super Design

Last month Mr. Jones presented an extremely worth-while discussion on short-wave reception and included a general description of a short-wave super of his own design. This month he continues with a more detailed discussion of this receiver

By Frank H. Jones

Part Two

small capacity that exists between the rocking plate in this resistor and the carbon element of the other terminal serves very nicely to couple the oscillatory current to the first detector, while the variable resistance serves to put just the right bias on the control grid of the detector.

The National dials are of the slow-motion type and are equipped with real vernier scales which read to tenths of degrees. These dials are absolutely free from back lash and while they are a bit expensive they are well worth while in any good short-wave set.

The overall dimensions of the set are somewhat greater than necessary, but it was thought better to err in this direction to avoid losses due to shields too closely placed. A reference to photograph Figure 9 shows four small vertical tubes diagonally back from the tube shields of the i.f. amplifier tubes and the second detector tube.

These tubes, which are made of brass, convey the grid leads from the coupling transformers to the control grid clips of the vacuum tubes. These brass tubes are ½ inch in diameter to keep losses low and at the tops of these tubes the grid wire continues into the vacuum tube shield through a spiral metal shield made of No. 16 copper wire coiled into the shape of a spring, bent over and soldered both to the brass tube and the vacuum tube shield.

The plate leads of the radio-frequency tubes go down directly through the brass floor of the set to the radio-frequency coupling transformers, and these leads are only one inch long. This design practically eliminates any chance of back coupling from any plate lead to any grid lead.

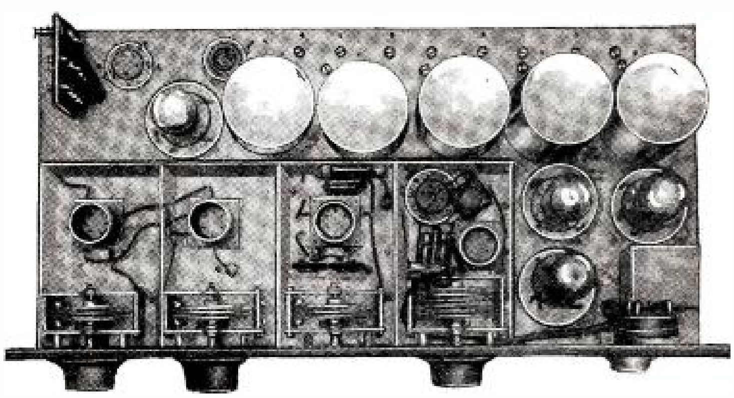


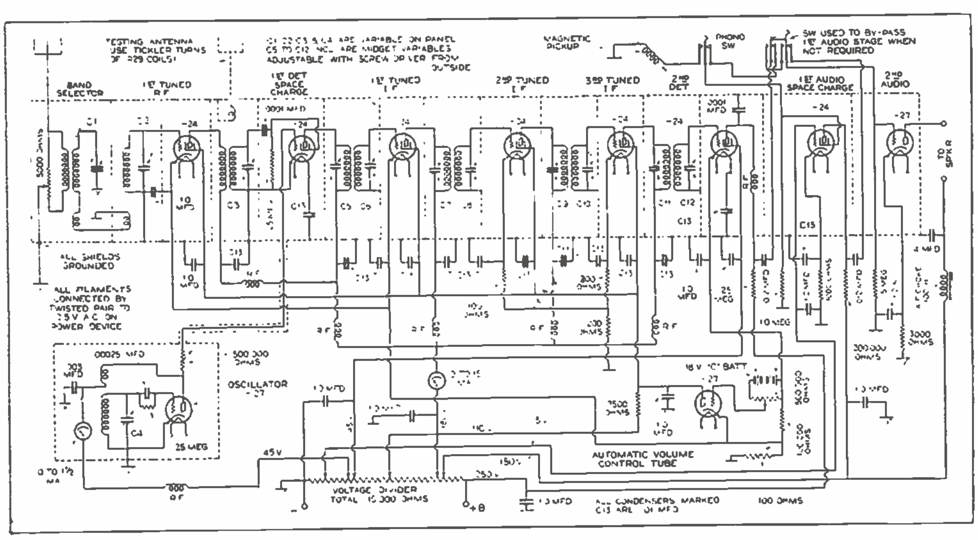
Figure 10. Top view with part of shields removed to disclose layout

The plate lead of the first tuned radio-frequency tube, the grid lead of the first detector tube, and the lead coupling the oscillator to the first detector tube go under the floor of the set and, to keep the shielding complete, all three of these leads are carried separately through ¼-inch copper tubes which can be seen in the bottom view of the set, and each of these copper tubes is grounded to the floor frame. All the external leads of the oscillator are completely shielded, even to the back of the oscillator milliammeter.

The Power Supply

The power pack used for the set is the National Thrill Box short-wave set "A" and "B" power unit. The power transformer in this unit has an electrostatic shield between the primary and the secondary, and this shield is grounded. A Silver-Marshall power transformer for 2½-volt tubes is bridged across the Thrill Box filament secondary power unit, taking care to phase out the two secondary terminals so that they will be additive and not bucking. As the Thrill Box A-B power unit only has capacity for a filament load of five -24 type tubes, this extra filament transformer takes care of the other half of the load, as this is a ten-tube set. Also the center-tapped resistor in the Thrill Box A-B power unit then serves both filament secondaries. Of course the primary of the S.-M. transformer is connected to the 110-volt a.c. power line along with the input leads of the A-B unit.

The very complete shielding makes it impossible for any signal or disturbance of any kind to get into the set except through the small hole where the antenna leads into the first shield.

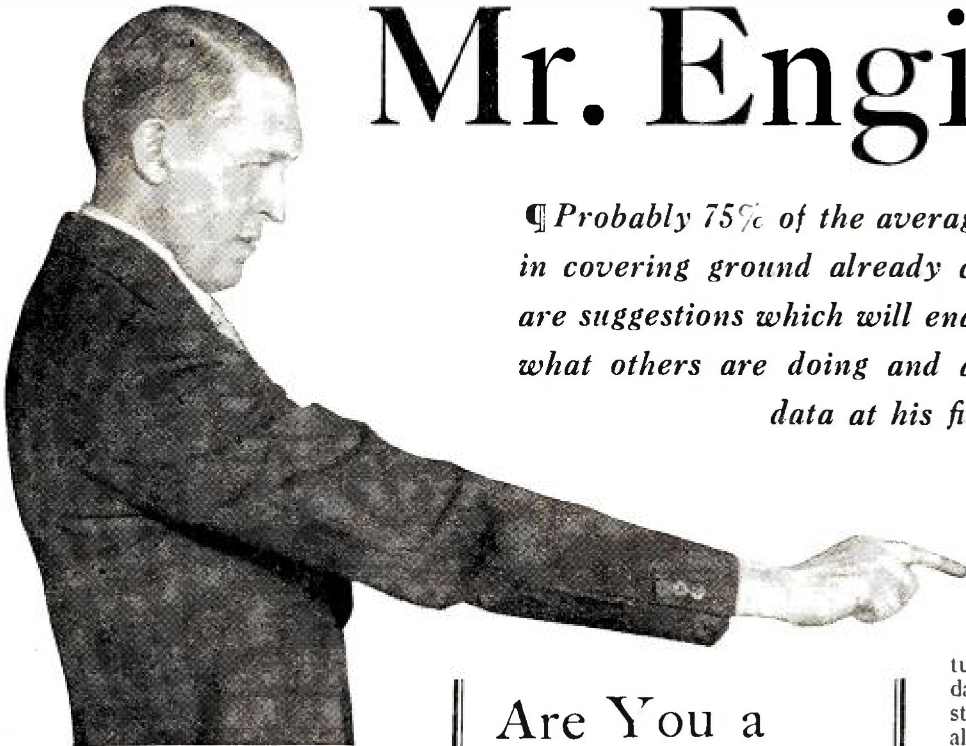


The circuit. This is a repetition of the diagram which appeared in the earlier article, in the August issue

You might be wondering why a set with so much radio-frequency pick-up needs two stages of audio. Well, it does not, as a radio set, but the two audio stages were designed into the set to furnish a good amplifier for a phonograph pick-up.

This set was designed to work with one audio stage, directly into a 15-watt power amplifier dynamic speaker unit. The audio stage used with the radio is really the second stage, although by suitable coupling the second detector will operate the power amplifier direct, with very good volume.

However, due to the very low background noise level of this set it is possible to use the two audio stages (*Continued on page* 238)



Mr. Engineer—

¶ Probably 75% of the average engineer's time is spent in covering ground already covered by others. Here are suggestions which will enable the engineer to know what others are doing and also to keep worth-while data at his finger tips

Are You a Radio Robinson Crusoe?

¶ Do you get first-hand information on latest radio developments?

¶ Do you know what other engineers in your field are accomplishing?

¶ Do you regularly receive periodicals and other literature pertaining to the radio field?

¶ Do you read this material regularly?

¶ Do you keep a helpful radio reference file which permits you to put your hands on desired information in a moment?

ENGINEERING differs from the pursuit of pure science in at least one important respect. Its successful practice depends almost wholly on co-operation—on close and continual contacts with others in the same and related fields, and with the ultimate consumer. It is not difficult to imagine a pure scientist, supplied with living necessities and a stock of apparatus, carrying on his work successfully for a long period of time on a remote island entirely out of touch with the rest of the world. Under similar conditions, our engineer would probably soon turn to pearl diving or some other form of profitable amusement. We assume, of course, that he has no duties other than following his own inclinations.

The hypothetical, marooned engineer lacks one of the most important engineering tools—*information.* A tabulated list of the major sources of this information might appear like the following:

1. Periodical literature.
   - (a) Proceedings of technical societies.
   - (b) Technical and trade journals.
   - (c) Abstracts.
     1. Periodical articles.
     2. Patents.
     3. References.
     4. Book reviews.
   - (d) Special information services, reports.
2. Technical Books.
3. Group Instruction.
   - (a) Lectures.
   - (b) Demonstrations.
   - (c) Conventions and expositions.
4. Conferences.

All of these sources except the first have been intentionally slighted, for our discussion is confined to printed matter and periodicals in particular. Because of its timeliness in the prompt reporting of current technical developments, this periodical literature occupies a unique position of its own, bringing with it, however, a number of perplexing and often neglected problems which have to do with its efficient utilization. These problems are complicated by the numerous sources, frequency of issues and limited availability of such material. Technical books of various sorts are invaluable to the engineer, but the publication of these books follows actual developments at a much later date and the product necessarily is restricted in scope and detail. Books also are available over long periods of time. Lectures, demonstrations and the other forms of instruction mentioned are usually temporary and preliminary expedients due to our limited capacities for remembering details, and they afford little of permanent value to the specialized worker.

Are You "Marooned"?

The radio engineer who does not continually make use of these sources of information is seriously hampered in his work. He is just as surely "marooned" as the hypothetical individual cited. He tends to be an expensive employee regardless of the amount of his wages for he is not likely to be familiar with the latest technical developments. He is due to be discarded for the radio industry is no longer inclined to support unprofitable investments of any sort. We offer recommendations to engineers as individuals who may have overlooked these significant facts a little later.

The penalty for scant attention to the literature of the art on the part of radio manufacturers, regardless of the existence of other channels of technical information, is immediately and continually reflected as increased development cost. This applies not only to the technical details of the product itself, but to the engineering equipment, apparatus and processes which are an essential part of the product development. It is rather ridiculous, for example, to assign to an engineer the problem of developing a piece of apparatus whose prototype has already been described in minute detail. Neither would it be called good practice, unless a new point of view is involved, to devote time to mathematical analysis of a certain special case of non-linear distortion when such a study was reported several years ago in a prominent British radio journal. Hundreds of similar examples will immediately occur to anyone with laboratory experience. In the manufacturer's case, the scope of this desirable information expands to cover the fields of materials and production methods and tools. The whole problem is a difficult one, calling for compromises and careful thought, and with this in mind the final general suggestions to radio manufacturers are ventured.

Are You Becoming A Back Number?

By Ralph P. Glover

Whenever a new problem is encountered, it seems logical than an inspection of the "prior art" should be the first step in its solution. It is only natural to look first for the known, available previous knowledge on the subject or related details.

Know Your Sources

This is easily recognized as the "Didn't so-and-so write an article on that?" stage in organizations where there is a negligible attempt to collect technical information in an orderly way. If the inquirer is correct, and can find the desired writing, he is probably satisfied. Let us hope that the article contains a bibliography which will lead him to the other information on the subject which he may never have seen or heard of before. Decidedly there are two problems here—one concerned with periodicals on hand, and another with periodicals which are not at hand, for one reason or another, but which we may be able to secure or consult when the occasion arises.

Too many engineers find themselves in the predicament of this one, who evidently depends on his memory for a reference file—and the memory isn't hitting on all six

In 1929 there were more than 100 important periodicals devoted to electrical engineering subjects alone. More than half of these were published in the United States and we can therefore guess that considerably more than half of them were in the English language. The 1931 Yearbook of the Institute of Radio Engineers, on page 263, lists 45 periodicals under the heading of Current Publications of Interest to Radio Engineers. While the list is not complete, it does reveal some interesting figures which are given in the table. It should be noted that 75 per cent. are English-language periodicals and that more than half of all those tabulated originate in the United States. It may be enlightening to compare the various totals with the number of periodicals which *you* have available.

STATISTICAL SUMMARY OF PERIODICALS DEALING WITH RADIO SUBJECTS.

CONTENTS	ENGLISH LANGUAGE AMERICAN	ENGLISH LANGUAGE BRITISH	FOREIGN LANGUAGE	TOTAL
RADIO ONLY	8	4	3	15
PARTIALLY RADIO	8	2	4	14
INCLUDING PHYSICAL ASPECTS OF RADIO	5	4	2	11
COMMUNICATIONS INCLUDING RADIO	2	1	2	5
TOTALS	23	11	11	45

It should not be assumed that it is necessary or advisable for any single individual or organization to accumulate all of the various radio publications, although this is actually done by the larger commercial firms, government bureaus, educational institutions and libraries. The selection should be based on actual needs after a careful appraisal of the probable value of the various contents. For economic and other reasons, individuals must usually restrict their lists to a greater extent than organizations. At the risk of appearing truismatic, it should be pointed out that even in the same general class, these periodicals are subdivided and specialized in contents; some frankly cater to the amateur, others are experimental and / or theoretical, and still others are devoted to the various commercial phases of radio. Variety would seem to be desirable in any selection. On the other hand, it is only a *fair* investment to purchase a considerable number of these journals for engineering purposes if the copies are not carefully read and cared for in an orderly way so they may be quickly located for reference purposes. Some sort of an index system will enhance the utility of the material enormously.

Regardless of the care exercised in selecting periodical literature to fit our needs, there are always important contributions to the art appearing in sources other than those which we secure regularly. Notable attempts to review and abstract the whole literature have been made by at least two governmental bureaus, the Bureau of Standards in the United States, and the Radio Research Board in England. These abstracts have been available to the profession for some time and are published monthly under the respective titles of "References to Current Radio Literature"[1] and "Abstracts and References."[2] Material in both cases is classified according to subject matter and in addition, in the first case, is given a class number in accordance with "A Decimal Classification of Radio Subjects —An Extension of the Dewey System."[3] As might be expected, there are many omissions and duplications which could only be eliminated by the establishment of a single professional agency for carrying on such bibliographical work, although this should not detract from the considerable credit due the bureaus mentioned for their care and enterprise in initiating such valuable services. Wherever possible, professional radio engineers should at least glance over these references as they are released. Other similar services of note are those of "Science Abstracts," published in booklet form in England, and the unfortunately incomplete sections on Radio and allied subjects which are a portion of the (*Continued on page 242*)

1. Appearing in each issue of Proc. I. R. E.
2. Published as a portion of Experimental Wireless and the Wireless Engineer (British).
3. Circular of the Bureau of Standards No. 138, obtainable from Superintendent of Documents, Government Printing Office, Washington, D. C., U. S. A. Price 10 cents in cash or money order.

Super Power *on* Long Waves

This concludes Lieutenant Wenstrom's presentation of his case for long-wave broadcasting. He has pointed out the advantages which such a system would offer and also the problems involved—with some suggested solutions

By Lieut. W. H. Wenstrom

PART THREE

LET us assume that the next stage of long-wave broadcasting will begin with the gradual extension of long-wave stations, which should be put in operation at intervals until the national long-wave chain is complete. When the last transmitter is finished practically everyone in the United States should have available a 200 kc. signal of 1 millivolt per meter or better—a signal at least ten times as strong as most rural listeners have been accustomed to in the past. The ordinary listener should here enter a field which has previously attracted mainly the experimenter. The demand for custom-built adapters and tuners should show a marked rise—so marked, in fact, that custom builders may not be able to keep up with it. At this stage mass production of tuners and adapters might enter the scene. A demand should arise for custom built combination receivers, tuning to both the 200 kc. band and the present band.

The design of such combination receivers presents few difficulties. To cover the present broadcast band, having limits of frequency ratio about three-to-one, variable condensers are required which can tune through a capacity ratio of about nine-to-one. As even a very wide band between 1000 and 2000 meters entails a frequency ratio of only two-to-one, standard condensers will tune easily through any long-wave band that is likely to be used. The corresponding long-wave inductances must be about sixteen times as large (four times as many turns) as those used at present. For two band coverage, therefore, the logical design is two sets of inductances, as shown in Figure 1, with anti-capacity switches throwing either set across the tuning condensers and the remainder of the circuit. This arrangement would be particularly convenient in the superheterodyne where a common intermediate frequency can be used for both long and short-wave signals, but it would be applicable to tuned radio frequency sets as well. Aside from such arrangements, it is possible to build two tuners, controlled from a common dial or separate ones, into the same cabinet with common amplifier and speaker.

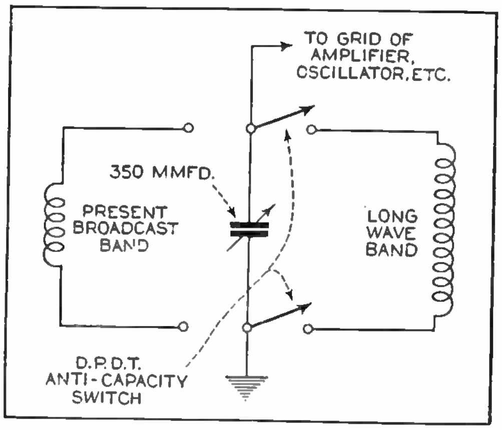


Figure 1. Band changing arrangement for use in a receiver designed to cover both the present wave-band and the proposed long-wave band

As the national long-wave system approached completion, receiver development would naturally tend towards complexity of design along with simplicity of operation. So many variables enter into possible selectivity and sensitivity requirements of the long-wave tuners that it is difficult even to guess at them. Will each long-wave station operate in a separate channel, or will the national chain be partly or wholly synchronized? How close to the new broadcasting channels will code transmitters of other services operate? No one can answer these questions at the present time. In general, selectivity requirements determine the number of tuned circuits a receiver must have, be they in coupling transformers, band pass filters, or whatnot. The greater the need for selectivity, the more tuned circuits in some form. The present broadcasting structure calls for at least four tuned circuits, but the long-wave system should be less exacting. It is possible that three or even two tuned circuits will be found sufficient.

As shown in Figure 2, long-wave broadcasting offers a distinct technical advantage in the matter of selectivity. In the long-wave case the carrier frequency is lower in relation to audio frequencies. This means that for a receiver of given selectivity there is less cutting of sidebands. Or putting it the other way around, for a given standard of quality (harmonic transmission) the long-wave receiver is more selective. This effect, which has been pointed out by Professor N. I. Adams of Yale University, is still another technical argument for the long-wave system.

As for long-wave requirements in the matter of sensitivity or overall radio frequency gain, they should also be less rigorous than present design standards. Today we consider that a broadcast receiver should show gain in the neighborhood of 70 db., which is actually represented by about three efficiently coupled screen-grid amplifiers. The probability is that, due to the high power recommended and consequent high signal levels, less gain will be ample for long-wave tuners. At any rate, long wave radio amplification will be comparatively easy. Aperiodic transformers will be more efficient, and even resistance-coupled radio frequency amplification may have some possibilities.

Completion of the Long-Wave Broadcasting Plan

When all transmitters have increased their power to the required values for universal true service broadcasting, receiver design should reach an even level. Combination receivers should be the order of the day, with or without electric phonographs, home recording, or other desirable variations. Mass production will probably limit the custom builder and the experimenter once more to their present confines. Outside the large cities and their suburbs the present spectrum may suffer somewhat in listener interest when compared with a newer and better service. But if the changes are wisely made, they should be a source of continued stimulation and profit to the radio industry, rather than the danger they might appear to be at first sight. Some dangers there naturally be, for all progress involves dangers of some sort. Man did not learn to use fire without burning his fingers.

Counting the Costs

Some maintain that the idea of a few super-transmitters operating on long waves is economically unsound. Granted that national coverage is desirable, the long wave method is not only sound, but economically superior to other methods. On present wavelengths something like eighty 50 kw stations, evenly spaced across the country, would be required to cover thoroughly the entire country. They would cost perhaps twenty-four million dollars to install.

The installation cost of the seven odd 200 kc. 1000 kw. transmitters would be far less. A pair of 800 foot towers would cost around $200,000, the transmitter up to the final stage around $250,000, and the tubes and circuits of the final stage perhaps $50,000. This latter amount assumes twenty 200 kw. tubes costing around $2,500 each. This brings the in-

Which?

Coverage With Present Waves

80 50 KW. Stations, Costing

$24,000,000

OR

Equal Coverage With Long Waves

7 1000 KW. Stations Costing

$4,000,000

stallation cost of each station to around $500,000, or $3,500,000 for the entire system. Thus long-wave super-broadcasting should accomplish the desired end at one-sixth of present wave cost.

The running expense of each long-wave super-station would be divided principally into tube expense and electric power expense. Assuming an average of four tube replacements a year, the annual tube bill would come to around $200,000. The electric bill for eighteen-hour-a-day operation at maximum power would be approximately $500,000 per station, but as we pointed out in a preceding article, it would be possible to save a large percentage of this by decreasing power under good transmission conditions.

There are, of course, many assumptions in the foregoing figures, but they are nearer maximum limits than minimum ones. They are at least sufficient to show that, judged by the results it may accomplish, long wave broadcasting is economical rather than extravagant.

Comprehensive Organization Essential

Naturally a system such as we have suggested is beyond the means of small organizations. The logical builder would perhaps be one of the two present broadcasting companies, one of the great electrical or radio companies, or some new organization of similar size and resources. The national long-wave network cannot be built and operated piecemeal, by conflicting local or sectional interests, with efficiency. Immediately on such an intimation there is likely to arise a prolonged and agonized yell of "monopoly"—anathema to many Americans.

Call it by whatever name you like, but widespread organization is necessary in many human affairs, particularly where technology is to be applied on a large scale. The intimate service of a family physician meets small competition from hospitals or clinics. The individual attention of an independent grocer is missed in chain store trading. But no one would think of building a parallel railroad to compete with the New York Central, or stringing telephone wires through the streets to compete with the Bell System. Likewise national long-wave super-broadcasting. Public service on so vast a scale must be performed by large and well qualified organizations. This does not mean government ownership, or monopoly in its narrow and profit-forcing sense. The corporation undertaking such a service can be limited by law to a reasonable maximum profit. As an ultimate development two transmitters, or perhaps more, would be desirable at each station, giving the listener choice of true-service programs. This would open the way for two competing companies, who could strive diligently in public service much as the National and Columbia systems do at present.

Radio Moves Forward

The scheme which we have suggested must stand or fall on its own merits. All we ask is that it be thoroughly and experimentally investigated. Whatever the means finally adopted, national true service broadcasting coverage, bringing radio to those who now most need it and to those parts of our country where future developments must find their greatest field, is the ideal that should govern American broadcasting progress. Other nations have begun to move in this direction. Throughout Canada there is general dissatisfaction with the present broadcasting situation, and the Canadian Radio League, including some of the most prominent men in the Dominion, has drawn up a plan for building a national system of six powerful transmitters so located as to reach every section of Canada. Soviet Russia has begun the construction of a vast national broadcasting system outspreading from a 500 kw. key station at Moscow. At the present time the United States leads the world in the field of radio—at least so far as quantity is concerned. If this leadership is to be maintained, we cannot afford to neglect new ideas, however radical they may seem at first. A technology so widespread and powerful as ours should be attuned to constant improvement.

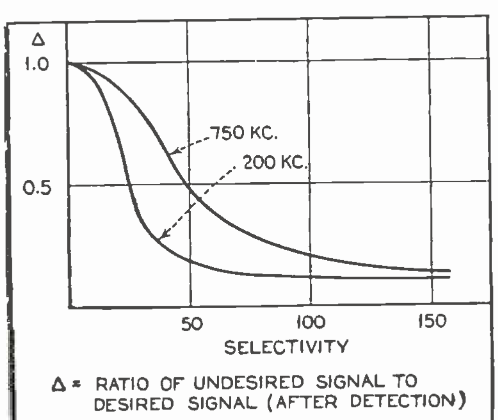


Figure 2. Relative tuning at 750 kc. and 200 kc. (after Adams), assuming receivers tuned to desired signals and separated from undesired signals by 10 kc. High values of selectivity mar quality

Looking Ahead

A few extracts from the Editor's schedule for the October Issue:

Quasi-Optical Wave Transmission and Reception (complete data)
Saxl

Audio Design Charts
Clough

Noise Measurements
Free

RADIO NEWS Prize-Winning Transmitter

A Deluxe Set Tester
Borst

Custom-Built Remote Control
Stevens

Receiving Television Pictures in New York
Replogle

Home Talking Moving Pictures

An Automatic A.C.-D.C. Broadcast Receiver
Cisin

Building a

A simple and inexpensive radiovisor which serves as a fitting mate for the

IT is the duty of the radiovisor to convert the received radio impulses of the television transmitter into visual images as it is the duty of the loud speaker to convert the radio impulses of the sound transmitter into sound. Last month we discussed the construction of the receiver proper for a television receiving installation. In this article we will discuss the radiovisor.

As is also true of loud speakers, there are many types of radiovisors, most of them operating on the same general principle. If the reader has constructed the short-wave receiver described last month, no doubt he is eager to add the radiovisor equipment so that he may look in on the programs listed in the daily papers. If Mr. Setbuilder has not the patience to assemble his own radiovisor from the kit of parts described here, he may purchase the complete equipment either in an attractive walnut cabinet or without one. Although this article is written especially for the home assembler, the purchaser of factory-assembled equipment will find the following instructions useful for the operation of his radiovisor.

How the Radiovisor Works

Essentially, the radiovisor consists of a neon lamp, a scanning disc driven by a motor and a lens which magnifies the image. To this may be added the self-synchronizer, a device which automatically keeps the scanning disc of the receiver in step with that of the transmitter. The neon lamp glows bright and dim in accordance with the modulation or variation of the incoming signal, the shadows appearing dark, the highlights light. The glowing neon lamp is seen through the minute holes arranged in a spiral around the edge of the disc. Only a single dot of light appears at a time, corresponding to one hole of the disc, but as the disc revolves, the dot of light takes the form of a horizontal line. Then the next hole appears, taking the shape of another line directly below the first one. The speed with which the disc revolves and the persistence of vision make it appear that all the 60 lines, equivalent to the 60 holes in the disc, are seen at once in a solid frame of light. The scanning disc is revolving in exact step or synchronism with the transmitting scanner.

The Jenkins Television Corporation manufactures three distinct types of radiovisors, to meet the three different classes of buyers. The cabinet model with scanning drum (instead of a disc) and automatic synchronizer has been designed for living room use. The completely assembled radiovisor without cabinet will receive the programs perfectly, while its parts are accessible for changes and additions in keeping with the advance of the art. The radiovisor kit resembles the second model when assembled, but is designed especially for those who wish to build their own radiovisors at the lowest possible cost. Let us assemble one of these kits.

*Jenkins Television Corp.

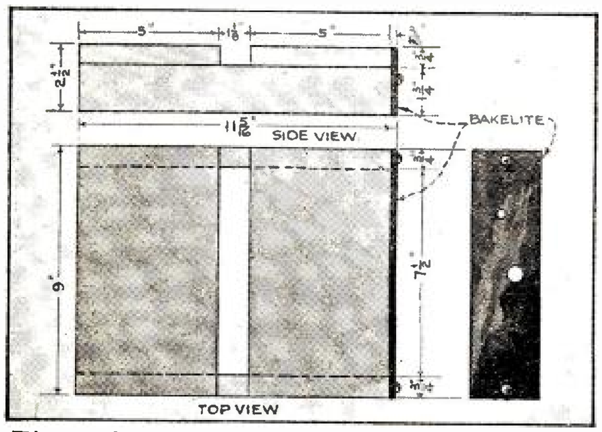


Figure 1. Specifications for wood base and bakelite control panel

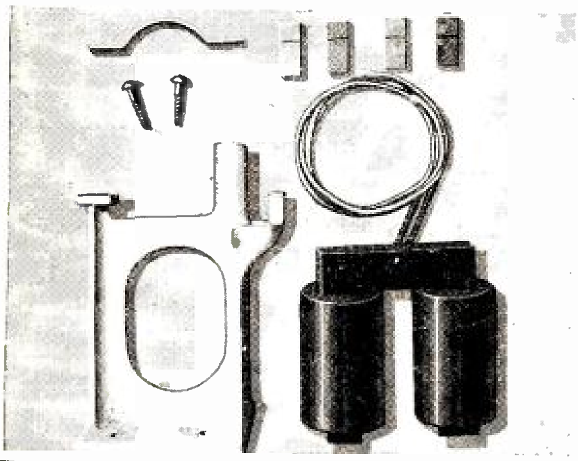


Figure 2. Parts for rear bracket assembly

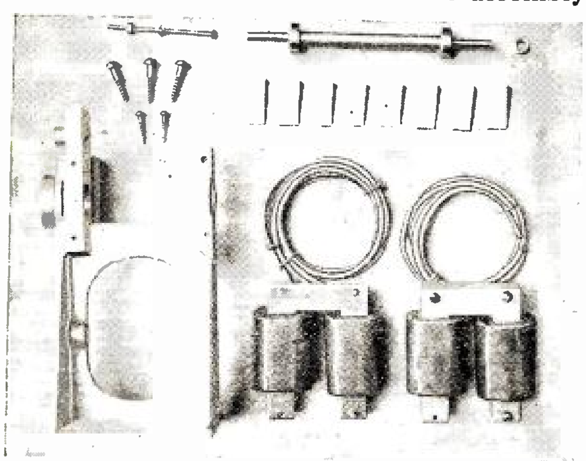


Figure 3. Parts for front bracket assembly

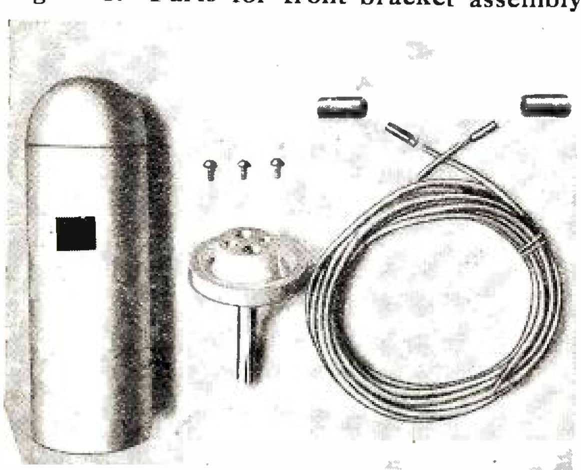


Figure 4. Neon lamp assembly

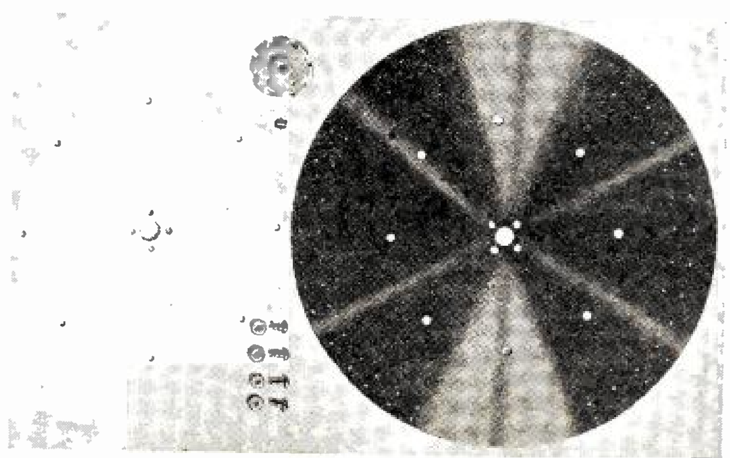
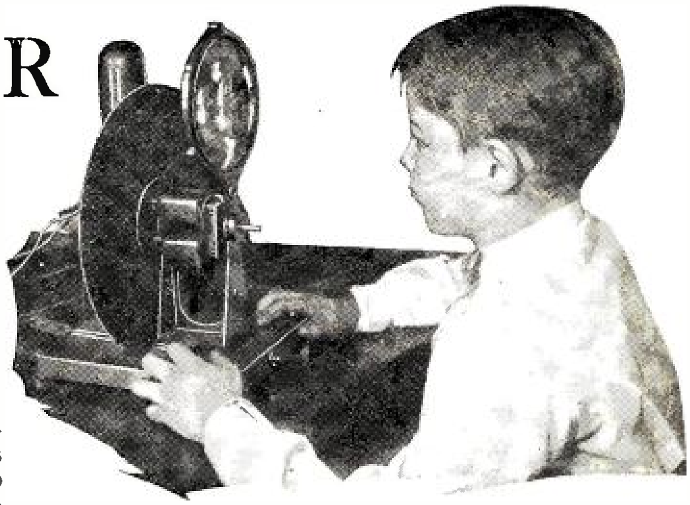


Figure 5. Scanning disc parts

RADIOVISOR

which is easy to build at home and television receiver described last month

By D. E. Replogle*



The radiovisor completed and in operation. The model shown here differs from the one described only in the use of a metal base instead of wood

Beginning with the platform or base, cut two blocks of white pine, maple or other wood that can be readily worked, each measuring ¾ x 5 x 9 inches. The pieces should be carefully planed and perfectly square. Then cut two more pieces measuring ¾ x 1¾ x 11⅛ inches each. Next a bakelite strip should be cut, measuring 2½ x 9 x 3/16 inches and the necessary holes drilled as indicated in Figure 1, which also shows the wood strips of the base.

Assemble the platform by placing the smaller wood strips on edge and bridging the larger blocks across them, allowing a space of 1⅛ inches between the larger blocks of wood. The pieces should be accurately and neatly fitted and nailed in place. The bakelite strip is now placed across one end, screwed to the end of the wood strip to form the control panel as shown in the completed assembly views of the radiovisor.

The template supplied with the kit is now placed on the base with the edge marked front facing the control panel. The proper holes have already been marked on the template which fits neatly to the edge of the wooden base. The holes as indicated on the template should be drilled through the wooden base. The platform is now ready for wiring.

Assembling the Parts

Figure 2 shows the components of the rear bracket assembly; the rear bracket, the rear electromagnet, the coil wedges and the rotor guard. The first step in the assembly of the rear bracket is to place the bracket upright on a table. The rear electromagnet is placed on top of the bracket with open end of magnet straddling the center post of the bracket. Next place the rotor guard on top of and across the open end of the magnet core. Align its holes with those of the pole piece and bracket, and slip through screws and tighten. Tighten the remaining magnet screw. Each coil should be pushed back as far as possible against the cross piece of the core. The wedges are then carefully inserted in the inside of the core, one facing the side of the coils, another facing the top of the coil. This precaution prevents noise when the radiovisor is in operation.

The assembly of the front bracket follows next. Figure 3 shows the parts of the front bracket: front magnets, front brackets, rotor spacer, shaft assembly, coil wedges, bearing clamping screws and the necessary screws and nuts for the assembly.

To begin assembly, place the front bracket on its base, upright, on the table. Place on electromagnet against one side, noting that the open end straddles the rounded bearing holder of the bracket. Keep wires or leads outside. Drive home screws that hold the magnet in position. Do likewise with the other electromagnet. Push the coils as far back as possible against the cross member of the magnet core and drive in wedges to hold coils tightly. Insert the rounded end of shaft and bearing through that end of the front bracket that is slotted through to the bearing hole. Push the shaft assembly as far as it will go, so that the ball bearing nearest the rounded end fits snugly in the boss at the far end of the bracket. If preferred, the shaft assembly may be put in place before assembling the coils on the front bracket. The ball bearings should be flush at both ends of the bracket. Draw up tightly and screw through the empty holes in the cores which are aligned with holes in the slotted bracket arm. Apply lock washer and screw. It is very important that the shaft be free enough to be spun with the thumb and first finger.

The Neon Lamp and Scanning Disc

Figure 4 shows the parts that are to be used in the neon lamp house assembly, consisting of the lamp shield, the base of the lamp shield, the lamp shield screws, the prong jack sleeves for establishing contact with the neon lamp prongs and the rubber-covered leads. The three felt cushions supplied should be cemented to the inside of the lamp house. The cushions prevent chatter due to the neon lamp vibrating against the lamp house. To assemble the lamp house simply place the neon lamp in the socket with the (*Continued on page 233*)

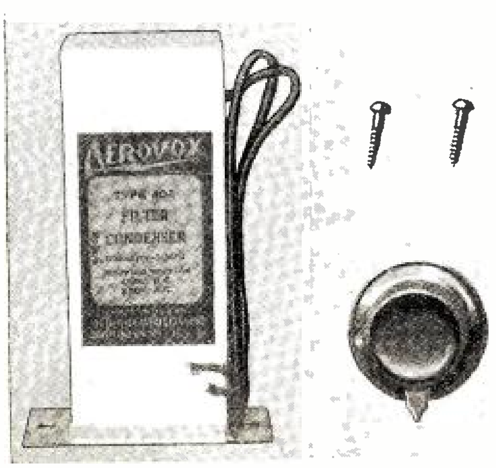


Figure 6. Control panel parts. Switch may be added if desired.

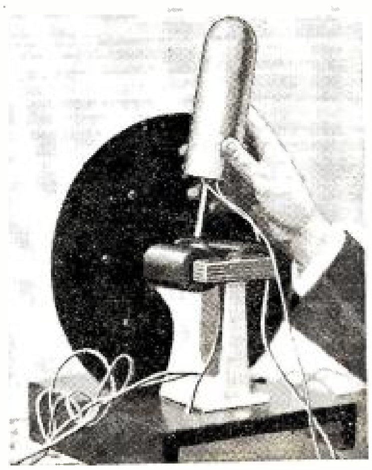


Figure 7. Method of mounting neon lamp

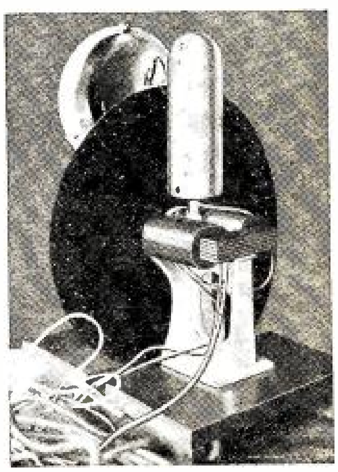


Figure 8. Rear view of completed radiovisor

Talking

Operation and

The effectiveness of talking movies in the proper operation and maintenance gestions offered here are based on the

By C. A. Johnson*

PART

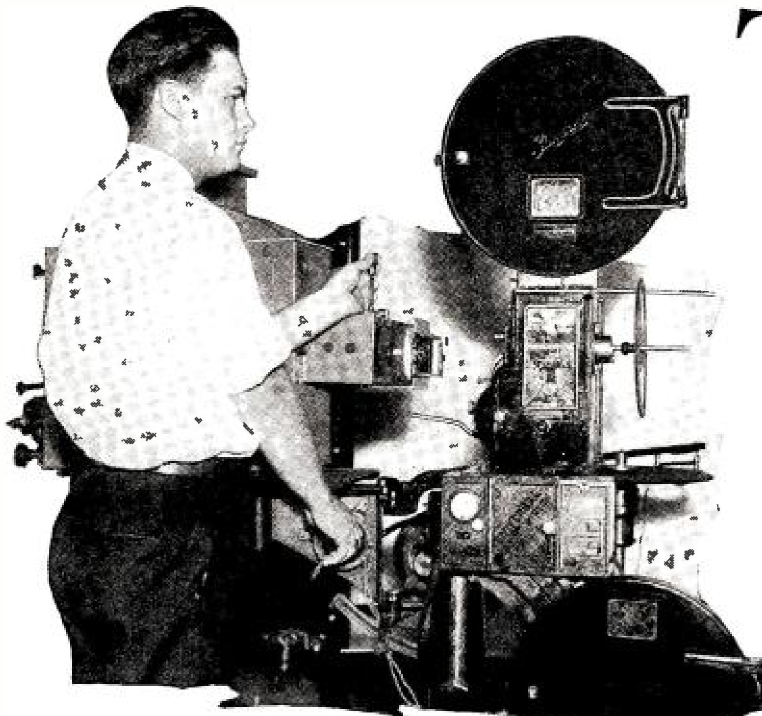


Figure 2. When starting the machine it should always be allowed to come up to full speed before the dowser is opened

THE proper installation of the right kind of equipment is the first essential to obtaining satisfactory results with sound movies. This has been described in a previous article in the July issue of RADIO NEWS. The next requirement which is equally important is the proper operation and maintenance of the equipment. It is the purpose of this article to discuss some of the features of proper handling of equipment (and the selection of suitable subjects for non-theatrical purposes).

Some of the first rules of the projection booth are so simple as to seem perfectly obvious, but it is the violation of these that is responsible for much of the poor quality projection that occurs outside the theater—and often in the theater for that matter. The design of booth space and the arrangement of the accessory apparatus, controls, etc., should always be made with the idea of the greatest possible convenience to the operating crew. Everything should be installed permanently so that there is a suitable place for everything and a chance for everything to be in its place. Regardless of the spare space available, none of it should be used for storage of equipment which is not actually used in running the show. On the other hand, everything which may be needed while the projection is actually in process should be readily accessible. A delay of a few seconds may often mar a show to the extent that the audience will never forget it. Although it is often necessary to make repairs or adjustments while the machines are in use, this possibility can be minimized by regular daily inspection and test before the show.

Importance of Regular Inspection

The projector itself requires regular oiling, cleaning, and inspection for worn and loose parts. The entire mechanism may be ruined if a single bearing is allowed to run dry and "freeze." Accordingly the operator should be absolutely certain that he knows the location of every oil hole and see that is is properly lubricated. The inspection for wear or looseness may be made at the time of oiling, thereby making possible repair or adjustment without loss of time. However, all oiling around a motion picture machine must be done with discretion to avoid getting surplus oil on the film sprockets or gates. Oil on the film is bad for silent projection and practically ruins sound projection. Accordingly, when the oiling is completed all surplus oil should be carefully wiped off. This can best be done by running the projector empty for a few minutes and then carefully cleaning the sprockets and gates. Stray bits of film and emulsion deposits may be removed with a brush and suitable cleaner. The projector should be cleaned thoroughly once a day, and wiped out after each reel. Emulsion often collects in the slit in the sound gate. If it is allowed to remain there it will scratch the sound track and render the print worthless. It is very important, therefore, that this point be inspected and cleaned after each reel, especially with new films.

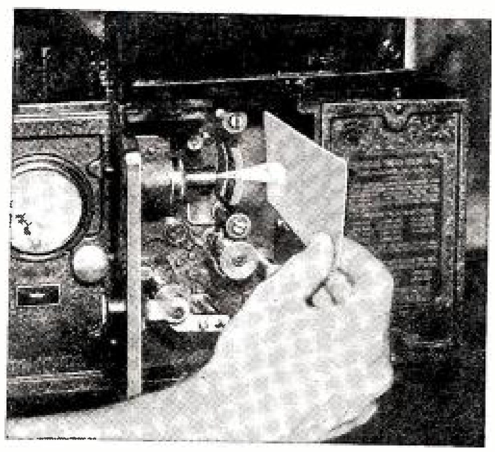


Figure 1. A necessary check for exciter lamp adjustment may be made by removing the tension pad assembly, inserting an index card over the photo cell window and adjusting the exciter lamp for maximum luminosity. An oval spot, free from aberration, indicates adjustment

Adjustments

There are, of course, no hard and fast rules as to what must be done to any particular projection equipment in order to get a good picture on the screen and good sound from the speakers. There are certain general points, however, which should be checked as a matter of routine.

The light source for the picture should be properly focused to give the maximum uniform illumination over the screen. The lamp house is provided with controls for doing this. When properly adjusted, the light should be concentrated on the back of the aperture plate so as to just cover it with uniformly distributed light. The screen illumination can then be checked by opening the automatic shutter and the dowser and turning the projector until the revolving shutter allows the light to shine through on the screen. When using a high intensity carbon arc, do this for only a few seconds at a time to avoid loosening the lenses. The image of the aperture should be centered on the screen. If it is out of center the projector may be shifted slightly to the right or left and raised or lowered until it is properly centered. Care should be exercised, however, not to disturb the alignment with the turntable if the latter is on a separate stand.

The optical system for the sound head is supposed to be properly adjusted when the head is installed. Instructions for checking this adjustment are furnished with the sound head and may be followed in checking it. It should not get out of adjustment as long as none of the parts are exchanged. However, when the exciter lamp is replaced it will be necessary to re-

*School of Commerce, New York University

Movies *for* Schools

Maintenance

schools depends to a large extent on of the equipment. The practical sug- authors' wide experience in this field

and C. C. Clark*

Two

focus it. There is usually some provision for aligning the sound track with the slit. This adjustment should be checked for each film, because there is sometimes a slight variation between prints.

All batteries should be carefully checked for voltage or specific gravity. Loose or corroded battery connections introduce all sorts of extraneous intermittent noises at a level which may be even higher than that of the signal itself.

In any complete installation meters are provided for checking the plate current on all vacuum tubes used. These should be checked before every show, making sure that in the case of push-pull stages the tubes are balanced well enough so not to introduce any noticeable distortion. The main amplifier and speaker circuits may be tested by means of the turntable and pickup with suitable test records. Once the operator has assured himself that this part of the equipment is functioning properly, he can concentrate on the sound head and sound head amplifier when looking for the source of poor quality.

To check the operation of the sound head proceed as follows. First, turn on the head ampifier and the exciter lamp. Next bring the fader up to the proper setting for running a show. Then open the sound gate and interrupt the exciter lamp beam by moving an index card or piece of paper in front of it. If the system is working properly, this should give a series of sharp reports in the horn. If there is sound. check the head amplifier by lightly tapping the first tube. If this gives a microphonic ring in the speakers, the trouble is in the photo cell circuit or optical system. If no sound is heard the trouble probably is in the head amplifier, or in the connection between the latter and the main amplifier equipment.

When a signal of the proper intensity is obtained from the photo cell, by interrupting the light beam, the apparatus is ready to be tested with a sample film. It is advisable to have some test films on hand in the booth for the purpose of such tests. The operator becomes accustomed to listening to these samples and can quite easily detect poor quality in the system by listening to them. A still better check may be obtained by means of a check film consisting of standard frequencies over the range from 60 to 8000 cycles, silent sound track, and various samples of music and speech. Such films are now available on the market at a nominal cost, and are very useful in checking the quality of the reproducing system.

When the apparatus has been checked with the sample films it should be further tested with at least one reel of the picture which is to be shown. This is important since it enables the operator to check the quality and level of the recording and thereby determine the proper settings for the tone control and fader. In the case of some films, (particularly if it is variable area recording), it may be necessary to slightly shift the alignment of the film with respect to the sound gate in order to get good quality. If there is time, the best procedure is to run through all the reels of any subject before showing it to an audience. During this rehearsal the film should be carefully checked for quality, level, syn- (*Continued on page* 243)

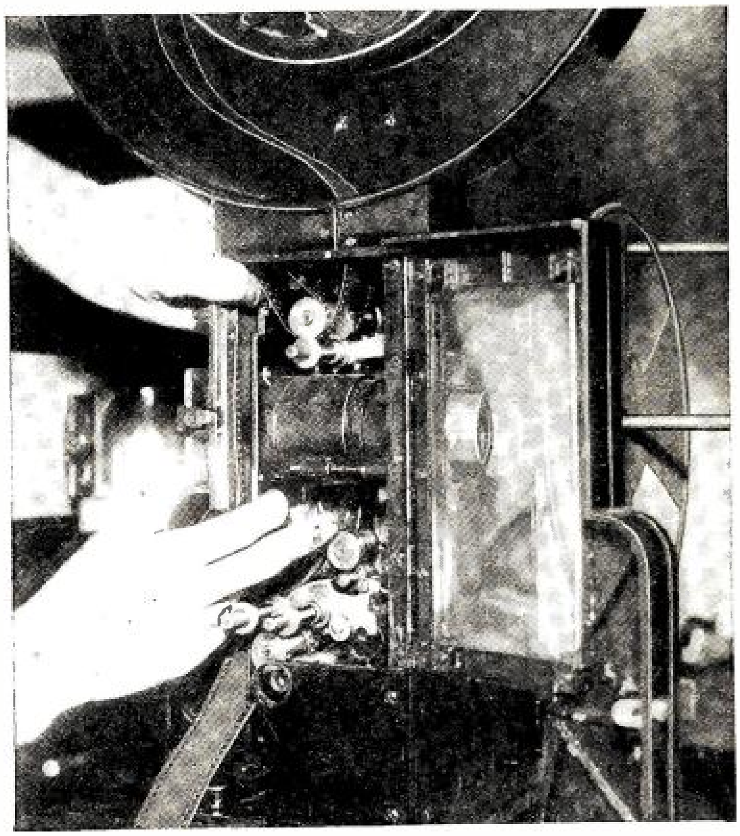


Figure 3. Shows a convenient way of holding the film when threading the projection head. The upper loop is made around the index finger of the left hand, thus leaving the middle finger free to pull the trigger which closes the tension pad against the aperture

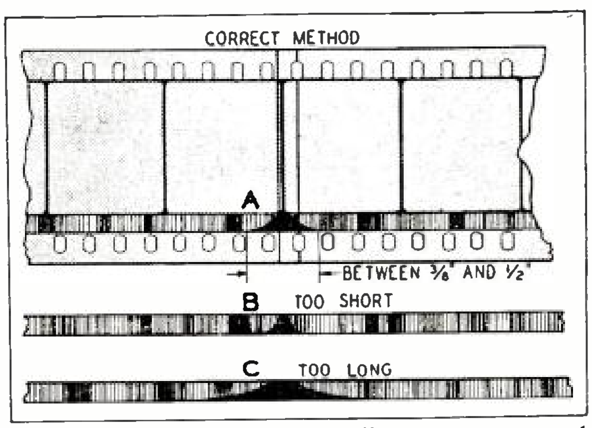


Figure 5. To avoid an audible disturbance as a result of spliced film, an opaque triangle is painted over the sound track at the splice

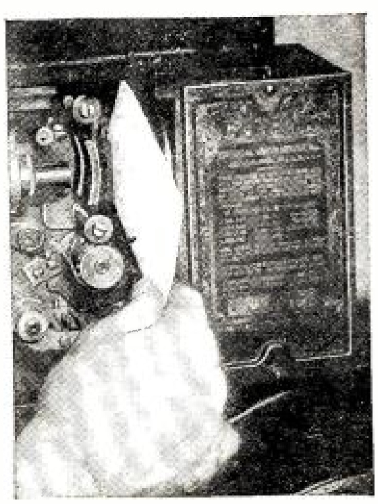
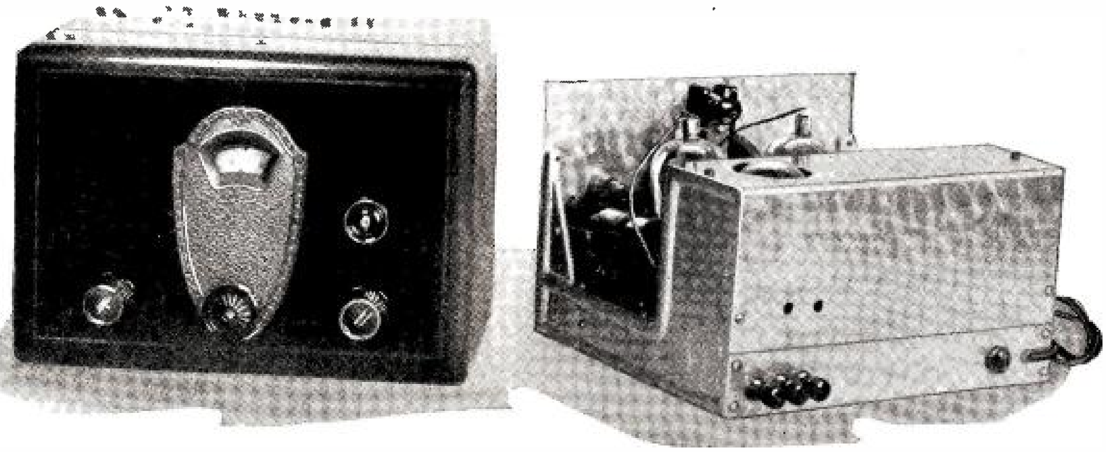


Figure 4. To check the operation of the sound head, interrupt the exciter lamp beam by moving an index card in front of it. This should give a series of sharp reports in the horn



Above, the finished unit in its cabinet. At the right is a rear view of the chassis without cabinet

A Short-Wave Adapter *of* Advanced Design

A new short-wave superheterodyne adapter which can easily be constructed by the average experimenter. It employs one r.f. stage ahead of the detector and is full a.c. operated

By Manson E. Wood

ABOUT a year ago a description of a short-wave unit designed by the author was described in these pages. The unit or general idea created quite an interest on the part of the readers of this magazine. We still receive letters on it from readers located in all parts of the civilized world.

It is our conviction that the method of short-wave reception described in the present article is suited better than any other to the needs of the average listener. When attached to the antenna and ground post of a good radio set this unit will bring in short-wave stations with surprising volume. It eliminates the necessity for changing the regular broadcast set in any manner or having another larger short-wave set around the house. The new unit is as easy to operate as the standard one-dial broadcast receiver, due to the absence of regeneration in any form. There are no plug-in coils to bother with, which adds to the pleasure of operation.

Any part of the tuning range of the unit may be used merely by turning the switches. With this unit and a good radio set you can have an ideal all-wave set up.

The Results Obtained

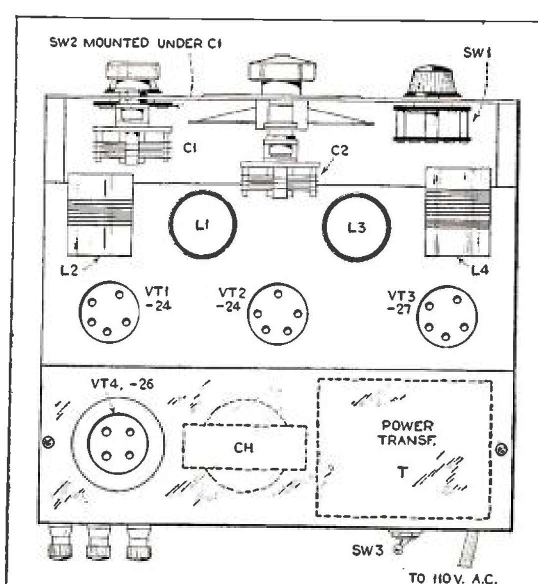
Every article of this type has some space devoted to the results which can be expected. The unit described in this article has been used by the author for nearly a year. There is nothing about the design which is guesswork. It has had the careful scrutiny of a number of good engineers.

The unit shown in the illustration was used by a radio dealer in Newburyport, Mass., during an exposition, to bring in London and Rome as a drawing feature for his booth. Attached to a small Bosch radio, we had volume enough from G5SW and I3RO so that these two stations could be easily heard from any part of the hall above the noise which is always present when thousands of people are milling around. This stunt has been performed a number of times in different parts of New England. In our own town of Wakefield, Mass., the general public was invited to hear the foreign stations mentioned above with the unit attached to a General Electric super. At no time during the demonstration could the full power of the set be used, due to the volume of the signals received. With established proof that the unit works well, I can see no reason why anyone cannot duplicate the results which we have shown are possible.

It is not the purpose of this article to go into detail about the technical features of this unit. It is our desire to present complete information on the new design so that anyone who cares to take the necessary time and effort to construct the unit can duplicate the results which have been obtained by the author and others.

An examination of the circuit will reveal nothing that is new. Most of the features of the circuit design were well established long ago.

If the reader has had enough experience in the art of short-wave reception so that he is familiar with the position of the stations in their respective bands, the circuit is about all that is necessary for him. One of the hardest points to learn when looking for stations on a new short-wave set is where the desired stations come in on the dial. This



Plan view showing location of parts on chassis is particularly true with those who are just coming into the field of short-wave reception. We knew a number of owners of short-wave receivers who have thrown up their hands in despair due to their inability to find the right places on the dial. This is particularly true with regenerative types of receivers.

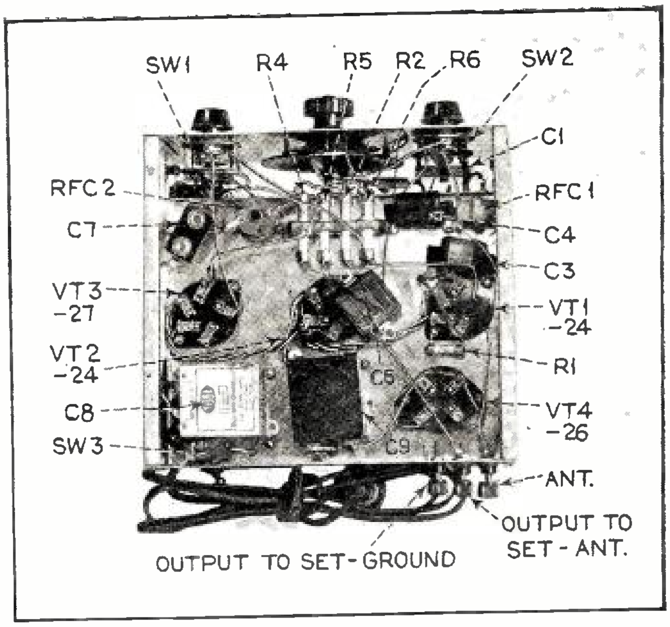
Suggestions on Construction

So, to those who have had little or no experience with short-wave receivers we strongly advise exact adherence to the coil data and parts, because we can predict very closely where the desired stations will come in and this is half of the battle. Every author of an article of this type is anxious to have the results he predicts duplicated. and the reader is therefore urged to follow the plans carefully.

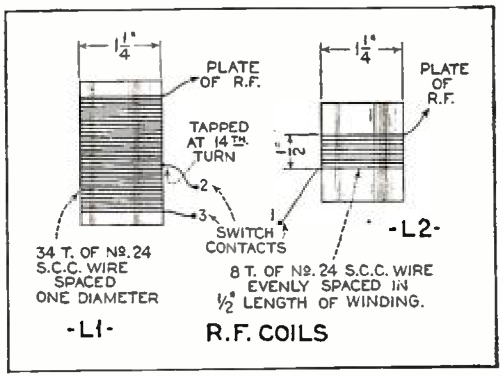
The coils are wound on thin-walled hard-rubber tubing. The drawings show the necessary detailed information. The spaced turns can be held in place by the application of clear lacquer. Be careful to so connect the leads from the coils to the switches that the wiring diagram is accurately followed. The switch positions are indicated on the diagram. Position one, or low-wave position on the switches of the unit in the illustration, is to the right, looking at the panel. The coils are so designed that there will be a slight overlapping of the three tuning positions to assist in the location of stations.

The power transformer. T, is located under the shield at the rear of the unit and is a special design for this unit. The filter choke, Ch. is also located under the pack shield and is a 30 henry. 20 milliampere size. The filter condensers. C8 and C9, are located under the chassis as shown in the illustration. The "B" supply problem in this unit is an easy one, because the current drain is small and there are no temporary instantaneous demands for large amounts of current as there would be if the pack was supplying an audio network. The resistor R7 holds down the high voltages when the unit is warming up and protects the filter condensers. The author has found that the –26 tube, used as a rectifier, stands up well if the filament is protected against excessive voltage, and can easily rectify the small amount of current necessary.

Use the best obtainable grid condenser at C5, because one side is connected to the plate voltage of the r.f. tube and a breakdown would cause trouble.

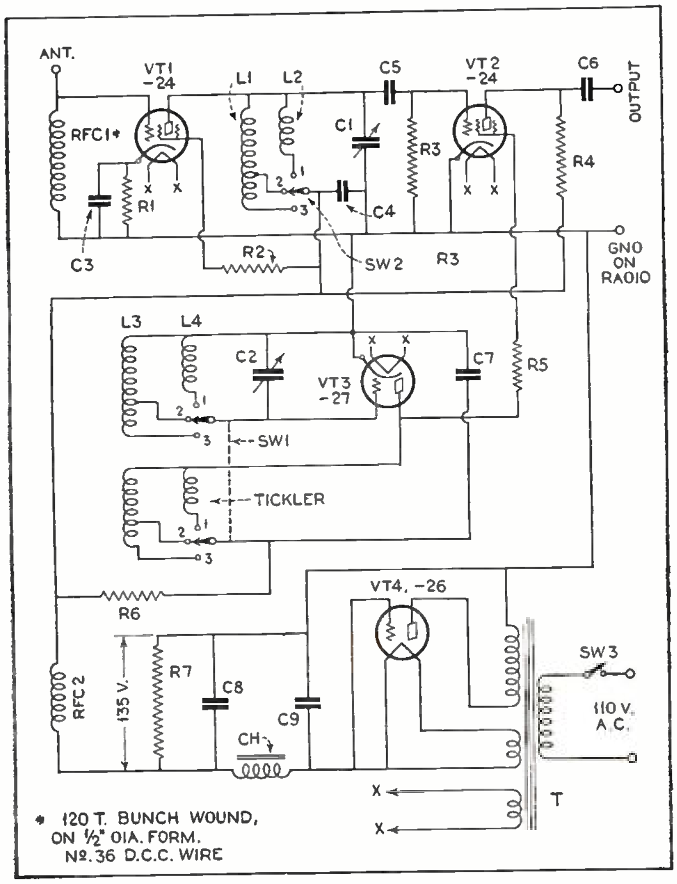


The under view of the chassis will assist the builder in mounting the parts



(Above)

Winding details for the r.f. coils



The circuit employed includes one screen-grid r.f. stage, screen-grid detector, –27 type oscillator and a –26 tube as rectifier

The panel and base of the unit are made from sheet aluminum, machine finished. The side frames are cast aluminum. The power pack shield is formed from sheet iron finished to match the rest of the chassis. Flush type sockets are used. No rickets are used in the construction of the unit so that any changes which may possibly come in the future can be easily made without any great effort.

Operation of the Unit

A few notes on the operation of the unit will be in order now. Attach the unit, ready to operate, to the antenna and ground posts of the radio set with as short leads as possible. Turn the dial of the radio set to 795 kilocycles or as near as you can determine that position. Turn the volume control of the radio set full on. Attach the antenna to the unit antenna post, but leave the ground connection on the receiver ground post. If the specifications have been followed carefully, G5SW will come in with the dial of the unit set at around 76 and the switches turned to position one. Rome or I3RO will come in around 73 on the dial. The Boundbrook experimental station will come in with the unit dial set at around 40 and the switches turned to position two. This dial setting will locate the stations in the 6000 kc. group. With the switches turned to point three, hundreds of amateur telephone stations can be heard from 0 to 38 on the unit dial. The small knob above the right switch knob is the condenser (C1) which tunes the r.f. stage and is broad tuning compared to the main dial. It can be used as a sort of trimmer for the main tuning dial.

The radio set dial setting which has been given above for a tuning key may not be useful to the reader in his location as a permanent adjustment. A powerful local station may tend to come in on top of the short-wave program and spoil reception. A point on the radio set (*Continued on page* 256)

Voltage Divider Design

A discussion of voltage divider design, including detailed information on how to calculate the required resistance values and power ratings

By I. F. Jackowski*

SINCE the inception of "B" battery eliminators and the better known power pack much has been said and written about the design and application of voltage dividing networks.

In spite of the large amount of data presented on this subject there seems to be a lack of knowledge of voltage divider design in many quarters. The design and application of voltage dividers is not only of considerable importance to the radio engineer in designing new receivers and power packs, but is also of great interest to the serviceman in making resistor replacements on radio sets and power packs. It is of importance to the amateur in the design of transmitters and to the experimenter in design of new circuits. Even those who have some knowledge of voltage divider design seem to have some difficulty in arriving at the desired results. It is simple to design a voltage divider, since it involves only a practical application of Ohm's law.

In going about the right way in figuring a voltage divider network it is first necessary to determine the load to be imposed upon the voltage divider.

Determining Resistance Values

For example let us arbitrarily assume that we have a receiver requiring several simultaneous voltages as follows: 450 volts at 100 ma., 250 volts at 25 ma., 180 volts at 6 ma., 90 volts at 16 ma., and 45 volts at 3 ma. Summing up all these currents, we find that we must have a power transformer capable of supplying, at the voltage divider, 450 volts at 150 milliamperes. This, however, is not all, since we have not taken into consideration the bleeder current. This is the current flowing in the resistor connected between the lowest side of the voltage supply (usually the + 45-volt tap) and ground. For such high currents as are being drawn by the receiver of this case we can assume a safe bleeder current of about 25 ma. We shall point out later why such high bleeder current is desirable.

It is clear now that we need a power transformer capable of supplying 450 volts at the filter output, as 175 ma. As shown in Figure 1, the first section of the voltage divider will have to cause a drop of 200 volts with a current of 75 milliamperes flowing through the resistor causing the voltage drop. The value of the resistance causing this drop, according to Ohm's law, is E/I or 200/.075 or 2666 ohms. This resistor is indicated in the diagram of Figure 1 as R.

At the 250-volt tap the current divides, 25 milliamperes of the 75 ma. current flowing through resistor R flows out of the pack into the receiver load while the remaining 50 ma. of current flows through the resistor R1. Accordingly Ohm's law gives the value of R1 as E/I equals 70/.05 or 1400 ohms. Here likewise the current divides, 6 milliamperes flowing to the receiver load and the balance of the 50 ma. or 50-6 = 44 ma. flowing through resistor R2. Hence the value of R2 is found through the same formula, E/I or 90/.044 = 2045 ohms. Here again as at each tap the current divides, 16 ma. flowing out to the receiver load, while the remainder of the 44 ma. or 28 ma. flows through resistor R3. Resistor R3 should cause a voltage drop of 45 volts, allowing 3 ma. to flow through to the 45-volt tap into the receiver load, permitting the remainder of the 28 ma. or 25 ma. to flow through resistor R4 as bleeder current. Therefore, E/I or 45/.028 = 1607 ohms, or the value of R3. The value of R4 is likewise found, E/I or 45/.025 = 1800 ohms.

The advantages of a high bleeder current are important. A high bleeder current permits the construction of a low-resistance voltage divider which naturally is much sturdier than the high resistance type. It permits more stable operation of the receiver because it acts as a reservoir, when one of the power supply taps is overloaded and draws more current than was originally intended, this extra current will be partially supplied through the reserve flowing in the bleeder resistor. An additional advantage is that a large amount of current flowing through the bleeder will considerably lessen the strain imposed across the filter condensers by the high voltage developed by the transformer.

Grid Biasing Voltages

If we also needed grid bias voltages we would require a transformer having a higher output voltage. Let us assume that we require in addition to the plate voltages supplied as shown in Figure 1, the following grid bias voltages: 80 volts, 40 volts, 13 volts and 6 volts. The grid bias voltage added to plate voltage makes 530 volts. Therefore if the transformer supplying the voltage divider in Figure 1 is also to supply the grid bias we will require a total output at the voltage divider of 530 volts at 175 ma. The diagram would then take the form of that shown in Figure 2.

To calculate the value of the grid bias resistors in a system such as that shown in Figure 2, we need only to divide the required grid bias voltages by the total amount of current flowing through the voltage divider.

To calculate the value of resistor R5, we divide 6, which is

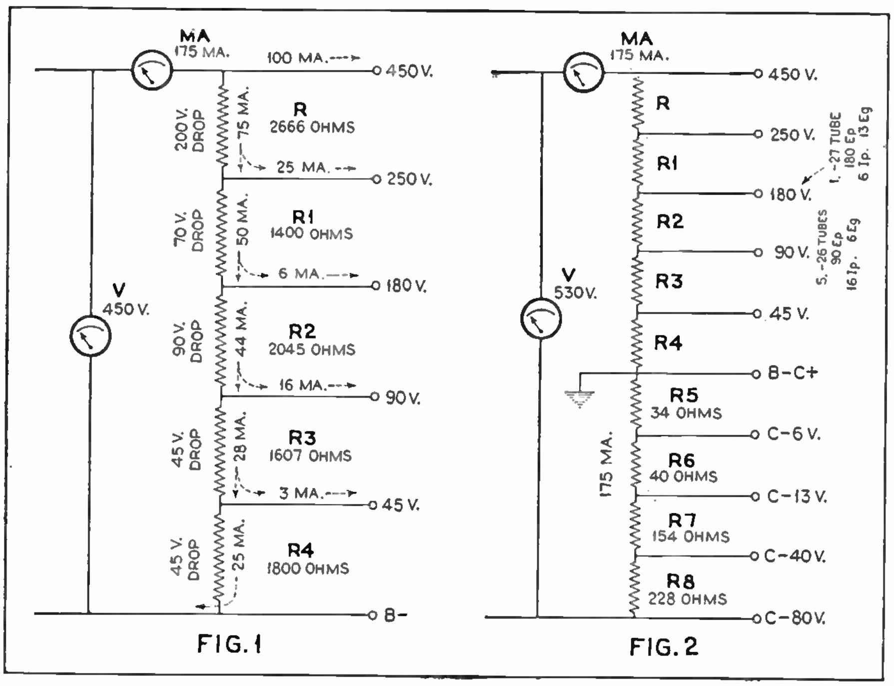


Figure 1. A typical voltage divider for a "B" power supply unit. Figure 2. A voltage divider designed to supply both "B" and "C" bias voltages

*Chicago Radio Institute.

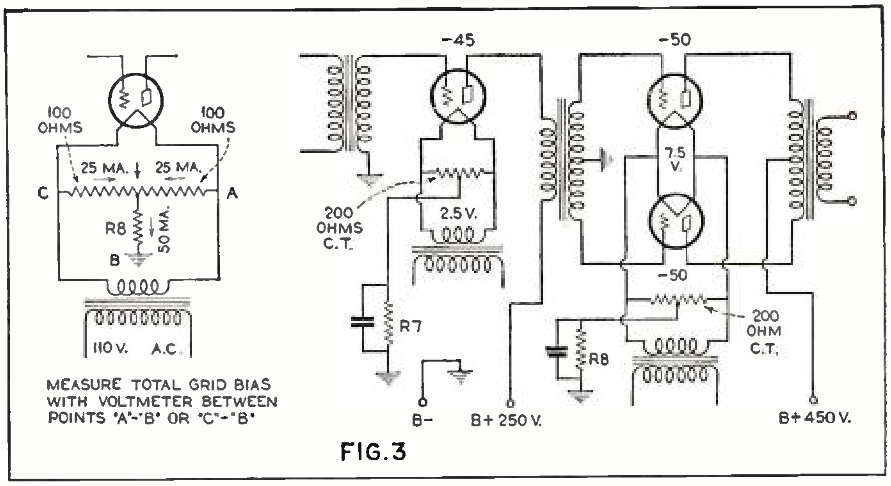


Figure 3. Illustrating the popular method of obtaining "C" bias voltages by means of a resistor in the filament circuits of the individual tube

the required grid bias for the five -26 tubes used in the circuit for which this divider is designed, by the total current flowing through the resistor, which is all the current consumed by the receiver plus the bleeder current or 175 milliamperes.

Then E/I or 6/.175 = 34 ohms.

The resistor R6 must produce a voltage drop of 7 volts so that the total drop at the second tap is 13 volts negative in respect to C plus.

Therefore E/I or 7/.175 = 40 ohms.

The resistor R7 must produce a voltage drop of 27 volts at the third C bias tap so that the total drop at that tap is 40 volts negative in respect to C plus.

Hence E/I or 27/.175 = 154 ohms.

Likewise the same procedure is used in calculating the value of R8. This last resistor must produce a voltage drop of 40 volts at the fourth tap so that the total drop at that tap is 80 volts negative in respect to C plus.

Then E/I or 40/.175 = 228 ohms.

It can be seen, therefore, that a resistor having a total resistance of 456 ohms tapped at the specified values would answer the purpose very nicely. This resistor would necessarily have to carry 175 ma. and therefore would have to dissipate $I^2 \times R$ or $.175^2 \times 457 = 14.0$ watts.

It must be remembered that the symbol E taken from Ohm's law means electro-motive force, or voltage, therefore, it may be the plate voltage, or the grid voltage depending upon whether we are calculating the resistance of the plate section, or that of the grid section. Then in calculating the plate section of the divider; E is the voltage that is to be lost in the resistor causing the voltage to drop from a high voltage to a lower voltage that is required to feed a certain tube. Take for instance the divider in Figure 1. We have 450 volts at the highest tap and need 250 volts to feed the -45 type tube. Subtracting 250 from 450 leaves 200, or the voltage drop that must exist across resistor R. Therefore, the result 200 is E.

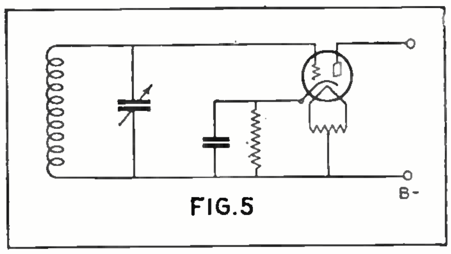


Figure 5. Providing the individual bias for a heater type tube, by means of a resistor in the cathode circuit

I is the current flowing through the resistor causing this voltage drop. In this case 75 ma. flows through the resistor. The formula E/I will then give the value of the resistor.

The symbol E in the grid bias section is found by referring to a tube characteristics chart. In this case we find that a type -50 tube draws 55 milliamperes at 450 volts plate with 80 volts on the grid. Therefore to calculate the grid bias resistor, we have E or 80 (when the plate voltage is 450 volts). I is the total current, 175 ma., flowing through the voltage divider of Figure 2. Then the formula E/I or 80/.175 = 457 ohms.

Another method of obtaining grid bias is that shown in Figure 3. This depicts part of the circuit for which the voltage divider under discussion is designed, but to eliminate feedback due to common coupling in the plate circuits the resistors R7 and R8 are removed from the voltage divider and installed in the manner shown. In making this change, however, the value for resistors R7 and R8 must be recalculated, since other conditions exist. The total current of 175 ma. flowing through resistors R7 and R8 in Figure 2 does not flow through resistors R7 and R8 in the case of Figure 3. Only the current in the plate circuit of the -45 tube flows through resistor R7.

Therefore the value for R7 is calculated as E I or 40/.025. In connecting the grid bias resistors in the filament circuit we must take into consideration the voltage drop across the center-tapped filament resistor and this drop must be subtracted from the drop that will be caused by the grid bias resistor.

Voltage drop = I X R or .0125 × 100
= 1.25 volts
then 40 — 1.25 = 38.750
hence E/I or 38.750/.025 = 1550 ohms.

Calculating resistor R8. With a 200-ohm potentiometer connected across the filament of the tube, Figures 3 and 4 we will have 50 ma. flowing through each half of it and consequently the voltage drop across each leg is equal to I × R or .05 × 100 = 5 volts.

We then have 80 — 5 = 75 volts
then E/I or 75/.100 = 750 ohms.

This second method of securing grid bias is further illustrated in the design of the receiver shown in the diagram of Figure 4. It is shown in this diagram how individual grid bias resistors are used in the radio frequency section, first audio and second audio stages. This method of obtaining grid bias is more frequently used because it is more efficient in design, in that the common coupling between the plate circuits of the tubes is eliminated. The grid bias resistors can be made smaller in size, physically because they do not have to carry the total plate current load of the entire receiver. The grid bias resistors need not be a portion of the power pack since they can be mounted directly in the chassis of the receiver when a separate power pack is used.

To calculate the value of the grid bias resistors used in the circuit of Figure 4, we need only to refer to a tube characteristics chart for the value of plate voltage, plate current, and grid bias. A -26 tube operated with a plate potential of 90 volts requires 6 volts of grid bias, and will normally draw 3 milliamperes of plate (*Continued on page 251*)

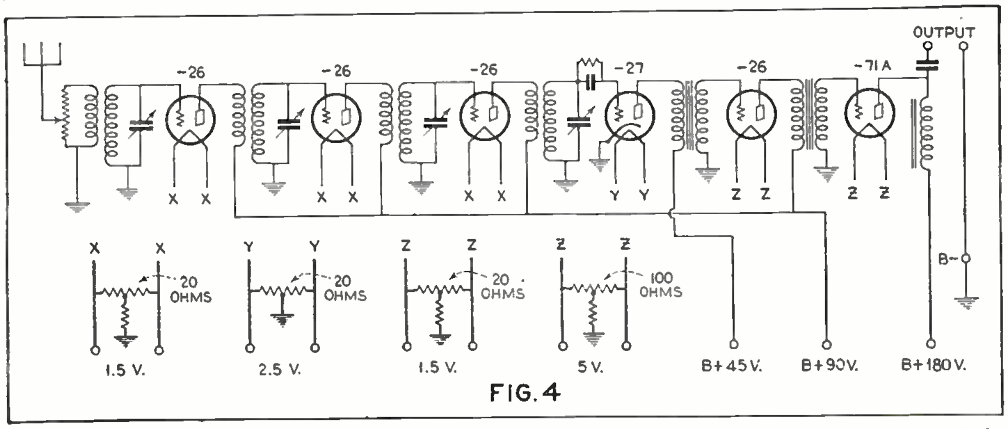


Figure 4. The tube circuits of a six-tube receiver in which three are individually biased and the three r.f. tubes biased as a group

Radio Physics Course

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 teachers' Question-Box aids teachers in laying out current class assignments.

By Alfred A. Ghirardi

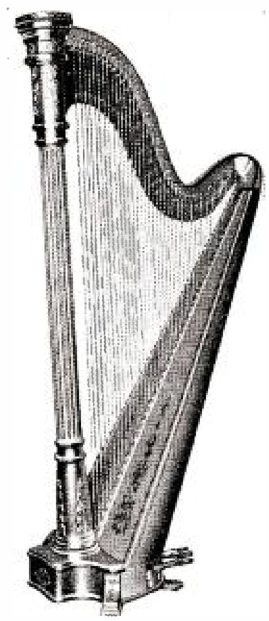
LESSON TWO

Sound, Speech and Music as Related to Broadcasting

IN radio broadcasting we are concerned mostly with speech and music, although at times noises are transmitted as part of plays and dramas. The dropping of a book on the floor, the crash of a piece of glass, the rattle of a train of freight cars, all produce sound disturbances that have no regularity of vibration and to which we can assign no definite pitch. Such sounds are disagreeable to the ear because of their lack of steadiness, regularity, or rhythm, and are accordingly classed as *noises.*

The Human Voice

Speech or vocal sounds are produced by the human organs of speech. The main vocal sound wave producing organ is shown in Figure 4. The lungs supply the streams of air by a bellows-like action. The air presses in and out of the windpipe, vocal passages, the elastic vocal cords "a a" in the larynx, the tongue, the lips and the resonant cavities of the nose and throat. The rapid movement of the vocal cords "a a" stretched across the top of the windpipe changes the size of the slit-like opening "b" through which the air from the lungs passes. This impresses on the air stream variations which are heard as speech sounds. The pronunciation of the English language is composed of about thirty-nine different sounds located in different parts of the frequency range. The "voiced sounds" are produced as described above, by the vocal cords in the larynx. They are located mostly in the lower register and possess most of the volume and energy of speech. The "unvoiced sounds" are produced without using the vocal cords at all. They are caused by the flow of air through small openings, or over lips, tongue and teeth. They have a hissing, rushing sound of the breath, and consist of the sounds like p, f, s, k, sh, ch, th. Most of these sounds are high pitched, and they are much weaker than the voiced sounds. The student is urged to pronounce these sounds in front of a mirror and notice the movements of his tongue, teeth and lips when doing so. These higher unvoiced sounds are absolutely necessary to the clear and distinct rendition of speech. A third class of speech sounds called the "voiced consonents" are produced by a combination of the two processes just outlined.



Photos by courtesy of Rudolph Wurlitzer Co.

Figure 1. The harp produces sounds of wide range. The pitch of each string is determined by length, weight, tension

Figure 2. The violin is an upper range instrument, covering approximately from 190 to 3,000 cycles

The length and tension of the vocal cords "a a" can be altered by muscular action with great rapidity, hence the extreme flexibility and great range of tone of the human voice. The vocal cords in men are thicker than in women and children, so they vibrate more slowly and produce the lower tones characteristic of men's voices. The sound waves produced by the vocal cords are greatly modified by varying the shape of the resonant cavity of the mouth. This is easily proven for oneself by uttering the five vowel sounds—a, e, i, o, u—one after another. The uttering of the shape of the mouth produces the change of the voice sound. This is called *articulation.* Changes in the flexibility or size of openings in any of the air passages, etc., may change the tone of the voice. Thus, when a person catches cold, the nose passages are blocked and the throat may be inflamed or swollen. The result of this interference to the free normal passage of the air pulses makes itself evident as "hoarseness" of the voice.

Musical Sounds

Musical sounds occur in the form of smooth, uniform vibrations of steady duration, until the dying of the sound. A musical sound is produced from a source of regular vibration. Thus, when a horsehair bow is drawn across the strings of a violin, they are set into vibration. This vibration is regular and smooth and results in a *musical sound.* Music is pleasing, because of its agreeable combination of sounds, which have been worked out more or less systematically.

Every sound has three identifying properties or characteristics, which distinguish or identify it from all other sounds. These are *pitch* or frequency; *quality* or timbre; and *loudness* or intensity.

The musician's term for frequency of vibration is *pitch.* Pitch is defined as the number of air waves per second produced by the vibrating source, or the number of air waves received by the ear per second. Sounds of low pitch like those of the bass viol, bass tuba, etc., are low in frequency, and therefore vibrate the ear drum slowly. Sounds of high pitch, like those of the flute, piccolo, etc., are high in frequency, and vibrate the ear drum rapidly. In stringed instruments the low notes are produced by the long, thick or heavy strings. For instance, on the piano, the low note strings are wound with wire and weighted down so they cannot vibrate so fast.

In the wind instruments we find the low

Figure 3. The saxophone produces the middle ranges of sound frequencies

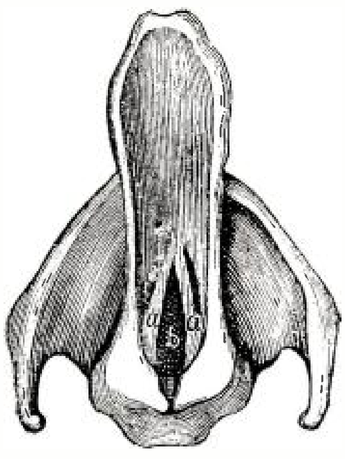


Figure 4. Human vocal organs. The vibration of the vocal cords "a a" varies the size of the opening "b" through which air from the lungs rushes

notes produced by the vibration of air in air columns of large volume—either long or of large diameter. The long air columns of the pipe organ and bass tuba are illustrative of this. The relative approximate lengths of some common wind instruments are piccolo, 12 inches; flute, 26 inches; trumpet, 55 inches; trombone, 107 inches, sousaphone bass tuba, 216 inches. The frequency of the lowest notes these instruments can produce can be found from the chart of Figure 7.

The notes of high pitch are produced by the light, thin, or short strings in string instruments and short or small diameter air columns in wind instruments. In instruments like the violin (Figure 2), mandolin, guitar, banjo (Figure 8) and ukulele a wide range of notes is produced with a few strings by "stopping" or shortening the vibrating length of the strings with the finger. The triangular shape of the harp (Figure 1) and the grand piano illustrate the application of the law of length by using longer and heavier strings for the lower pitches.

By impressing sounds of various measured frequencies on human ears it has been found experimentally that the normal ear is able to detect sounds of frequency about as low as 16 cycles per second, and about as high as 20,000 cycles per second. but not with the same degree of sensitivity.

Vibrations slower than 16 per second do not sound as one tone, they separate into 16 or less separate noises. Above 20.000 vibrations per second the vibrations are so rapid that the ear drum membrane and associated parts cannot follow them. Above this point we cease to hear. The ear is most sensitive to frequencies between 500 and 4,000. Below 16 cycles per second the sense of feeling occurs before the sense of hearing. The actual frequency range which the human ear will respond to varies among individuals. It is narrowed by weakening of the sound and also by advancing age of the person. Some persons cannot hear the chirp of crickets or the high notes sung by certain birds and insects. The range of sound frequencies employed in ordinary speech lies between about 200 and 3.000 cycles per second.

The Simple Siren

The effect of the frequency or rapidity of occurrence of the individual sound waves can be demonstrated very convincingly by the use of a simple siren (Figure 5). This consists of a small circular flat disc mounted on a central shaft so it can be rotated rapidly either by hand, by an electric motor or even in a lathe. A circle of evenly spaced small holes are drilled in the disc. A rubber hose or small metal pipe is arranged directly over the perforations or holes so that a flow of air under pressure is forced through the holes when the disc revolves. This flow of air is naturally cut off or interrupted as each solid portion of the disc passes the air pipe, and as a hole passes the air pipe a puff of air shoots through the hole. Therefore, a vibration of air is produced by each hole. The frequency of the air vibrations depends upon the number of holes that pass the air jet during each second. Multiplying the number of holes in a circle on the disc by the number of revolutions that it makes per second gives the vibration frequency per second. The speed can be measured with a revolution counter or tachometer. By varying the speed of the disc, or by drilling several circles of holes, each circle having a different number of holes, various sound frequencies can be produced. If the number of holes on each circle is one-half the number on the next, each circle will produce a note one octave higher or lower than that on the next circle if the disc is rotated at constant speed. By choosing suitable high and low speeds and numbers of holes it is also possible to determine the upper and lower limits of audible frequencies with this apparatus. This experiment is a very interesting one, especially when made with a number of listeners in a group. Also by perforating some circles with the same total number of holes, but with the holes slightly uneven (two closer together, making the next two further apart, as at B, Figure 5) the frequency will be the same, but the succession of air puffs will not occur in the

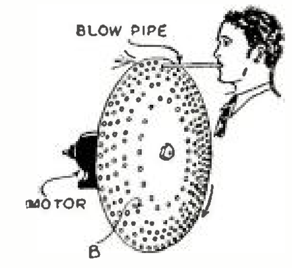


Figure 5. Siren disc. The blowpipe directs the air in puffs through the holes when the disc rotates. Sound waves result

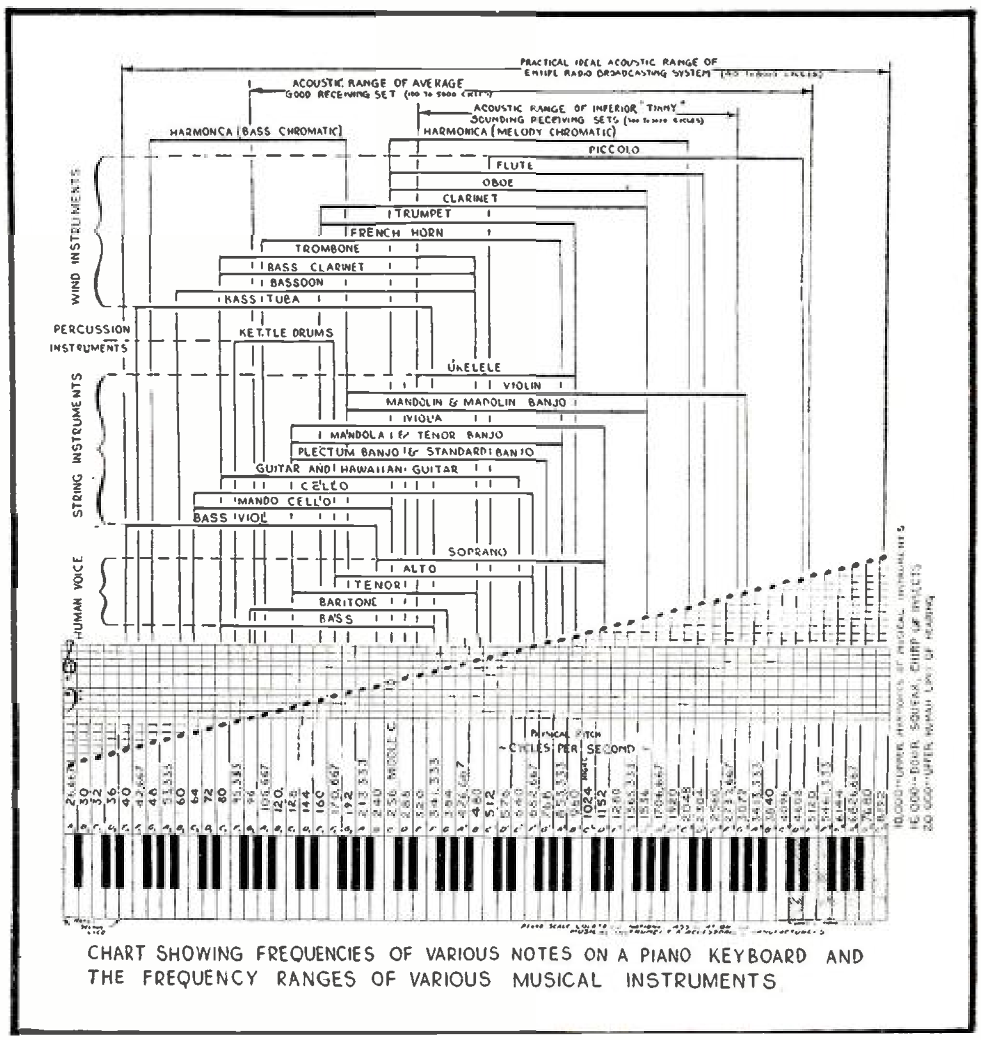


Figure 7. Chart showing fundamental frequencies of the various notes on a piano keyboard and the fundamental frequency ranges of various musical instruments, and the frequency range of the human voice

PHYSICS and science instructors will find these review questions and the "quiz" questions below useful as reading assignments for their classes. For other readers the questions provide an interesting pastime and permit a check on the reader's grasp of the material presented in the various articles in this issue.

The "Review Questions" cover material in this month's installment of the Radio Physics Course. The "General Quiz" questions are based on other articles in this issue, as follows: Super Power on Long Waves, What Goes On in Your Vacuum Tubes, Voltage Divider Design, Using Tuned Audio Circuits, RADIO NEWS Prize "Ham" Receiver, Seven Rules for Radio Appreciation.

Review Questions

1. *When a bottle of soda is opened, a sound is heard. Explain this.*
2. *Distinguish between noise, speech sounds and musical sounds.*
3. *What are three identifying characteristics of all sounds?*
4. *Explain the operation of the human organs of speech.*
5. *Define "pitch.". What is a low-pitched sound; a high-pitched sound?*
6. *What is the approximate range of sound frequencies which the average person is able to hear?*
7. *Describe an experiment which proves that the pitch of a sound depends upon the frequency of vibration.*
8. *Describe an experiment which shows the exact upper and lower limits of sound frequencies audible to the human ear.*
9. *Explain the various methods used to produce sound waves in musical instruments.*
10. *Name three musical instruments able to produce sound waves lower than 100 cycles per second. Name three able to produce fundamental sound waves about 2,000. Name two able to produce the entire range of musical sound waves.*
11. *Why does increasing the speed of rotation of a phonograph record change the character of the music produced? Would this raise or lower the pitch of the music?*
12. *Why is the length of the horn or air column in the bass tuba much longer than in the piccolo?*

same order. The sound produced will appear different as judged by the ear. This illustrates the effect of "timbre or quality" of a sound.

How Musical Instruments Work

The various musical instruments produce sound waves in different ways. Thus the violin, 'cello, piano, banjo, etc., produce sound by means of strings which are set into vibration. On the piano, for instance, low notes are produced by the vibration of long, heavy, loose strings, while shrill or high notes are produced by short stretched strings.

The wind instruments are classified as of two kinds—wood and brass. The most common of the wood-wind instruments are the flute, oboe, piccolo, clarinet, bassoon and English horn. The brass-wind type are the cornet, trumpet trombone, French horn, bass tuba, saxophone (Figure 3), alto horn. In all of these the air is vibrated in a hollow tube either by reeds by blowing against the sharp edge of an opening. or by the lips of the player. In wind instruments different pitches are obtained by changing the length of the air column by moving a slide as in the trombone, or by opening and closing holes as in the flute, saxophone, trumpet, etc.

Figure 8. The banjo, a "plucked" instrument, has a range between 128 and 960 cycles per second, approximately

The percussion instruments are those that are beaten, shaken. rattled or jingled. Among these (Figure 6) are the kettle drums. bass drum, cymbals, snare drums. tambourine, xylophone, bells. and the piano. The pipe organ is a wind instrument and has become a collection of all possible wind instruments controlled by keyboards and stops with possibilities of string tone and percussions as well. The human voice is really of the vibrating air column type.

Each musical instrument has a definite range of sound frequencies which it can produce. The chart of Figure 7 shows the fundamental frequencies of the various notes on a piano keyboard. The frequency ranges of the various musical instruments are indicated above this in direct line with the piano key frequencies. The range of the pipe organ is about the same as that of the piano and is not indicated here.

Figure 6. Percussion instruments have no definite pitch, for the most part, and are used to lend novelty and rhythm to music

Octaves and Frequency

Middle C lies near the middle of the piano keyboard and represents a frequency of 256 cycles per second. The lowest, C3, is 32 cycles. The C2 above this is an octave of it and has a frequency of 32x2, or 64 cycles. The *octave* of a frequency is a frequency twice as large. For instance, low C3 is 32 cycles per second, the second octave of this is 32x2 = 64, the third octave 64x2 = 128, the fourth octave (middle C) 128x2 = 256, the fourth octave C1 is 512 and so on.

The horizontal spacing of the chart of Figure 7 may be rather puzzling to the reader. It is evident that in going from the low notes to the high ones the actual increases in frequency between the adjacent piano keys is not the same. The frequencies of the tones are arranged according to the octaves in such a manner that the various octaves occupy equal horizontal spaces on the chart, irrespective of the actual number of cycles covered by the octave. One octave means doubling of the frequency. Thus we have one octave of tone if we jump from 100 to 200 cycles. We also have one octave if we jump from 1000 to 2000 cycles. The latter jump covers 1000 cycles while the former covers only 100 cycles. Yet both ranges cover just one octave.

In music we are interested in all of the octaves between certain limits. Therefore, in radio reproduction of music we are also interested in the same thing. As will be seen later it is common practice to plot amplification curves of audio amplifiers, etc., in this same way with the frequency scale plotted according to octaves. Mathematically this is known as a logarithmic scale, because it is really plotted according to the exponents of the numbers instead of the actual numbers themselves.

Close examination of the chart of (*Continued on page 254*)

General Quiz on This Issue

1. *In an eliminator supplying both "B" and "C" voltages to a receiver does the "B" or "C" portion of the voltage divider require resistors of higher power rating? Why?*
2. *Is it possible to so design a receiver that good overall fidelity will be obtained in spite of side band cutting in the r.f. end? What is the principle employed?*
3. *What advantages are obtained by employing a separate heterodyne beat tube instead of an autodyne detector in reception of c.w. signals?*
4. *Explain in detail the purpose of the "B" battery in the circuit of a radio receiver.*
5. *What is a proton? An electron? In what characteristic are these two absolutely opposite?*
6. *Would it be more or less complicated to adapt a broadcast receiver to long wave (over 1,000 meters) than to short waves?*
7. *Why is a high bleeder current to be preferred in designing a "B" power supply unit?*
8. *How does a suitably tuned audio amplifier help to eliminate interfering signals, in receiving c.w.?*
9. *What is the function of the grid in a vacuum tube? How does it work?*
10. *Why does a dimly lighted room lend itself to a fuller appreciation of radio reproduction than one which is brightly lighted?*

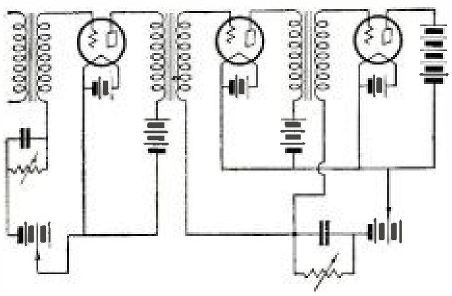
Latest Radio Patents

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

Conducted by

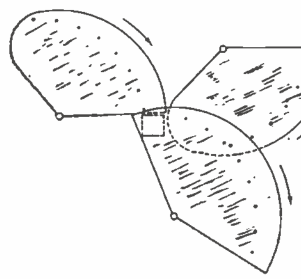
Ben J. Chromy*

18,037. MEANS FOR AMPLIFYING ELECTRICAL CURRENTS OF AUDIBLE FREQUENCIES. WALTER VAN B. ROBERTS, Princeton, N. J., assignor to Radio Corporation of America, a Corporation of Delaware. Original No. 1,759,631, dated May 20, 1930, Serial No. 90,771, filed Feb. 26, 1926. Application for reissue filed July 24, 1930. Serial No. 470,507. 3 Claims.



1. In combination, a series of amplifiers, each having anode, cathode and control electrodes, input and output circuits, the cathodes being conductively connected, the control electrodes being connected to their respective input circuits, the anodes being connected to their respective output circuits, and another connection from the input circuits to the cathodes including a bias condenser and a bias battery for maintaining the numerical value of the average potential difference between the said control electrodes and cathodes substantially equal to the peak value of the signal voltage applied to the control electrodes when said peak value exceeds said battery voltage, and equal to the battery potential when said peak value is less than the battery voltage.

1,801,430. OPTICAL SYSTEM. CHARLES E. HUFFMAN, Montclair, N. J., assignor to Jenkins Television Corporation, Jersey City, N. J., a Corporation of Delaware. Filed Nov. 7, 1929. Serial No. 405,352. 1 Claim.



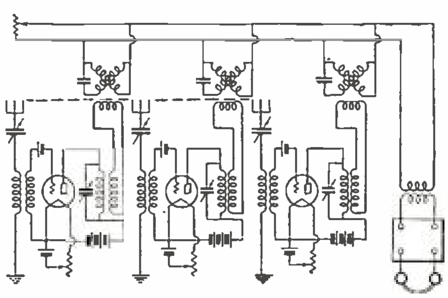
In a television system a first scanning device, a second scanning device, a third scanning device, and means for moving each of said devices in succession across a picture field, each device completely scanning the subject or object in lines that mutually intersect.

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

1,794,389. SECRET TRANSMISSION SYSTEM. RICHARD HOWLAND RANGER, Newark, N. J., assignor to Radio Corporation of America, a Corporation of Delaware. Filed Apr. 21, 1928. Serial No. 271,670. 18 Claims.

1. A transmission system including a plurality of signal channels, and means for continuously and interruptedly switching from one to another of said signal channels at predetermined and variable time periods.

1,794,730. SHORT-WAVE RECEPTION. HAROLD O. PETERSON, Riverhead, Long Island, N. Y., assignor to Radio Corporation of America, a Corporation of Delaware. Filed June 19, 1925. Serial No. 38,166. 13 Claims.

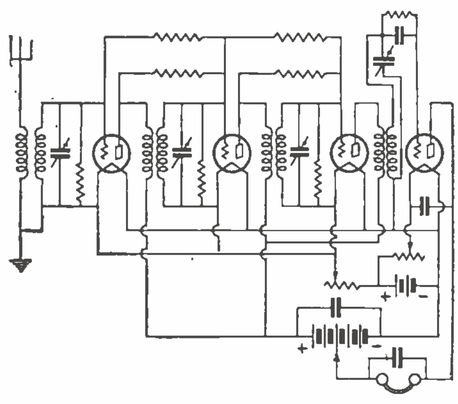


3. In combination, a transmission system connected to a central receiving station, phase adjusters associated with the transmission system, detectors coupled to the phase adjusters, and an impedance on the free end of the transmission system of such a value as to prevent reflection of the signal wave.

1,796,116. MECHANICALLY SELF-EXCITED PIEZO-ELECTRIC STABILIZING MODULATOR. ALEXANDER MCLEAN NICHOLSON, New York, N. Y., assignor, by mesne assignments, to Federal Telegraph Company, a Corporation of California. Filed Jan. 18, 1927. Serial No. 161,854. 10 Claims.

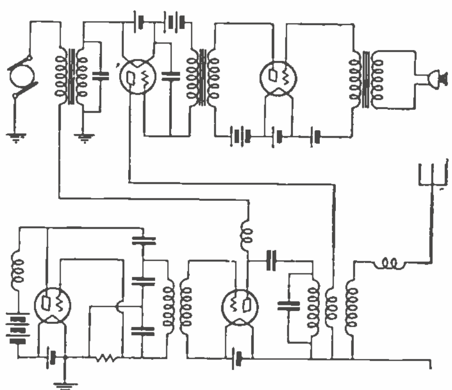
1. In a system for producing electrical oscillations of relatively high frequency, modulated at a range of relatively lower frequencies, a thermionic amplifier, input and output circuits associated therewith, a piezo-electric crystal device connected in said input circuit, said crystal device converting mechanical vibrations thereof into electrical oscillations, and mechanical means connected with said crystal device for vibrating said crystal device at the frequency of oscillations desired to be produced and at the frequency desired to modulate said oscillations.

1,799,169. RADIO CIRCUIT. WOLFF KAUFMAN, Paterson, N. J., assignor to Samuel E. Darby, Jr., Scarsdale, N. Y. Filed Dec. 3, 1928. Serial No. 323,341. 7 Claims.



1. In an arrangement of the type described, the combination comprising a plurality of audions each having a grid, plate and cathode, input and output circuits for said audions coupled together to provide a multistage radio-frequency amplifier, and conductive high resistance connections between the grid electrodes of said audions.

1,795,714. ABSORPTION CONTROL MODULATING SYSTEM. EDMOND M. DELORAINE, Blackheath, London, England, assignor to Western Electric Company, Incorporated, New York, N. Y., a Corporation of New York. Filed Sept. 20, 1926, Serial No. 136,502, and in Great Britain, Sept. 21, 1925. 7 Claims.



1. The method of modulating a high-frequency wave in accordance with a wave of lower frequency which comprises absorbing at least a part of the energy of alternate half cycles of the said high-frequency wave in accordance with the lower frequency wave, and manipulating the said absorbed energy to augment modulation during such absorption and to effect a variation of amplitude of said high-frequency wave in an opposite sense in the remaining half cycles thereof.

(Continued on page 255)

With the Experimenters

Conducted by S. Gordon Taylor

A Simple Sound Wave Recorder

The high price of cathode ray tubes and the associated equipment need keep no experimenter from "seeing what sound looks like." It is possible to construct a simple device that will give very satisfactory results at almost no cost. If you have an old watch, a loud speaker unit, an audio-frequency amplifier and a few pieces of mirror, you have all that is necessary.

The essential part of the set-up is a small mirror, about 1/16 of an inch square, cemented to the balance wheel shaft of an old watch. The watch is taken apart and everything but the framework and the balance-wheel shaft is discarded. The balance-wheel itself is broken off the shaft and the mirror, which may be cut from an ordinary looking glass, is fastened in its place. Ambroid cement, which was used several years ago in making cone speakers, serves very nicely, but any celluloid cement will do the job. The shaft with its mirror is then placed in the bearings and the watch framework reassembled. A strip of brass bent as shown in Figure 1 serves to hold the watch assembly in position above the loud speaker unit. A fine silk thread is fastened to the diaphragm of the latter and wrapped once around the mirror shaft and then fastened to a small spring and adjustment screw arranged as shown.

In order to test this piece of equipment it may be connected to the output of an ordinary broadcast receiver. If a beam of light is allowed to strike the mirror and be reflected onto a screen it will be drawn out into a line. Since nothing can be determined from this, it is necessary to spread out the line into a wave form. This may be accomplished by means of a small four-sided mirror as shown in Figure 2. It may be made by cementing four square mirrors to a wooden cube. This should be mounted on a shaft and may be turned by hand or be driven by a motor in the direction of the arrow.

A very bright light must be used. The sun would be very satisfactory, but it is usually behind a cloud or on the other side of the earth when most wanted. The light from an amateur motion picture projector will work very well in a darkened room.

If it is desired to make your own sound a simple two-stage amplifier may be used together with a microphone. It is possible to use a receiver unit for a microphone, but the tone quality suffers. In this connection it may be said that care should be taken throughout to use good quality radio parts, since a distorted wave will result if the sound is distorted.

Photographs of the wave forms may be taken. The reflected beam of light is directed directly into the lens of a camera and the shutter held open while one face of the revolving mirror moves the spot of light across the film. The result is shown in Figure 3.

JOHN L. RENNICK,
Two Rivers, Wisconsin.

Subjects Covered

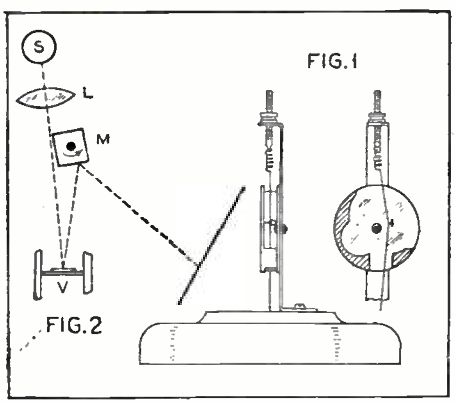


Figure 1 shows the details of the vibrating mirror assembly. The rotating mirror M of Figure 2 is necessary to spread the light beam in a horizontal direction, while V vibrates vertically

Figure 3. This is the picture of the moving light beam, obtained with the apparatus described in this article and using an ordinary camera. It is necessary to use a very powerful light

One-Tube A.C. Receiver

I am enclosing a circuit diagram, Figure 4, of a one-tube a.c. receiver together with a list of some of the stations received.

The tubes used are -27's. The r.f. transformer is a New York coil 200-550 meter coil on a UY base.

The filter condensers are 1 mfd. and 6 mfd. The choke is a 3½-to-1 audio transformer.

The filament transformer is a General Electric bell-ringing transformer with the secondary rewound for a secondary voltage of approximately 2 volts. No trans-

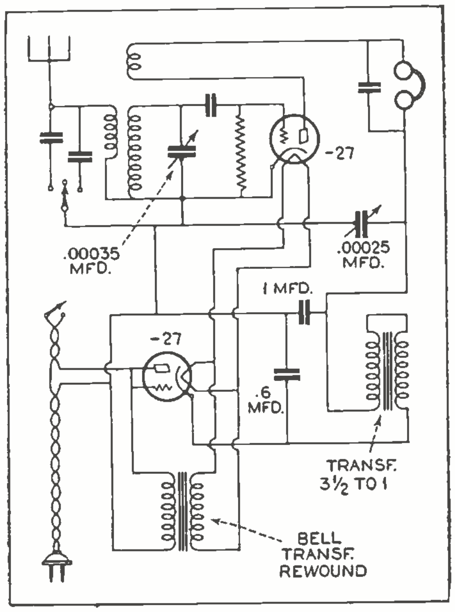


Figure 4

former is used to supply the plates of the rectifier, as the voltage drop across the rectifier is sufficient to reduce the 110-volt supply so that the detector receives the correct voltage for good operation.

The set has very good volume, even though there is only one tube used. KOA comes in almost as good as the locals. The fidelity of the set is also very good.

Below are listed some of the stations received: WBBM, WMAQ, KFRC, KFI, KGW, KOA, KJR, KLZ, KSL, KFYR (daylight), WGN, FAB, KGA, KHQ.

Hoping the above information may prove helpful to some who wish to build an a.c. receiver out of the old junk box.

GEO. T. MCNEILL,
Saskatoon, Sask., Canada.

Crystal Receivers Still in Use

With all the refinements of the present-day radio receivers, most of us are apt to forget that crystal receivers are still being used. In rural districts especially they are apparently giving very good results. Mr. Lawrence Fesler, Jr., of Sioux City, Iowa, for instance, writes that his crystal receiver is going strong. He gives a list of the following stations received: KSCJ, Sioux City, Ia.; WOW, Omaha, Neb.; WLW, Cincinnati, Ohio; KMOX, St. Louis, Mo.; WTAM, Cleveland, Ohio; WMAQ, Chicago, Ill.; WCCO, St. Paul, Minn.; KUSD, Vermillion, S. D.; WNAX, Yankton, S. D.; WAAW, Omaha, Neb.; WFNR, Chicago, Ill.; WFAA, Dallas, Tex.; WENR, Chicago, Ill.

Mr. Fesler writes the following about the receiver he uses:

"There is nothing more interesting than a good crystal set. I have constructed one that will bring in distant stations clearly. The set contains a coil with a slider. This coil is wound with No. 22 double cotton-covered wire. This coil is

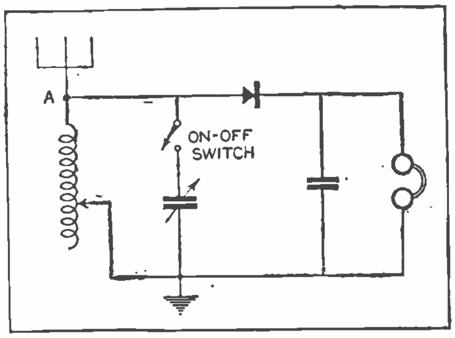


Figure 5

wound on a cover from a dry cell. The coil is three inches long and the wire scraped where the slider touches. A forty-three-plate condenser is used. It is hooked in series with an on-off switch. This helps, because many stations can be received better without the condenser. I have a small fixed condenser (.001 mfd.) hooked across the phones. The crystal holder and detector are made out of tin. The crystal I use is a ten-cent crystal that I bought. The hookup is shown in Figure 5.

"The headphones I use are a pair of Federals, type 53-W. 2200 ohms. The ground is a long wire from an outside water faucet into the house. The aerial is not so high. It is run from the side of the house to a small tree. This makes the aerial lead-in very short."

LAWRENCE FESLER, JR.,
Sioux City, Iowa.

Testing Crystal Detectors for Sensitivity

A crystal detector, of either the adjustable type or fixed, can be tested for sensitivity in a very simple manner, as shown in Figure 6. A 22½-volt "B" battery is connected in series with a voltmeter that

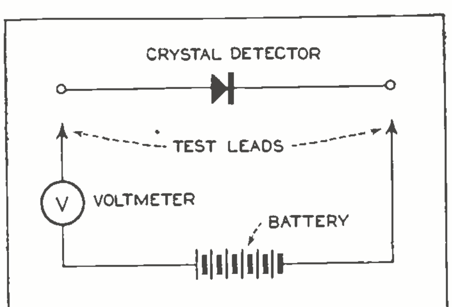


Figure 6

reads to at least thirty volts, and the two free leads, one connected to the voltmeter and the other to the battery, are touched to the two terminals of the crystal detector, and the reading of the voltmeter noted. The two test leads are then connected to the terminals of the crystal in a reversed direction, and the voltage reading again noted. The sensitivity of the crystal detector can be determined by calculating the difference in these two voltage readings. The larger this voltage difference is, the greater is the sensitivity of the detector. Sometimes, with a good detector, a voltage of two volts will be obtained when the current is flowing in one direction through the crystal, and eighteen or twenty volts when the current is flowing in the opposite direction.

A crystal detector is primarily a rectifier, and this difference in voltage is due to the rectifying action of the detector. The unilateral conductivity of the detector permits the current from the battery to flow almost unhindered in one direction, but offers a high resistance to the current when the connection is such that the current is flowing in the opposite direction. This test makes it easy for the radio store man to try out the crystal detectors that his customers bring in for examination; and also to test the detectors that he sells.

CHARLES F. FELSTEAD,
6CU, Los Angeles, Calif.

A Home-made Microfaradmeter

Many different methods can be employed to measure the capacity of condensers, but, unfortunately, most of the methods are either too expensive or not very accurate. For all purposes of the experimenter or the serviceman a microfaradmeter that will work on 110 volts

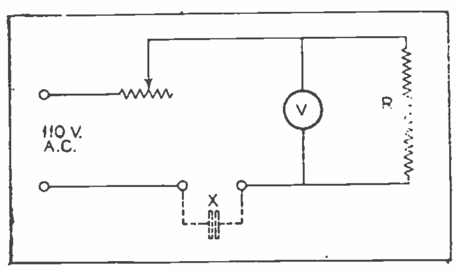


Figure 7

alternating current answers the question very nicely, but most microfaradmeters are very expensive.

Figure 7 shows a good microfaradmeter that may be easily built and calibrated by the experimenter. Referring to Figure 7, R1 is a 400-ohm wire-wound variable resistance; R is a 1500-ohm, 25-watt resistance; V is a Weston model No. 528 a.c. voltmeter; X is the capacity to be measured. The above values are not very critical.

After the instrument has been assembled and wired it is ready to be calibrated. The calibration is the most vital factor in the construction, because the accuracy of the instrument depends entirely upon the calibration. The first step in the calibration is to set (with X shorted) the resistance R1 so the voltmeter will read lower than the line voltage ever falls—100 volts is a convenient reading. Then connect condensers of known capacity, one after another, across the terminals X, noting the reading of the voltmeter for each condenser. For best results several standard capacities ranging from .1 mfd. to 1.0 mfd. should be employed in this calibration and above 1.0 mfd. enough condensers, or condenser combinations, should be available to provide calibration points about .5 mfd. apart up to the required maximum reading of about 8.0 mfd.

Capacities of known values for use as standards are not always available. In that case a fairly accurate calibration is obtained by measuring up a number of condensers having a given capacity rating and then taking the average voltmeter reading for the group as a calibration standard.

After the readings have been completed plot a calibration curve on graph paper with the horizontal scale marked off in volts and the vertical scale in microfarads.

Finding the capacity of an unknown condenser is very simple. After setting the voltmeter at 100 volts (or what voltage you choose), note the voltage the meter reads after the condenser is placed at X, trace this voltage on the graph you made, and read the capacity in mfds.

ROY D. EAGLE,
Whittier, Calif.

Bridge Type Tube Rectifiers

The means of obtaining plate power supply for medium power transmitting tubes (such as UV-211) has given radio amateurs some difficulties. The bridge

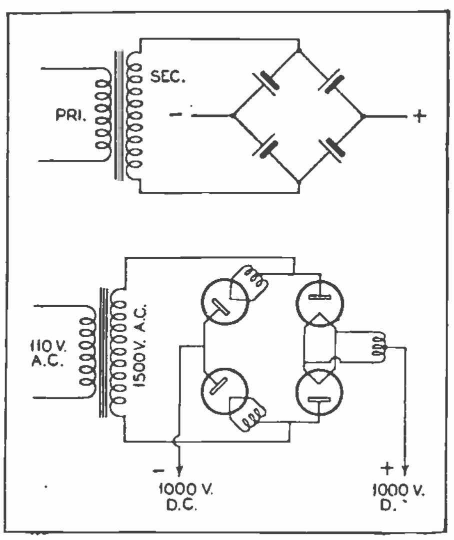


Figure 8

type tube rectifier offers a simple solution of the problem.

It takes the principle of a bridge connected chemical rectifier whose circuit diagram is shown in Figure 8. Let us assume that at a certain moment the upper end of the secondary becomes positive. Then it is easy to see that in the bridge circuit (upper side) current will be passed towards the right only, for the left arm is connected the other way. Similarly, in the bottom half of the bridge, current can only pass from the minus terminal toward the bottom. The right arm will not pass current in a downward direction.

In the next half cycle, when the potentials are reversed, the lower end of the secondary becomes positive and here we see that the rectifier unit to the right will let the current pass so that again the same terminal remains positive. The result is that we always have two rectifier units in use at a time and these are in series. Consequently we can work with a voltage twice as high as the rating of one rectifier unit.

By using four UX-281 tubes and a power transformer with a secondary winding of 1500 volts and three windings of 7.5 volts each, a good rectifier can be made. The circuit is shown in Figure 8.

WATSON FENG,
Shanghai, China.

Replacement Element for Hot-Wire Meter

While conducting some experiments with small currents from the low-voltage winding of a step-down transformer I was in need of an ammeter. Not having one on hand, I decided to replace the burned-out wire element of a handy hot-wire galvanometer, calibrate it on direct current with a direct-current ammeter and thus avoid the expense of a new a.c. ammeter.

In my impatience to get my data without the delay which would be involved in sending to the manufacturer for a new wire element, I thought of trying a piece of filament wire of an electric light bulb. I tried it, and this article is here to say that it worked. The wire must be handled very carefully. The resulting sensitivity was practically as good as the manufacturer's wire, and I had saved time and money.

JOSEPH L. MCGRATH,
Wollaston, Mass.

An External Pre-selector

Below in Figure 9 is a circuit diagram of a pre-selector which is not new by any means, but I have never seen it mounted in the manner shown. It is

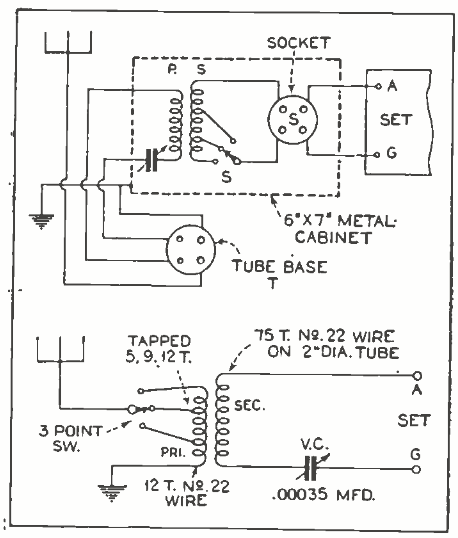


Figure 9

adaptable to any set and I have found it to increase selectivity and sensitivity, especially in my Crosley Showbox, and it has performed likewise in three other sets that I have made them for. There are four combinations possible by simply plugging the tube base into the socket in any position.

This is made possible by drilling out the two small holes in the socket so that they are the same size as the large holes. Possibly the large contacts on the socket will need closing together to allow sure contact with the small prongs.

The .00035 variable condenser is mounted on the front of the 6" x 6" x 7" metal cabinet. The coil (specifications Figure 9) is mounted behind the condenser. The three-point switch, S, is

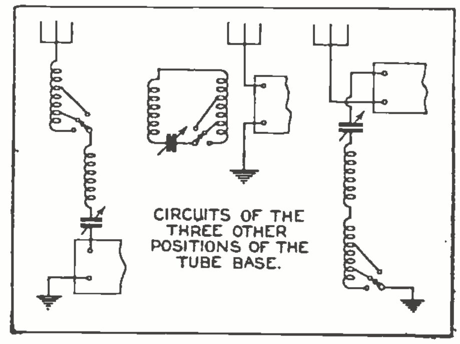


Figure 10

mounted on the side of the cabinet and the UX sub-panel socket on the rear of the cabinet on the inside so that the tube base may be plugged into it on the outside. The four leads from the selector come out through holes in the back, the secondary wires being just long enough to allow the plug to be inserted in the socket. The two remaining leads going to the Ant. and Gnd. of the receiver. The cabinet is grounded. When the plug is inserted with the pin in a position that corresponds with the arrow or P and G on the socket, the broadcast receiver will operate normally and when the plug is reversed the selector is in the circuit. The other two positions will also work. See Figure 10.

I found a vernier dial on the condenser handy, as it tuned very sharp, especially using the small primary. This arrangement makes a very neat appearance on top of a cabinet or console.

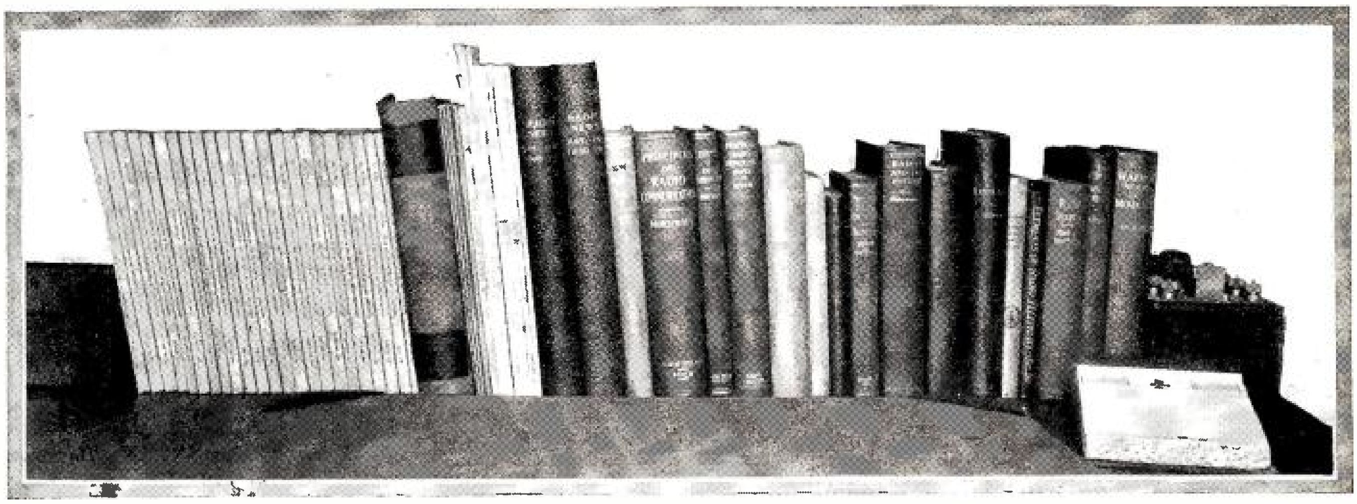
WESLEY BRADSHAW,
New London, Conn.

Hints on Automatic Volume Control

Automatic volume control does not reduce static nor improve distance and tone quality, as some people seem to believe. It is merely an important improvement on the manual form.

If you take an old type of receiver, that is, the non-automatic type, and while tuning it carefully adjust the manual volume control to compensate for varying signal strengths so as to receive all signals with the same volume, you have, to a certain extent, the action of the automatic volume control. When, in the new sets, no signal is being received the receiver is adjusted to maximum sensitivity, while when a loud signal is being received the receiver has a low order of sensitivity. The manual volume control knob

(*Continued on page 252*)



Radio Science Abstracts

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

Conducted by
Howard Rhodes

Practical Radio, by James A. Moyer and John F. Wostrel, Fourth Edition, McGraw-Hill Book Company, Inc.

We have here an elementary textbook on radio, evidently written in a manner so as to appeal and be helpful to the experimenter and radio service man with but a fair knowledge of the fundamentals of radio circuits. To such groups we are sure this book will prove useful.

This Fourth Edition differs from previous editions mainly in the addition of considerable information on television, rectifiers, alternating current tubes, loud speakers and short-wave receivers. The book deals but slightly with the details of the construction, testing and repairing of receivers since these are covered in a companion book by the same authors on construction and repairing.

The first half of the book discusses the various component parts of a radio receiver; there are chapters on audio frequency amplification, radio frequency amplification, loud speakers, vacuum tubes, and power supplies. The chapter on radio frequency amplification will, we believe, be especially interesting to those having but a slight knowledge of radio theory, since it covers most of the past and present circuits. There are also chapters on the operation and care of radio receivers, common troubles and their remedies, television and general applications of radio. The appendix included at the back of the book gives chronologically a record of the important discoveries in radio since the year 1831.

Mathematics for Self Study, by J. E. Thompson. A four-volume series covering Arithmetic, Algebra, Trigonometry and Calculus, each volume about 300 pages. D. Van Nostrand and Company, Incorporated.

This group of books on mathematics is designed primarily for those who wish to study mathematics at home without the aid of a teacher. All four volumes are well written in a clear and accurate manner. Many practical problems are included so that the student learns the subject in such a manner that he can appreciate its value. We have seen altogether too many texts on mathematics that were abstract in their general treatment and which contained many impractical but "tricky" examples that leave the student with a feeling that mathematics is an intricate and quite useless branch of the sciences. The treatment used in these books by Thompson is such, however, that the utility of the subject is always foremost in the mind of the reader. These four books are really the finest little series on mathematics that we have seen.

The book on arithmetic discusses the fundamental operation, calculations using decimals, methods of simplifying calculations, powers and roots, logarithms and their use, etc. The latter part of the book is devoted largely to material that forms the basis for the use of mathematics in enginering and the association between ordinary arithmetic and trigonometry.

The book entitled Algebra covers the subjects of exponents and radicals, imaginary and complex numbers, equations and their solutions and the solution of problems by means of equations and logarithms.

The third book of this series, Trigonometry, considers the functions of angles and triangles and the manner in which they can be used to solve various electrical and other types of problems. It explains how to use trigonometric tables and how to solve problems involving oblique triangles.

Calculus is the subject of the most advanced book of the four that compose the series. It discusses differentials and their application to the solution of problems, integrals and their application.

For anyone who wants to study mathematics or brush up on some forgotten school work, this little series can certainly be recommended. They are complete, well written and so full of practical problems that the reader cannot help but leave the books with a better understanding of the fundamental usefulness of mathematics.

1931 Trouble Shooter's Manual, by John F. Rider, Radio Treatise Co., Inc.

Here is a book that certainly ought to be in the hands of every service man and experimenter who does work on manufactured receivers. It contains the circuit diagrams of some 800 receivers together with the circuits of all the well-known makes of set testers and other service equipment. All the circuits are clearly marked, in many cases the actual values are given and in most instances color code charts are included showing the colors of the various wires used in the wiring of the receiver. Such information, of course, simplifies the service problem, since it makes it easy to locate various units and determine the circuits to which each individual wire connects. From our examination of the book it appears that it contains the circuit of practically every manufactured receiver that has been made.

Mr. Rider certainly deserves credit for the compilation of this Trouble Shooter's Manual; we know only too well the amount of time and energy that it must have required. Included in the book are the circuits of many receivers and testing units whose manufacturers have steadfastly refused, in the past, to release such data.

The book contains about a thousand pages and includes besides the many circuit diagrams a reasonably complete discussion of methods of modern trouble shooting and the testing of radio receivers. The circuits are all printed on pages measuring eight inches by ten inches.

X-Rays Have Many Uses in Industry, Art, and Science, by Harold G. Petsing, The Electric Journal, April, 1931.

When X-rays are mentioned the first thought that comes to mind is the application to medicine and surgery and little thought is given to their many other uses. The fact is, however, that X-rays are now in common use in many industries where they are used to detect flaws in castings and in electric insulators, and internal structure of silk, paper, rubber, etc. X-rays have even been used to detect artificial jewels and the age and sex of mummies in a museum. The author covers the non-medical uses of X-rays in considerable detail and points out that their cost is well within the means of all large concerns. It is not unlikely that in the future every great industrial organization will install high voltage X-ray tubes to detect all manner of flaws in manufactured products.

The New Variable Mu Vacuum Tubes, by A. G. Campbell, Radio Engineering, April, 1931.

Without introducing any really new material the author gives a very good summary of the characteristics of the variable mu screen-grid tube. He points out that the variable mu characteristic may be obtained by suitably altering the structure of the tube in any one of many possible manners; the electrodes can be of varying diameter, the cathodes or grids can be tilted or one or more gaps can be introduced. The article concludes with complete data on the characteristics of the variable mu tube.

Cathode Rays in Television, by H. R. Wright, Radio Engineering, April, 1931.

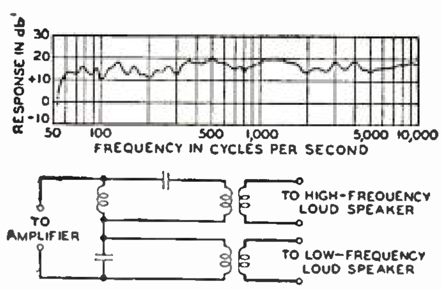
The author describes some of the work by the Westinghouse Laboratories on the use of the cathode ray tube in the television system. The article includes diagrams of the internal construction of the cathode ray tube and the discharge circuit used for framing the image. By the use of such an arrangement framing of the picture at the receiver may be made automatic. Other advantages are that the brilliancy of the light is sufficient to permit the image to be viewed by a number of people and furthermore the power required is quite small, being in the order of that required by ordinary radio tubes.

Acoustic Delay Circuits, by W. P. Mason, Bell Laboratories Record, May, 1931.

Over a hundred years ago Regnault used the water mains of Paris for an extensive series of tests to determine the velocity of sound in pipes and whether the velocity varied with the diameter of the pipe. He fired a pistol at one end of the pipe and determined the amount of time required for the sound of the shot to reach the other end of the pipe. Later experiments have indicated that sound waves are propagated in a tube in a manner closely analogous to the propagation of electric currents over a wire except that the sounds through a pipe travel very much slower. These facts have been used in the Bell Laboratories in the design of circuits where it is necessary that the speech be delayed for a short period of time. It has been found that obtaining the delay by the use of a tube is preferable to delaying it by purely electrical means.

A Loud Speaker Good to Twelve Thousand Cycles, by L. G. Bostwick, Bell Laboratories Record, May, 1931.

Twelve thousand cycles is within the highest octave that can normally be perceived by the human ear. Yet it has been found that certain voices and musical instruments and many sounds such as the crushing of paper, the jingling of keys,



Connected to the power supply, through the circuit shown, the high-frequency loud speaker and a low-frequency speaker will efficiently reproduce almost all audible sounds

hand clapping, etc., generate harmonic frequencies that go as high as twelve thousand cycles, and a loud speaker producing all tones up to this frequency is therefore essential if perfect reproduction is to be obtained. Reproduction of all frequencies from about 60 cycles up to 12,000 cycles was obtained by the use of two loud speakers connected to the same amplifier. A large Western Electric loud speaker, similar in type to those used in theaters, was used to reproduce the lower range in frequency and a very small loud speaker suspended in the mouth of a large loud speaker reproduced all the higher frequencies. The two loud speakers were connected to the amplifier in a manner such that most of the energy above 3000 cycles was delivered to the high frequency loud speaker and most of the energy below 3000 cycles to the low frequency loud speaker. The accompanying curve and circuit indicate the overall frequency response of the loud speaker and the manner in which the two units were connected to the amplifier.

The Suppression of Radio-Frequency Harmonics in Transmitters, by J. W. Labus and Hans Roder. Proceedings of the Institute of Radio Engineers, June, 1931.

In the present paper the harmonic components of the antenna current are determined in terms of the corresponding components of the plate current of the power amplifier of transmitters. After investigating the cause of harmonic currents and pointing out the difficulties arising in connection with an exact calculation of the harmonics of the field strength, the discussion is confined to the effect of the circuits inserted between plate and antenna circuit on the suppression of harmonics. Several types of circuits are considered and the current ratios of the harmonic antenna currents with respect to the fundamental are given. For better comparison, the results are tabulated.

It has been found that, in general, the suppression of harmonics as given by the above ratio is proportional to the product of the volt-amperes in each individual circuit of the network and to a power of the order of the respective harmonic. Moreover, a general law has been derived, according to which for a given total volt-amperes of the whole filter network the optimum number of individual circuits can be determined. Finally the advantage of the push-pull amplifier and another circuit which inherently compensates harmonics has been discussed and also the detrimental effect of the distributed capacity of the coupling device which provides an undesired path for the harmonics has been described.

A Device for the Precise Measurement of High Frequencies, by F. A. Polkinghorn and A. A. Roetken. Proceedings of the Institute of Radio Engineers, June, 1931.

A description is given of equipment which has been constructed for the measurement of radio frequencies between 5000 and 30,000 kc. The equipment consists of a million-cycle quartz-crystal oscillator as a standard of frequency, means for producing harmonics and subharmonics of this frequency, and means for combining voltages of these known frequencies with a voltage whose frequency it is desired to measure so as to produce beat frequencies in successive stages, the beat frequency produced in each stage having one less digit than that in the preceding stage. A calibrated electric oscillator is used to measure the frequency of the last stage. An indicator gives the frequency of the unknown after a series of dial adjustments. The precision of a completed measurement is estimated at better than three parts in a million.

Receiver Design for Minimum Fluctuation Noise, by Nelson P. Case, Proceedings of the Institute of Radio Engineers, June, 1931.

The effects of various changes in both tube and circuit conditions have been investigated with regard to their influence on the limitation which fluctuation noise sets on the sensitivity of a receiver.

It is concluded that for minimum noise the following conditions should obtain: The gas pressure in the tube should be less than 10^{-4}mm of mercury; the antenna-to-grid transfer circuit should be as efficient as possible; the plate-circuit load impedance should be high enough to give a gain of at least five for the first radio-frequency tube apart from the antenna coupling circuit; and the cathode emission should be high enough so that the tube is always operating under dense space-charge conditions.

(*Continued on page 256*)

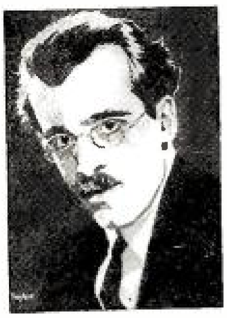
Backstage in Broadcasting

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

By

Samuel Kaufman

ONE of the most important additions to the NBC personnel in recent months is the acquisition of Erno Rapee, former conductor of the Roxy Symphony Orchestra, as general musical director of the chain. Thus a new peak in an adventurous musical career is reached. Less than a score of years ago, Rapee played the piano in a cafe in New York's dismal East Side. Now, at the age of forty, he will direct the musical fare of millions of listeners throughout the nation.



Erno Rapee

Rapee was born in Budapest in 1891. He studied piano while very young and was graduated from the Budapest Conservatory with high honors in 1907. He played with orchestras in Vienna, Berlin and Budapest and officiated as assistant conductor to Ernest von Schuch of the Dresden Orchestra. Then he toured South America and Mexico before coming to New York. He has been associated with S. L. Rothafel (Roxy) in several New York theatres the latter managed over a period of thirteen years. In 1925, Rapee returned to Europe as musical director of UFA films in Germany. While there he served as guest conductor of prominent symphony orchestras. He was absent from the Roxy Theatre for nine months of 1930 during which time he served as director of music for Warner Brothers Pictures. Rapee achieved new popularity as conductor of the 200-piece symphony orchestra which presented a series of Sunday morning charity concerts last Spring for the benefit of unemployed musicians.

STATION WOR and thirty-four other transmitters through the United States are presenting a unique recorded program series featuring a large number of screen stars. Known as the "Radio Newsreel of Hollywood," this series of fifteen-minute programs was actually produced and recorded in the Capital of Filmdom by the radio staff of a New York agency. The designers of the programs told the writer that the reason the "electrical transcription" method was utilized in preference to a "live" chain system was that the screen stars were not available at satisfactory broadcasting hours. By the recording method, it was stated, stars performed before the microphone at any hour convenient to them. Some programs were recorded at midnight and others even at breakfast time, with the result of a series of highly interesting presentations. The programs which went on the air early this Summer will continue for a total of fifty-two weeks.

DURING his recent visit to the United States, Sir John C. W. Reith, director-general of the British Broadcasting Corporation, paid high compliment to the American broadcasting systems, but expressed the opinion that the English "monopolized-radio" system was more practical and efficient. In an interview, Sir John told this writer that the quality of American commercial programs was high, indeed, but the sponsorship idea could never be adopted in England on account of the British listeners' dislike to advertising announcements on the air. He stressed the importance of international program exchange and predicted that there will be considerable growth in this field. During his brief visit, Sir John broadcast over the networks of the NBC and the CBS and addressed meetings of the National Advisory Council on Radio in Education and the National Radio Editors' Association. Sir John received a medal from the CBS for his contributions to broadcasting. The network plans to make several more awards of this type in the future.

Sir John Reith

Facsimile of the medal awarded by CBS

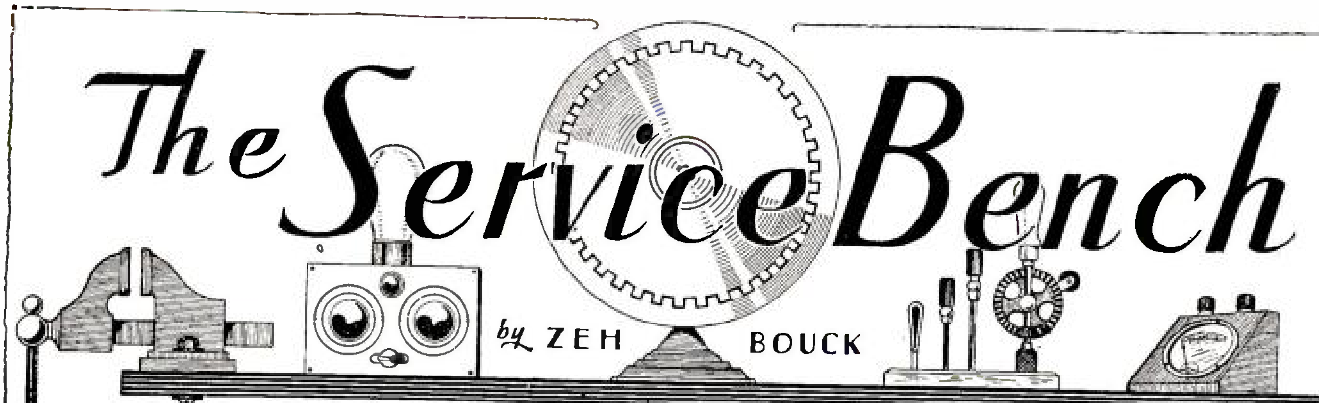
BOTH the NBC and the CBS have recognized the value of outdoor concerts as popular Summer radio fare. The New York Philharmonic Symphony Orchestra concerts at the Lewisohn Stadium in New York gained a prominent program spot on the CBS summer schedule, while the NBC featured the Goldman Band concerts, from the Mall, in Central Park. Thus several of the more important names in the concert field were brought to listeners throughout the nation, in months when the "big names" are usually absent. Willem van Hoogstraten, Fritz Reiner and Albert Coates, world-famous conductors, featured the CBS schedule, while Edwin Franko Goldman, noted American bandmaster, and composer, directed the NBC concerts.

Franko Goldman

DURING a program of American music on the NBC, October 4, network officials will reveal the conditions of a contest for the best orchestral works written by American composers. According to a preliminary announcement made by Merlin H. Aylesworth, president of the chain, a series of awards totaling several thousands of dollars has been planned to encourage musical composition in this country. Mr. Aylesworth explained that the delay in announcing definite details before October was occasioned by the enlisting of advice and co-operation of leaders in the field of music. The only limitations placed, for the present, upon competitors is that the compositions submitted by them must be for orchestral rendition and must not take longer than twelve minutes to play.

HERBERT GLOVER, director of news broadcasts for the CBS, tells this writer that the carbon microphone which has become obsolete for studio presentations is still a reliable standby

(*Continued on page 239*)



Shielded lead-ins offer one solution of the interference problem; an interference locator, a bloodhound on the trail of man-made static; convenience plus in the Service Shop; Trimmer condensers an obstacle in the Tropics, but here is a suggested remedy

Reducing Noise With Shielded Lead-Ins

By Boris S. Naimark

THE serviceman, particularly in areas supplied with d.c., can add considerably to his income by specializing in the reduction of noise generally coming under the head of "man-made static". The sensitivity of the modern screen grid superheterodyne is of such an order that the signal to noise ratio is seldom satisfactory in the modern apartment house installation—a condition that is especially aggravated in direct current districts.

Filter Installation

Often the first mode of attack is the installation of some form of filter in the power leads to the receiver, generally radio frequency choke coils, wound with a heavy wire, bypassed to ground with center-tapped filter condensers. However, such devices often drop the d.c. potential to an undesirably low value (resulting in very slow heating of the cathode type tubes) and are expensive. This last item is of considerable importance, because sets are sold today on a small margin of profit, and the quotation is generally made on a completely installed basis with no consideration given to the possibility of a filter accessory.

In many instances the noise is picked up by an indoor antenna or lead-in running close to elevator or other power lines, and the obvious solution lies in the use of an outside antenna, strung as far as possible from the source of interfering disturbances, and connected to the receiver with a shielded lead-in. However, experts differ as to the exact type of shielded lead-in to be employed. It will be discovered in the R. C. A. service manuals that the engineers of this organization do not recommend the grounding of the external copper shield. On the other hand, the Stromberg-Carlson engineers advise, "The lead-in wire should be run through grounded metal conduit, or an insulated wire, shielded with a copper wire braid, which is grounded at each end, should be employed as a lead-in down to the radio receiver."

As a matter of fact my own experience has demonstrated that both authorities are correct, the desirability and necessity for grounding the shielding varying with different installations. The shielded lead-in aerial is, of course, the most inefficient of all possible designs, the efficiency of the antenna varying inversely with the efficiency of the shielding. Grounding the shield increases the shielding effect. No more shielding should be used than is necessary, therefore, in some cases, it will be possible to get away with the ungrounded installation, and in others, where noise is particularly bothersome, it will be necessary to ground the shield. However, when the shield is grounded, a thorough job must be made of it, and when ungrounded, equally careful precautions must be observed to see that the shield does not become accidently grounded. Careless installation in these respects will often result in more noise than the shielding tends to eliminate.

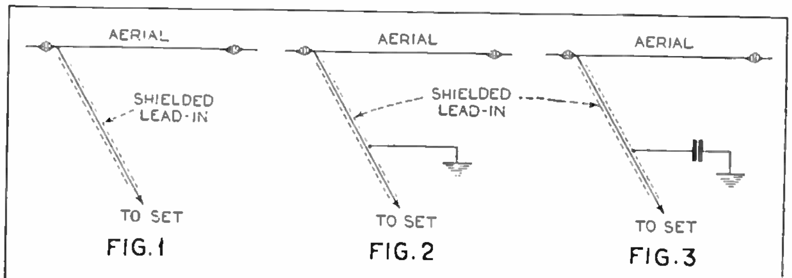
I have found a compromise arrangement effective in many instances of moderate disturbances—the grounding of the shield by means of a small condenser, the effect of a direct ground being approached as the capacity increases. Any capacity from .00025 mfd. up will be effective. The three possible arrangements are shown in Figures 1, 2 and 3 in the order in which they have been discussed.

A convenient type of shielded antenna wire is marketed by the Holyoke Company. It consists of stranded wire covered with gutta-percha and a weather-proofed fabric. Part of the coil is also covered with a woven metal braid, as shown in one of the accompanying photos. Thus the antenna and shielded lead-in are combined in a continuous length of wire, insuring low resistance through the elimination of joints.

Special antenna wire with the antenna proper, at right, and a shielded lead-in, left, combined in one continuous length

When a shielded lead-in in either of the three suggested connections does not materially reduce noise and interference, recourse must then be made to the ultimate filter arrangements, which have been described in RADIO NEWS from time to time. The most simple of these consists of two choke coils, one connected in each power lead of the receiver, and with each side of each choke coil bypassed to ground with a two microfarad condenser. The choke coils must be wound with heavy wire such as Number 12, to avoid an undue voltage drop.

Neither shielded lead-in nor filter arrangements will be effective in altering the signal to static ratio—static here referring to natural atmospheric or similar disturbances picked up by the antenna proper.



Figures 1, 2 and 3—Showing the various possibilities of a shielded lead-in in the reduction of artificial strays

AN INTERFERENCE LOCATOR FOR THE SERVICEMAN

AFTER nearly a year of laboratory and field tests, the Tobe Deutschmann Corporation has placed on the market the Model 230 Interference Locator. This instrument was developed in response to the demand by power companies, municipalities, and radio-service organizations for a sensitive and portable instrument, designed to meet the requirements of men specializing in the location of radio interference.

In sensitivity and selectivity this instrument is said to be the equal of most modern a.c.-operated receivers, and without being connected to the power line it responds to electrical disturbances which may be distributed along it. This sensitivity is achieved by use of type 232 tubes in a specially designed tuned radio-frequency circuit, and by the provision of a variable control for tuning the input circuit of the instrument to resonance with the interfering electrical impulse.

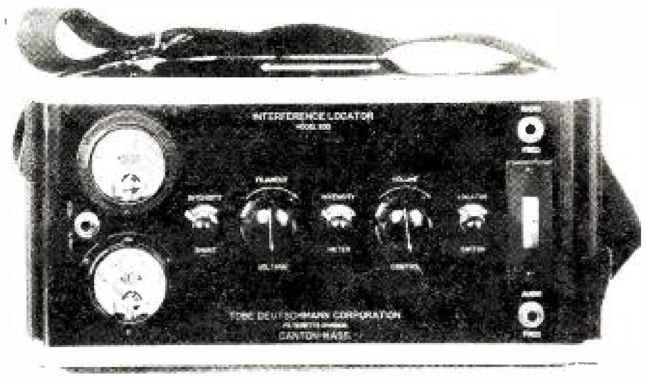


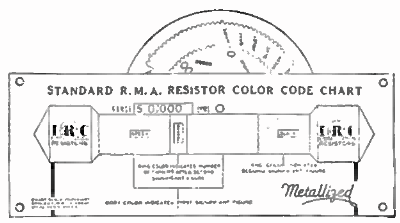
Figure 4—A portable interference locator for the serviceman, opening a new and profitable field of radio service in co-operation with the local lighting company

Portability is obtained by use of aluminum wherever possible in the construction of the instrument. A cast aluminum frame supporting the chassis provides rigidity, as well as extreme lightness. The construction of the Model 230 Interference Locator is such that it may be used with equal facility in an automobile, or while being carried by the operator.

For tracing interference along high tension lines, or within a building, the instrument may be easily carried by means of a strap over the shoulder of the operator. When the instrument is being so used, all of the instruments, switches, and volume control knobs, being located in the top panel, are clearly visible and easily accessible, Figure 4. The frequency selector knob and resonating condenser, located in the right-end panel, are conveniently placed for operation while the instrument is being carried.

This same location of instruments and controls makes for ease of operation when the instrument is used in an automobile. A typical method of installing the instrument is shown in the accompanying photograph, Figure 5. When the instrument is so installed the operator may adjust the frequency selector or resonating condenser while driving the car, and may observe the instruments at the same time. Jacks are provided to allow the connection of auxiliary "A" and "B" batteries when the instrument is being used in an automobile. The use of these auxiliary batteries will prolong the life of the small batteries mounted within the locator.

The meters (*Continued on page 255*)

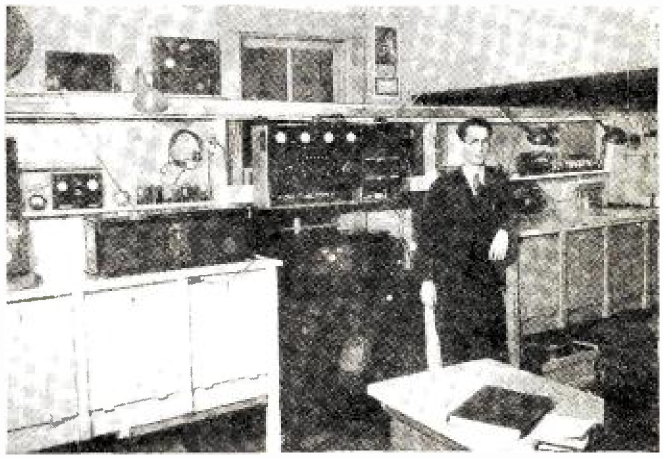


IN the Service Bench in the July issue, an item appeared offering to provide the new Standard R. M. A. Resistor Color-Code Chart, without cost, to the first 500 bonafide servicemen requesting same on their own printed letterheads. The response was so heavy that within five days after the July issue appeared the 500th request had been received and within the next few days this number was increased by several hundred. In view of this extraordinary demand, the International Resistance Company has decided to supply these charts to all servicemen, and the offer is hereby renewed to enable those servicemen, who may have overlooked the first offer, or those in foreign countries, who, because of the limited number offered, probably felt that their requests could not be received in time to be within the first 500 received, to obtain a chart.

This offer is now being made to all servicemen readers of RADIO NEWS. *The only requirement is that requests be written on servicemen's letterheads or on the letterheads of the servicemen's employer. All letters should be addressed to Department L,* RADIO NEWS, *350 Hudson Street, New York City.*

ALL IN A DAY'S WORK

V. V. NILES, of the Radio Hospital, Greely, Colorado, sends us the accompanying photo of his service shop, one of the features of which is the carrier track, or trolley, on which the test equipment is suspended and by means of which it is readily conveyed from one bench to another. As Mr. Niles writes, it works out this way: "Mr. Jones brings his radio into the shop to be repaired, and says he will return for it twenty-four hours later. The testing equipment is put in place, the work nicely started, when Mr. Smith comes in with his radio and informs us that he wants his set repaired immediately because there is a special program he wants to hear in two hours. Here is where the carrier comes in handy. As Mr. Jones did not want his set right away, we push the equipment over to Mr. Smith's set and proceed testing his set. After Mr. Smith's difficulties have been adjusted, the equipment is returned to Mr. Jones' set without loss of time. The same results could be otherwise obtained, but not so quickly and would tie up more equipment. We are using this system and find it very practical.



The service shop of V. V. Niles, Greely, Colorado, showing the test equipment suspended on a rolling track

"The equipment employed is the Day-rad type H-180 test panel. The phonograph pick-up on top of test equipment is used for testing audio circuits and demonstrating the quality that may be had from a record through a radio receiver.

"One of the benches is equipped to test battery sets, and the other to test electric sets. The battery bench is equipped with ¼-ampere fuse in each lead to protect the batteries and tubes in case of a short circuit. There is a switch which cuts a 10-watt lamp in series with the 'B' when locating a short circuit.

"Separate aerial and ground connections are available on both benches through clips and switch arrangements."

Balancing Trimmers in the Tropics

The trimming condensers supplied in parallel with the tuning sections of the usual gang condenser are often worse than ineffective in the tropics, according to George Muller of Georgetown, British Guiana. "After a few months of active service," declares Mr. Muller, "the power factor goes way up, and the sensitivity of the receiver drops. It is then best to remove the trimmers altogether and balance the receiver by the use of small external capacities. I find winding together two six-inch lengths of bell wire, with well waxed insulation, provides an (*Continued on page 255*)

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

Conducted by

The Technical Staff

Midget Receiver

Description—This compact Envoy receiver is made in four types, namely: 110-volt a.c., 220-volt a.c., 110-volt d.c., 220-volt d.c. The a.c. receiver utilizes two multi-mu –35 type tubes, one –24 screen-grid type tube, one –47 pentode type tube, and one –80 type rectifying tube. The d.c. model employs three –36

screen-grid type tubes and two –33 pentode type tubes. Both a.c. and d.c. sets are equipped with phonograph pick-up jack, tone control and electro-dynamic speaker. The cabinet measures 18 inches high by 15 inches wide by 9 inches deep.

Maker—Insuline Corp. of America, 23 Park Place, New York City.

Set Analyzer

Description—This set tester, model No. 90, is designed to meet practically all radio service requirements on all types of radio receivers and tubes, including the new power pentode radio. With this device it is possible to measure voltages up to 900 volts on each side of the center-tap windings of the power supply transformer. The set tester employs a universal a.c. and d.c. meter of the copper-oxide rectifier type. A tandem scale selector switch and push-button switch provide a simple switching arrangement for connecting the meter to any of the universal analyzer

plug and cable circuits terminating at the tube sockets and associated pin jacks located on the panel. The instrument is housed in a sturdy carrying case measuring 11 inches by 9 inches by 4½ inches and the total weight is less than six pounds. The carrying case is equipped with a slip-hinge cover which may be easily removed when testing.

Maker—Supreme Instruments Corp., Greenwood, Miss.

Public-Address System

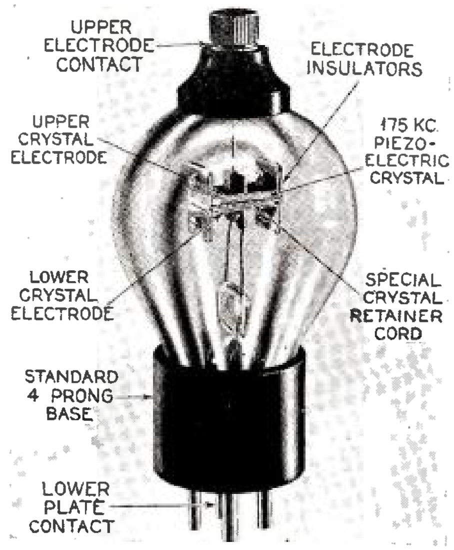
Description—The self-contained sound-amplifying system illustrated here, resembling in appearance a telephone switchboard, is capable of providing radio, phonograph and microphone programs. It is operated from the 110-volt a.c. supply and is so designed that it can be easily and quickly installed. In addi-

tion to the radio-frequency tuner, audio-amplifier and the electric phonograph, the associated apparatus consists of one electro-dynamic reproducer with extension cord, one double-button carbon microphone, one adjustable microphone stand and 25 feet of microphone extension cord. The walnut cabinet measures 45 inches in height by 24 inches wide by 24 inches deep.

Maker—Amplifiers Limited, San Francisco, Calif.

Quartz Crystal Tube for Stenode Receiver

Description—The new quartz crystal tube which is utilized to provide the exceptional selectivity of the Stenode Receiver is mounted on a standard UX base and is similar in dimensions to the –45 type power tube. This form of construction provides a convenient mounting for the receiver. The quartz crystal is sturdily supported in a medium vacuum which provides temperature insulation and insures permanency of characteristics. The electrical connections are brought to the tube cap and the plate prong on the tube base. Complete constructional details are illustrated on the accompanying photograph.



Maker—Stenode Corporation of America, Hempstead Gardens, Long Island, N. Y.

New Compact Receiver

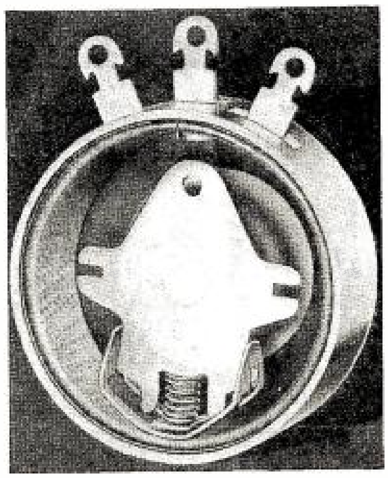
Description—A mantel type eight-tube superheterodyne receiver which utilizes two of the new multi-mu –35 type tubes, one –24 type tube, three –27 type tubes and one –47 pentode type tube for the power output stage. The –80 type tube is used for rectification. The receiver is equipped with tone control and a dynamic speaker. This receiver, which is known as the

Roosevelt, is available in several different cabinet models. The cabinet illustrated here measures 18 inches high by 16 inches wide.

Maker—Commonwealth Radio Manufacturing Co., 847 W. Harrison St., Chicago, Ill.

Volume Control

Description—The Frost series wire-wound volume control, type No. 20, has a smooth, noiseless action, due to the design of the variable arm or contactor which makes two separate line contacts with the resistance element. The variable contactor is made in the form of a shoe with two runners each measuring 3/32 inch in width. Equalization of pressure is applied by spring tension, midway between the two runners which reduces contact pressure and diminishing cutting or scoring of the resistance wire. The device is enclosed in a dust-proof case and



they are available in single and tandem units with or without a.c. switches.

Maker—Chicago Telephone Supply Co., Elkhart, Ind.

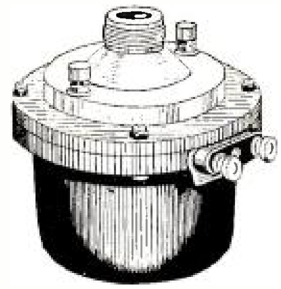
Audio-Amplifier Panel

Description — An audio-amplifying system with all parts mounted on steel panels and so designed that a combination of these panels can be adapted to virtually all needs for sound distributing systems. The tubes employed in this particular audio amplifier are one –27 type, two –45 type and two –50 type. Two separate power supplies are employed and the rectifying tubes are one –80 and two –81 type vacuum tubes. Matching transformers are available for a variety of input and output circuits. All apparatus is mounted on the rear of the panel and is protected by dust covers.

Maker—General Amplifier Co., 27 Commercial Ave., Cambridge, Mass.

Giant Dynamic Unit

Description—The Amplion Octaphase model No. AA-1040 air-column dynamic unit is designed for heavy-duty service and it is said that this unit is capable of developing an efficiency of 28%. The frequency range of this speaker is from 40 to 8000 cycles and it is suitable for use in theatres, large auditoriums and for any occasion where great volume is desired. The unit weighs 15 pounds and both the diameter and height are 5¼ inches.



Maker—Amplion Products Corp., 42 W. 21st Street, N. Y. City.

Electro-Dynamic Speaker

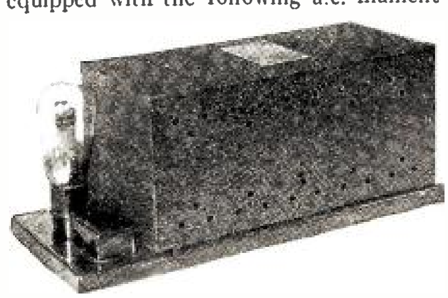
Description—The Rola series F electro-dynamic reproducer is designed to match the critical load requirements of the new Pentode power tube, and it is particularly adapted to the small type of radio re-

ceivers and for home talkie installations. The overall diameter of this speaker is 8 inches and its weight is under 5 pounds.

Maker—The Rola Co., 2570 Superior Ave., Cleveland, Ohio.

A Compact Power Supply

Description — The heavy-duty power pack type K-139 is designed to meet the power requirements of practically any modern a.c. receiver. It has a maximum direct-current output for plate supply of 125 milliamperes at 300 volts. It is equipped with the following a.c. filament



windings: 4 volts at 6 amperes, 2.5 volts at 12 amperes, 2.5 volts at 3.6 amperes and 5 volts at 2 amperes. The parts are mounted on a steel base measuring 14½ inches long by 6¼ inches wide by 6 inches high. Provisions are made to operate the unit from line voltages between 110 and 125 volts by means of taps on the primary winding of the power transformer.

Maker—Pilot Radio & Tube Corp., Lawrence, Mass.

Lever Indicators

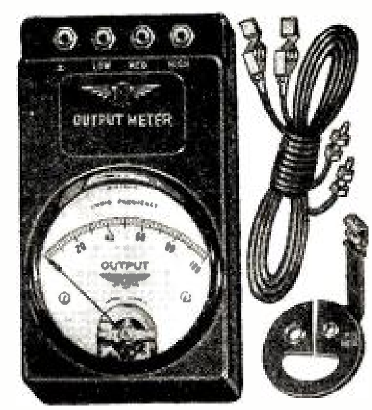
Description—The lever indicators illustrated here are designed for a quick but accurate instrument control on transmitting equipment and laboratory apparatus. The pointers and hubs of these instruments are made of cast bronze and the knobs, handles and guard disc are of bakelite. They are available to fit either

¼-inch or ⅜-inch hubs.

Maker—National Co., Malden, Mass.

Output Meter

Description—An output meter for the use of the radio serviceman or radio experimenter. This instrument permits the operator to see when the point of best adjustment is reached, instead of relying on the human ear, which cannot be de-



pended upon when making accurate adjustments of radio-frequency stages. By means of three measuring ranges, it may be adapted to the output circuit of any receiver. It is a portable instrument and is complete with leads, test clips and socket adapter.

Maker—The Jewell Electrical Instrument Company, 1642 Walnut St., Chicago.

Portable Public Address System

Description—A portable sound amplifying system featuring a six-foot exponential horn equipped with a dynamic air column unit. The equipment consists of a two-stage audio amplifier, a two-button

carbon microphone and a microphone stand, an exponential loud speaker and fifteen feet of connecting cable. The two leatherette carrying cases with the entire equipment weigh 90 pounds. This port-

(*Continued on page* 250)

Mathematics in Radio

Geometry and Its Application in Radio

PART NINE

In this department we are continuing the series on mathematics prepared by Mr. J. E. Smith (President of the National Radio Institute), which heretofore has appeared in the Junior Radio Guild. The first of the series on the "Mathematics in Radio" appeared in the December, 1930, issue of RADIO NEWS.

Those of our readers who have followed the series from the beginning and who wish to continue into the realm of higher mathematics will find these interesting studies continued here.

Although the subject has now progressed beyond the "Junior" stage, it has been decided to complete the series because of the numerous requests received from readers.

—THE EDITORS.

THE cross-sectional areas of conductors have been represented by a convenient unit called the circular mil and it eliminates the use of the constant π (equal to 3.1416).

Wire Areas

If a wire conductor has a diameter of 1 mil (.001"), it is said to have an area of 1 circular mil. If the conductor has a diameter of 2 mils (.002"), it is said to have an area of 4 circular mils; if 5 mils in idameter, an area of 25 circular mils, etc. A mil is one thousandth of an inch. Thus, the area of a circular conductor expressed in circular mils is equal to the square of the diameter in mils.

A few examples of wire sizes will be given:

Size B & S Gauge	Diam. Bare Wire in Inches	Diam. Bare Wire in Mils	Area in Circular Mils
14	.0641	64.1	4107
16	.0508	50.8	2583
18	.0403	40.3	1624
20	.0320	32.	1022
22	.0253	25.3	642.4

The current-carrying capacity of a wire is directly proportional to the area of the wire and it can be seen that a table showing the area in circular mils is a convenient unit for calculation. In designing coils for radio use, whether they are for audio frequency transformers, power transformers, choke coils, or loud speaker field windings, the engineer needs to have a basis of design to determine the size of wire necessary for the particular coil under consideration. The current going through these windings is generally pre-determined, and a basis of design is calculated in order to prevent overheating of the winding. For small choke coils as used in filter systems, and for audio frequency input and output transformers which do not carry excessive amounts of current, an allowance of about 700 circular mils per ampere is used as the basis of design. Thus, if the output transformer is to carry 35 milliamperes (.035 amperes) we find that the wire should have an area of 700 × .35, which gives us 24.5 circular mils. A reference to a wire table shows us that No. 36 B & S gauge will be satisfactory since it has an area of 25 circular mils.

Now, for larger power work, it becomes customary to express the current capacity of a wire in amperes per square inch. An engineer has occasion to refer to a conversion table for converting an area in circular mils to an area in square inches, but this table may not be available and geometry is an aid in showing this relation.

As an illustration, let us wish to express the area of No. 14 B & S gauge in square inches. We find from the table that it has an area of 4107 circular mils. The diameter of the wire is the square root of this value, expressed in inches is .0641, and we know from geometry that the area of a circle is equal to π times the square of its radius, which in this case is .03205 squared times π. This gives us .00324 square inches. Now the ratio of this area expressed in square inches to the area expressed in circular mils will give us the conversion factor of .0000007854. Thus, we find from geometry that in order to convert any area in circular mils to an area in square inches, it is only necessary to multiply the area in circular mils by the factor .0000007854.

VOLUMES—Proposition—Theorem

The volume of a rectangular solid is equal to the product of its three dimensions. This proposition is rendered evident by reference to Figure 1. We have represented there a rectangular solid divided into unit volumes, and by considering the number of unit volumes in each section, we see that there are 16 unit volumes in the first section, a like number in the second section, and since there are four similar sections it can be stated that the volume of this particular rectangular solid is the product of 16 and 4. Since the dimensions of the rectangular solid are respectively 4 × 4 × 4, we have as a general statement and theorem that the volume of a rectangular solid is equal to the product of its three dimensions, a × b × c.

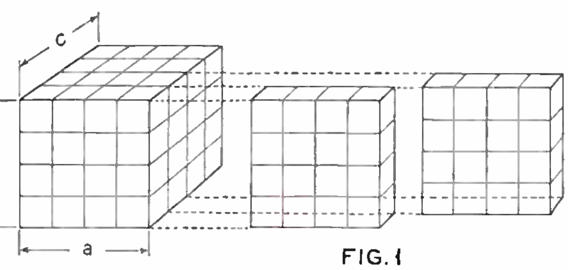


FIG. 1

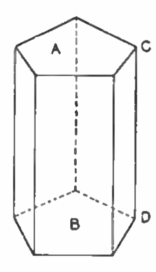


FIG. 2

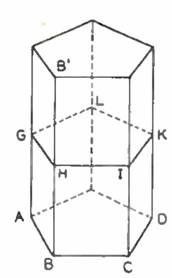


FIG. 3

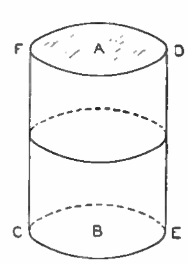
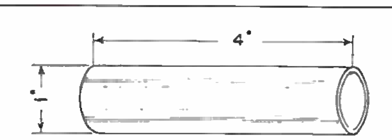


FIG. 4

Proposition—Theorem

The lateral area of a prism is equal to the product of a lateral edge by the perimeter of the right section.

NOTE: The explanation of this theorem and the one which follows is for the purpose of determining the surface areas of cylindrical coils. There are occasions, such as the design of loud speaker field coils, radio frequency transformer coils, and cylindrical resistors where the areas of the round surfaces are a factor in the determination of engineering requirements.



SURFACE AREA = 3.1416 X 4" = 12.65 SQ. IN.

FIG. 5

The proposition as stated above is not, in itself, (*Continued on page 237*)

Rome and London come in like locals

JUST AS CLEAR—JUST AS LOUD

SCOTT ALL·WAVE

A TRULY international receiver has been the desire of radio enthusiasts for years, and the hope of engineers since radio began. And what listener hasn't wished for a receiver that would bring him—not only the whole of North America—but the major stations on the other continents as well, and as easily? 1931 sees the perfected realization of all such dreams, in the new and genuinely excellent Scott ALL-WAVE Receiver.

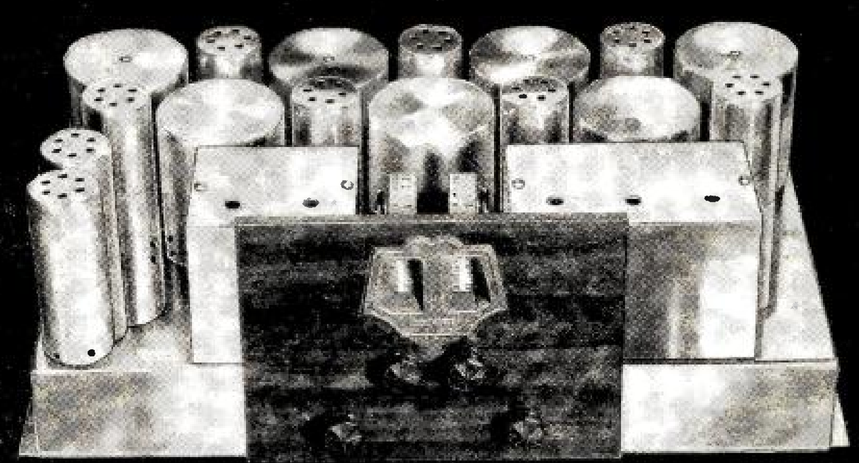
The new receiver tunes from 15 to 550 meters. Actually—without exaggeration—it brings in Rome, London and many other foreign stations below 200 meters, just as clearly and with the same volume as a local broadcast. Grand Opera—the *real* Grand Opera, comes in direct from Rome to afford Scott listeners the musical thrill of a lifetime. And Big Ben, tolling off the hours in the House of Parliament in London, sounds as though it were right over head. Such reception is a REGULAR, DAILY event in homes equipped with the new Scott All-Wave Receiver.

New Standards for Short Wave Reception

The performance of the Scott All-Wave below 200 meters is not to be confused with the unsatisfactory short wave reception of the past. There are no sharp edges—no irritating squawks—no mushiness or other disturbing receiver noises to take from the thrill of listening to the other side of the world. The short wave broadcasters unroll their music, voice and song thru the Scott All-Wave, with the same liquid smoothness as those within the 200-550 meter band.

Credit goes to new kind of Intermediate Amplifier

The truly amazing performance—the unlimited range—the actual 10 kilocycle selectivity—all are due to the new type intermediate frequency amplification employed in this receiver. Never before thought of—never before attempted—this system of amplification accomplishes exactly what superheterodyne engineers have sought to achieve, ever since the advent of this admittedly superior receiving circuit.



SUPERHETERODYNE

GIVES A NEW MEANING TO "TONE"

The tonal reproduction of the Scott All-Wave is equally as refreshing as its sensitivity and selectivity. From a whisper to concert volume, every note—every delicate shading is faithfully reproduced. The push-pull audio amplifier employed gives results impossible to otherwise obtain.

MAIL NOW

Scott Transformer Co. N-9
4450 Ravenswood Ave., Chicago
Send me full details of the new Scott All-Wave Superheterodyne. I am a Dealer ☐ Set Builder ☐ Service Man ☐ Radio Fan ☐

Name....................................

Street....................................

Town.......................*State*..........

5-YEAR GUARANTEE

To simply say that we believe the new Scott All-Wave to be the finest receiver ever built, does not suffice to express our confidence in the engineering and quality construction that makes Scott performance possible. So—we guarantee each Scott All-Wave for five years and agree to replace any part—free of charge—that fails to give perfect service within that time.

Make the SCOTT ALL-WAVE Prove Itself to You

Decide right now to have the ultimate in radio. Plug the new Scott All-Wave into a base board socket in your own home. Tune in Rome—tune in London—tune in Chelmsford—listen to Sydney, Australia—to Buenos Aires—to Bogota, Colombia—enjoy short wave foreign stations to your heart's content. Then step thru the broadcast band for the domestic stations. You'll find them all on dial, and all with far more volume than you can ever use. The price of the new Scott All-Wave is amazingly low. Write for full particulars at once.

SCOTT TRANSFORMER CO.

4450 Ravenswood Avenue ~ Chicago, Illinois

"Sparks" Sails the Seven Seas

(*Continued from page 186*)

The next reminder I had of the Stefanson Expedition, strange to say, was in Hongkong, China, some years later, when I bumped into Billy Nemens, of the schooner "Mary Saxe," which was broken up in the pack-ice in the early part of the expedition, from which disaster Billy told me he had escaped with the aid of a dog team which finally hauled him down to Nome. After wintering there he came out in the spring and returned to the States, later becoming a navigating officer on one of the trans-Pacific liners, which accounted for his presence behind a gin-fizz in the Hongkong bar at the time of our meeting.

Well, after my trip to the Arctic, I tried California again and with better luck, for I managed to get a run south to Mexico, around the Gulf of California, to Guaymas, Topolobampo, San Blas, Los Mochis, and a few other little villages amongst the cactus. There was very little excitement during the trip, most of my time being spent sun bathing on the deck of our palatial steam schooner, one of the one-legged type, so well known in the earlier days of the western coast. However, we were just in time for a little amusement by the way of a general rough and tumble with a small band of Yaqui Indians. We had traveled on to Los Mochis from Topolobampo about twenty-five miles distant and scarcely entered the little broken down Spanish hotel when we were raided by a band of rebels, who kept us going hot and heavy for a considerable time. However, we finally managed to persuade them that their old hunting grounds were the safest, and once again peace reigned. Quite a number of the boys received pretty bad wounds, but were taken care of as well as possible and soon we were having a sociable mezcal (cactus whisky) and cigar together on the old hotel veranda, or at least the part of it which was left after the shindy.

Our Money Is "Falso"

From Los Mochis I traveled in company of two other of the boys to Guaymas, and everything went well until we decided to spend some money, for on tendering same we were marched off to police headquarters, where the chief, clad in half a shirt and about four and a half acres of sombrero, went through our pockets, took out all the bills, smoothed them all out very carefully and smilingly stamped "falso" on them. This little mark of falsity made us broke to the wide world, and had it not been that an American ship had just floated into Guaymas, we should have been in a sad plight. We discovered that we had omitted to remember that Mexico's national sport was revolution, and therefore also omitted to notice that Topolobampo, from whence we had traveled, was in the hands of Villa, whilst Guaymas was a town of the Carranzistas, and with all Villa money in our possession, you see the reason of our downfall.

Mexico was all very well, but with a bunch of Yaquis about, who were not content to merely shoot one, but whose great delight was to carve one up like any other joint of meat, decided in my mind that there were much healthier places in the world, so San Francisco soon found me putting up a few persuasive arguments with the wireless chief and soon again I was on my way, this time fitted out with a brand new tropical rig and bound for the Hawaiian Islands, "The Gem of the Pacific." Here I spent a very busy and exceptionally interesting time in connection with a high-power station for trans-Pacific transmission and reception, which was being built on the crater of an extinct volcano.

A Philippine home. One room, subdivided, sun-proof thatch and hula-hula finish. Pigs and chickens in the basement

There were lots of hot days, but some glorious nights, and some of my happiest times were spent on the beautiful Waikiki Beach, with moonlight surf-riding parties and motor drives around the whole island of Oahu, on whose shores Honolulu is located. But it seemed that I was doomed to be a wanderer, for I was just getting thoroughly used to the climate when a cable from the States requested my presence there and I was soon waving a sad hand to dear old Honolulu shores. I had to go to Seattle again almost directly from San Francisco, and on my arrival there I was just about to jump into a taxi, when a sweet little voice balanced by about nine small whiskers on each side, said: "Hello, old chappie; how the bloomin' blazes did you jolly well get here?" and on turning round, lo and behold, was a young fellow whom I had known in London, England, who had apparently grabbed off a spare admiral's job, judging by the amount of gold braid he was wearing, but I afterwards discovered he was merely a wireless hofficer on a Hinglish linah, don't yer know! I certainly had a great surprise when I found who this chap was, and to tell the truth, I hardly knew at first whether to kiss him or kill him, he looked so nice. However, I merely gave him the "glad" and allowed him to buy me a cocktail. (Yes, them was the good old days, them was.) Well, this little fellow was Bertie from London, and he very quickly conceived the idea that it would be nice for an old friend of the family, as I happened to be, to travel with him to China, whence he was next bound, so being somewhat fed up with the jumping around that I had had with my old firm, I decided to quit and take this opportunity of getting a trip to the Orient, and after interviewing the steamship agents, all matters were arranged and in about ten days I was under way for the Far East as second operator under the charge of dear Bertie.

The voyage was a very successful one across the Pacific, but Bertie kept me busy threatening his life in reply to his repeated onslaughts of authority. He had never worn gold braid before, and it was the funniest thing in the world to watch his airs and graces around the decks, and most of us used many superfluous "sirs" to dear Bertie just to see how he would fall for it, but he did not see through our distinct politeness and respectful courtesies until we persuaded the skipper to "sir" him, and finally he came to earth most disgustedly, after which he spent most of his leisure hours in a quiet corner of the deck with a small lemonade and a volume on the Chinese dialects.

We sighted Nojima Light, the first guiding star to mariners bound up the channel to Yokohama, in whose harbor we were soon anchored, and which incidentally presented one of the world's most magnificent sights, for it was cherry blossom season, and everywhere was one huge mass of blossom, towering above which were the many quaint Japanese temples. They presented a most entrancing sight with a very fitting background in the stateliness of old Fujiyama, the snow-capped mountain which signifies Nature's enormous monument to the religion of the people around her base, and putting an exquisite finishing touch to the scene.

I spent much time taking in the sights, including a visit to Kamakura and Tokio, and landing back in the European club in Yokohama only to be greeted with a "Shanghai swindle," which means you're stuck for drinks for the crowd.

Man-Eating Savages

In about a week we were bound for Hongkong by the way of other Japanese ports, viz: Shimidzu, Yokkaichi, Kobe, Moji, Kutchinutzu and Nagasaki, also including a short stay at Keelung, Formosa, on the island of Taiwan, where the man-eating savages are still in existence. The boatmen here have huge eyes painted or carved on the front of their little craft, in order that they may see their way, and, strange to say, they will not venture out without these eyes. Finally we arrived at

(*Continued on page 234*)

Building a Radiovisor

(*Continued from page 209*)

smooth surface facing the looker-in. Place the shield over the lamp, with window or opening aligned with plate of lamp. Align screw holes of shield with those of lamp socket member, insert screws and tighten. The lamp house is now complete.

Figure 5 shows the components of the scanning disc assembly, consisting of the scanning disc, rotor, copper hub flange and screws.

To assemble the sixty line scanning disc, hold the black disc in the left hand with the side of the disc facing the assembler which shows the spiral of tiny holes running clock-wise towards the center. Place copper hub flange at the back of disc, aligning its holes with those in the back of the disc. Drive home screws. Place rotor on side facing the assembler, align holes with those on center of disc and insert flat headed screws in rotor, through disc and copper hub flange, slipping nuts on rear side and drawing up tightly. The sixty line disc assembly is now complete.

The components of the motor controls can be clearly seen in Figure 6. These consist of rheostat, fixed condenser and the screws to hold the latter in place. These parts are mounted on the under side of the platform or base. A small toggle switch, such as is employed for the usual socket power radio set, is desirable but not essential for the starting and stopping of the motor. Mount the condenser on the under side of the platform, under the wood block adjacent to the bakelite panel, screwing the condenser to the left-hand upright board. The rheostat is mounted in the 13/32 inch hole on the right side as viewed from the front of the panel. The switch, if employed, is mounted in the 9 16 or middle hole intended for that purpose.

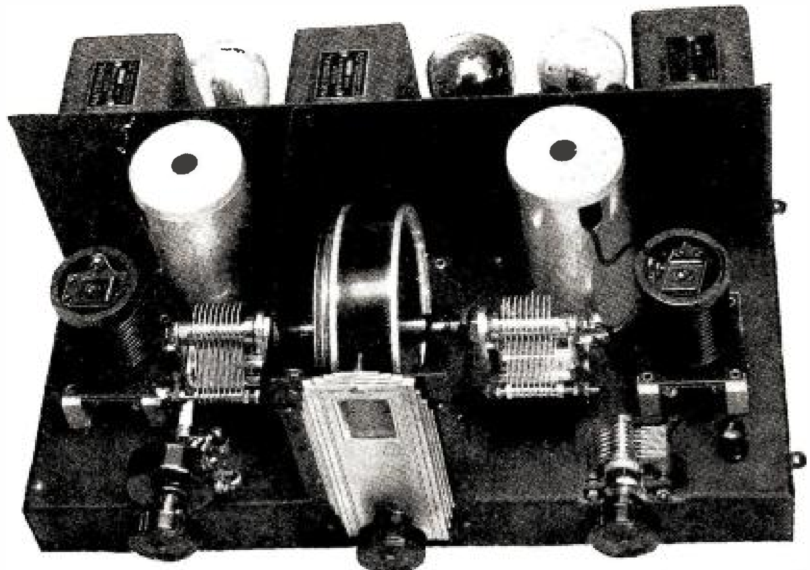
Mounting the Components

The major components of the radiovisor have now been assembled and are ready for mounting on the platform. First the front bracket is mounted, with the rounded end of the scanning disc shaft facing the front or panel end of the platform. It will be noted that small holes already drilled in the platform precisely align with the three small holes in the bracket base, while the large-hole aligns with the larger hole in the platform for the passing through of certain wires.

Next, the scanning disc is mounted on the shaft protruding from the rear of the front bracket. The rotor spacer is slipped over the square end of the shaft and pushed back against the ball bearing. Then the scanning disc is slipped over the shaft and pushed back against the spacer, after which the set screw in the rotor is tightened.

The rear bracket is now placed on the platform and so positioned that its holes align with the holes already drilled in the platform. The pole pieces and rotor guard should now surround the motor. The screws are driven home through the

(*Continued on page 235*)



"Sparks" Sails the Seven Seas

(Continued from page 232)

Hongkong, the big city of the Orient, and which appeared more like a musical comedy stage at first sight, in view of the fact that there's an exceptionally varied array of uniforms here—Chinese, Hindoo, English soldiers and sailors, American sailors, and the Portuguese naval men from their Canton River settlement, Maco. So one can easily imagine Hongkong on a sunny day, with all the boys on leave. There is much to be said about this wonderful city of the Far East, but space will not permit, so I will carry on by telling you that, with all the interest I found there, coupled with a new Oriental cocktail and a Chinese boy to fan me all day for a quarter, I decided to stay a while.

Hongkong and High Life

My luck was again in here, for it happened that a wireless man was wanted to equip a number of British ships, so I became a resident of Hongkong and had the time of my life for about six months, but all good things come to an end, and once again I plowed the peaceful Pacific and soon found myself an inmate of one of San Francisco's hotels.

So far, so good with my travels as a wireless life has led me, but it has just occurred to me that I am merely endeavoring to write an interesting article for radio and travel fans, and to carry on with the full and interesting account of all that has befallen me during my wanderings would take very considerably more space than might be permissible, and therefore I deem it necessary to jump part of my map by saying that, after the sojourn in China, I later was there again visiting the old haunts in Hongkong, also adding to my trip, Shanghai, the "Paris of the Orient," Canton, Macao, Tsingtau, Woosung, and several of the smaller unimportant settlements of the Yangtse River.

Apart from my Oriental wanderings, I was later afforded the opportunity, through construction, operating and equipping work, to visit Nicaragua, Panama, Peru, Chili, Brazil, Cuba, South Sea Islands, Manchuria, Siberia, Ceylon, Straits Settlements, and also made business trips across both the United States and Canada.

Then one fine day I was reminded there was a war on in Europe—I was in New York at this time. It was 1915, and the reminder came from an old traveling acquaintance, a veterinary surgeon, who was taking horses across the Atlantic for the French army, and it took very little time to decide that I also was a veterinary surgeon and get an assistant's job aboard, all of which seems very simple and comfortable, but believe me, friends, I couldn't look a horse in the face for months and months after. They worried me so much, I simply had to get a different slant on life, so I journeyed to London, after unloading the horses at Brest, and joined the Royal Naval Air Service, where I very soon found myself tapping away at wireless up in a dirigible. Later I was transferred to aeroplanes for signaling purposes, for they needed operators badly, so I buzzed away in the air with the rest of the busy bees.

About a couple of years later, I decided it a better proposition to take a chance of breaking my own neck by becoming a pilot, rather than staying with the wireless and allowing the rattle of the magnetos in the headphones to send me to the "nut-house," or waiting for another pilot to make a bum move at the expense of my good health. I've handled both planes and dirigibles and haven't yet decided which is the best or worst. The first takes such queer notions so suddenly that it keeps one generally dizzy, whilst the latter stays in the air so long it's more like a starving proposition, and I hadn't even got my mother-in-law to throw out by way of amusement.

Well, so I had got into the war—oh, boy, some war! Got terribly wounded first week, broke four teeth trying to get ahead of a piece of hardtack—and then came the great struggle, but there, who the blazes wants to know about that? It's all over now, and besides, I guess there must have been at least two other fellows in the war besides me, so maybe they will tell you all about it. All I know is that I was in the Naval Air Service, the Royal Flying Corps, the Royal Air Force, was with the Canadians, the South Africans, the Australians, the English—was a private, a corporal, a mechanic, a petty officer, a sergeant, sergeant-major, a second loot and first loot, also a jailbird for three weeks, the latter position being attained through the process of hitting a naughty little second loot with three whiskers each side of his kissable little mouth, which annoyed me. Yes, I did fly every way—up, down, down right, down wrong, landed in the sea, in the fields, on top of buildings, in a mess and in the hospital. So you see my army life was much the same as my civilian career of ever-changing chapters, and after another trip across the Atlantic and a quiet two months in Winnipeg hospital I decided war was no place for me, and I said to myself, "Go West, young man, go West," and I whistled again and hiked.

Back to Hawaii

Once again I breathed the glorious air of California and as soon as I was on walking terms with my legs, after their refusal to operate in Winnipeg, I looked up some of my old acquaintances, only to find that the first five I inquired about had made their final dash "over the top," never to return to California again. They were some of that "old gang of mine" and this naturally somewhat sickened me, and not feeling too good myself, I decided that an easy job on a cargo ship would do me some good, so I very soon found myself sun bathing again on deck and after an excellent ten-day trip I was again in the soothing atmosphere of the sub-tropical climate of Hawaii, where I came in contact with one of the old gang from the western coast, now a naval officer on communications. He gave me an excellent time for the month we stayed in Honolulu, after which I traveled to Central America, Panama and the West Indies, and soon on to New York, from whence I again re-shipped for Northern Africa, including Algeria, Tunis, Egypt, Syria, Palestine, Turkey, France, Germany, Holland and later on to Ceylon, Singapore and the Philippines.

My trip finally finished in New York, to which headquarters I had been transferred from the Pacific division, and strolling along old Broadway I bumped into another old friend, strangely enough to say, the one who sent me out on the fishing boat many years before from Seattle, and he being in a position to offer me a good proposition, our meeting resulted in a shorter sojourn in New York than I had originally figured upon, for I soon was bidding farewell to "Lil' ole Noo Yoik," bound for London, England, as European manager to the firm.

Radio's Wanderlust

Whilst I was in Europe, conditions changed and I later became a manufacturer of radio apparatus, but to the detriment of my bank roll, with the result that another job had to be secured, and this necessity found me putting in a winter picking up wrecks along the English Channel and far out into the Atlantic, which was all very well for one winter, but one winter was quite enough, so I packed once again, and well, here I am back again on the right side of the Atlantic, finally, doomed to become a landlubber, for "radio in the home" found me a merchandiser in its midst—then a publisher requested my presence as a radio editor, and just for spite I'm taking it out on you.

I'm still on the right side of forty—at times I still falter in my "landlubber's" career—who knows—who cares?—maybe I'm slated to be "just a wanderer"—the radio wanderlust is in my system; perhaps I shall again swing with the tide. At times I can hear the clanging of the bridge telegraphs, voices of the captain and mates bellowing their orders—"cast off the lines there," "Full astern," "Hard a-starboard," "Full ahead," and then silence as the engines thud rhythmically and "The Road to Mandalay" rings in my ears.

Your Vacuum Tubes

(Continued from page 197)

electrons travel at hundreds of miles per second variations in grid voltages take instantaneous effect upon the plate current.

Depending on the relationship and structure of the elements in the tube, a change of one volt of electric pressure on the grid may effect the plate current as

(Continued on page 242)

Building a Radiovisor

(*Continued from page 233*)

bracket base into the wooden platform. The scanning disc should be twirled to make certain that it turns free and that the rotor does not rub against the coils or the core of the rear magnet. About 3/16 inch is the proper distance between the front of the scanning disc assembly and the ends of the front magnet. The rear magnet core and back of scanning disc are about 3/16 inch apart.

The lamp housing shown in Figure 7 is mounted on the rear bracket by inserting the long pin of the lamp socket in the hole in the center post. The pin or protruding portion of the lamp socket permits raising or lowering of the lamp, or turning it from side to side, in order to frame the picture.

The magnifying lens assembly, as shown on the finished radiovisor, does not come with the kit but can be purchased separately and easily put on the front of the radiovisor by placing the lens in its holder and screwing the assembly onto the front of the radiovisor.

The wiring of the radiovisor is very simple, provided the wiring diagram which accompanies the kit is followed precisely. The leads have been colored for convenient identification.

Operation

The wiring completed, the radiovisor is ready for attachment to the shortwave receiver, described last month.

This accomplished, connect the shortwave receiver to a speaker in order to facilitate the tuning of the television signal, which may be audibly recognized by the steady pitched buzz of the television transmitter. When the signal has been tuned into maximum volume and clarity it may be transferred to the radiovisor. The neon lamp should glow when it is connected to the output stage of the receiver. The motor is turned on, and as the scanning disc gains speed the image will appear. The scanner is kept at the proper speed by means of the rheostat and snapping the switch off and on several times, while the picture is framed by moving the lamp housing vertically or turning it horizontally.

Synchronization is the most important term in the adjusting of the radiovisor. The images as viewed may lean to the left or right, depending on the scanning disc gaining on the transmitted image, or falling behind. To get the disc in perfect synchronization with the transmitted image, the speed control rheostat should be turned to the left or the right until the desired effect is obtained. It is possible to hasten the synchronization by pressing lightly on the protruding scanning disc shaft at just the right time and place. A little experimenting with the controls of the radiovisor, and the operator will get the knack. The self synchronized radiovisors with shadow boxes will be discussed in a future article in RADIO NEWS.

The experimenter is not "telewise" until he understands the operation of his set. If the set does not work properly

(*Continued on page 241*)

Seven Rules for Radio Appreciation

against radio listening is the habit of operating receivers too loud. Some of the faults thus introduced are due to the apparatus itself, such as the various kinds of electric distortion which overloading may create. Still more serious faults exist, however, in the room. Too great loudness of radio music means, for example, too much reverberation in the room and usually some distortion by this reverberation, for the musical sounds of different pitches are not reflected by ordinary walls in the same manner or to the same degree.

Other faults of too great loudness originate in the ear. Low tones, for example, have a remarkable ability to "mask" or conceal higher tones, especially the higher harmonics upon which so much of the quality of music depends. Accordingly, if the average radio receiver is played too loud the result is a mushy condition of everything that is heard so that the perfection of musical reproduction vanishes almost completely.

Behavior of Sound Waves

The behavior of sound waves under any individual set of circumstances depends so largely upon accidental differences of walls, furniture, room shape and the like, that it is impossible, experts agree, to set down any rigid rule for the loudness which should be used or for the exact placement of the listener. What each radio owner must do for himself is to discover, by trial, just what is the best placement and the best loudness for his particular set and his particular room. The temptation will be always to operate the receiver too loud. Except when radio is used for dancing, there is no technical or esthetic use for operation loud enough to be heard more than very dimly in adjoining rooms.

The masking effect of one sound or another is the chief reason, also, for the rule requiring quiet in the room. A distinguished New York musician of much experience in radio broadcasting likes to tell the story of a friend of his who frequently entertains guests to listen to important radio programs. The guests being seated properly and apparently ready to listen, this gentleman sets the volume of the receiver at a relatively low point most suitable for good hearing. For a few moments, he reports, the members of the average party remain quiet and really listen. Presently someone thinks of something to say and makes a remark to his neighbor. Gradually conversation increases, presently it has become general. Meanwhile the host, seated where he can reach the volume control, has gradually increased the volume until it is so loud that all quality has been lost and everyone is seriously annoyed. After a time someone musters nerve to speak up whether the music is not too loud. The host then replies he thought the people wanted to listen and since conversation seemed to be desired also it was necessary to raise the radio volume until the conversation was drowned out.

(*Continued from page* 189)

The moral is that conversation then ceases in that particular party for good, until the radio program is over; something which should be the universal rule. People who attend concerts or theatrical performances and insist on conversing the while usually are put out. The same should be true of radio listening. Conversation and listening to the radio are acoustic incompatibles, just as sure to fight with each other as fire and water. The chief requirements for perfect radio listening probably involve, however, the mysterious matter which psychologists call illusion. Theatrical performances fail or succeed, books are flops or best sellers, public speakers are negligible or impressive, all because of their varying abilities to create this element of illusion. Any distraction, it is probable, helps to interfere with this, and this is particularly true of a distraction which runs counter, in some manner, to the impression in which the play or book or radio program is endeavoring to create.

A remarkable instance of this kind has developed in connection with the attempt to use radio music on railway trains. French psychologists, observing some months ago the results of train radio, came to the conclusion that programs usually were not impressive or pleasing on the railway train, not so much because of general distraction or miscellaneous noise as because the rhythm of the radio music was not likely to correspond exactly with the rhythm of the car wheels clicking over the rails. Everyone remembers Mark Twain's famous verses fitted to the rhythm of this wheel click. Listening to this and to a radio program at the same time, the passenger is likely, the psychologists report, to be receiving two markedly different rhythms. Apparently this is something which the mind does not enjoy even if it is tolerated.

Avoid Interruptions

Precisely how these psychological facts are to be applied to home listening is a complicated matter. Probably the only rule which can be set down at present is that any interruption is to be avoided so far as possible, for precisely the same reasons that theatres and concert managers endeavor to avoid interruption of their audiences. Perhaps the most common of radio interruptions is the habit of the person operating the set to get up every few minutes and alter some adjustment. For proper listening this, at all costs, should be avoided.

It is claimed by experienced musicians, also, that the present habit of many broadcasting stations of interspersing long station announcements or advertising material between parts of a program is constituting perhaps the most serious single disturbance with the illusion of the program and with the pleasure of the listener. This problem of how to do successful radio advertising without annoying the listeners (which annoyance would be, of course, the greatest possible sign of ill success) constitutes, however, too complicated and uncertain a matter to be discussed here in a paragraph.

One hint concerning the effective creation of illusion by radio programs is the psychology of familiarity.

Some months ago Mr. H. W. Larson of the General Radio Company made some interesting experiments on children. He read to the children various fairy stories and similar literary productions, some new, others old and familiar. Meanwhile, by a simple amplifying equipment, he counted the rates of heart-beat of his child auditors. Old and familiar stories, he found, quickened the heart-beat more than new ones; something which is a general psychological law and which explains why it is that more pleasure and greater illusion will be created, on the average, by old and familiar songs and stories than by ones of novelty or strangeness.

Psychology of Color

One set of facts undoubtedly of great influence on the creation of illusion by radio or otherwise are still but little known. These are the facts about the psychology of color. It has been urged and it may be true that the color of light and walls in a concert hall or a room for radio listening should be green. The theory is that mankind has been evolved amid green surroundings, the prevailing green of vegetation. Accordingly, it is argued, green-colored objects seem more natural to most people and create less mental disturbance than red or blue.

The theory is plausible, but psychologists have learned that plausibility is not the only thing to ask from theories of the operation of the human mind. All such ideas must be put to the experimental test of facts, and these tests, so far as color psychology is concerned, have not yet been made. It is quite probable, other investigations imply, that the mental reactions of human beings to different colors will be very different in different individuals. If so, a green room might be best for some listeners, a red room for others, which would mean that control of color psychology under ordinary circumstances is quite impracticable.

These same uncertainties apply, by the way, to the numerous methods which have been suggested for "playing colors" in such devices as "color organs" and the like. The underlying theory of these things is that the harmonics and effects of colors may be correlated somehow or other with harmonics or disharmonic effects of sounds. Possibly so, but much laborious psychological work must be done, the experts insist, before it can be assumed that any set of color changes will be effective as an adjunct to a set of musical sounds. It is very much more likely, all psychological theory indicates, that the effect of color is merely to weaken the illusion and the pleasure of the music alone.

Here belongs a mention, too, of the remarkable psychological phenomenon of

(*Continued on page* 237)

Mathematics in Radio

(*Continued from page 230*)

perfectly clear but a review of the definitions employed in solid geometry will clarify the meaning of the theorem.

Definitions

A prism consists of two faces of equal polygons in parallel planes, and the other faces are parallelograms. It will be recalled that a polygon is a plane bounded by straight lines. Thus, in Figure 2, we have a prism consisting of two equal polygons of faces A and B, and we see that the side surfaces are parallelograms. The equal polygons are called the bases of the prism, the parallelograms the lateral faces, and the edges are called the lateral edges. Thus, CD is one of the lateral edges.

The altitude of a prism is the perpendicular distance between the planes of its bases.

In considering Figure 3, let GHIKL be a right section of the prism. A right section of a prism is a section made by a plane perpendicular to the lateral edges of the prism. Now the lateral edges of the prism are equal since they are sides of a parallelogram and also GH, HI, IK, etc., are respectively perpendicular to their lateral edges. Therefore, the area of one of the lateral faces, say AB′ is equal to its base BB′ times its altitudes GH. In like manner, the areas of the other lateral faces are equal to their bases times their altitudes. It is seen that the sum of these altitudes is the perimeter of the right section, and that the sum of the areas of the lateral faces is the lateral area of the prism. We have, therefore, proven that the lateral area of a prism is equal to the product of a lateral edge by the perimeter of the right section.

Proposition—Theorem

The lateral area of a circular cylinder is equal to the product of the perimeter of a right section of the cylinder by an element.

A review of the definitions employed for cylinders will be of interest here.

Definitions

A cylinder is a solid bounded by a cylindrical surface and two parallel plane surfaces. Referring to Figure 4, we have the cylinder CD with its two parallel bases A and B, and its cylindrical surface, called the lateral surface.

The altitude of a cylinder is the perpendicular distance between the planes of its bases.

A cylinder is a right cylinder if its elements, as DE, CF., etc., are perpendicular to its bases, and is a circular cylinder if its bases are circles.

A right section of a cylinder is a section made by a plane perpendicular to its elements.

In considering Figure 4, let S denote the lateral area, P the perimeter of a right section, and E the element of the cylinder CD. We can inscribe in the cylinder a prism with its base a regular polygon, with a lateral area, and having a right section of a certain perimeter. From the previous theorem, we know that the lateral area of this inscribed prism is equal to the product of its lateral edge by the perimeter of its right section.

Now, if the number of the lateral faces of the inscribed prism is indefinitely increased, its lateral area will approach the lateral area of the cylinder as a limit, its perimeter of the right section will approach the perimeter of the right section of the cylinder as a limit, therefore, the lateral area of a circular cylinder is equal to the product of the perimeter of a right section of the cylinder by an element.

From this, it can be seen that the lateral area of a right cylinder will be the

(*Continued on page 253*)

Seven Rules for Radio Appreciation

(*Continued from page 236*)

"color hearing." About five per cent. of the public, it is found, possesses a greater or lesser degree of this power. To such individuals certain notes of the piano keyboard may sound blue, red, still others yellow or other tints. This is not a mere verbal metaphor. The notes in question actually produce in these sensitive individuals a mental sensation of the color concerned.

In a smaller percentage of persons tastes have color associations of the same kind. Unpleasant tastes, for example, usually create a color sensation of brown. Pleasant tastes are likely, it is found, to be green or yellow. One individual examined by the present writer reports, for example, that everything sour tastes green, that oily substances (which happen to be disliked by this person) taste brown, that pepper has a tinge of red, that milk, water and other relatively insipid substances taste blue and that gin invariably has a tinge of bright pink.

Undoubtedly these curious reactions are extreme examples of sense mixture in the brain. Often they may interfere, it is probable, with the perfect hearing of radio programs or other music. It is probable that all of us have some degree of similar powers, which may be harmful or considerably beneficial to our enjoyment of musical matters. If more were known about these curious color linkages in the mind, some of them might be played upon for actual increases of intellectual or esthetic enjoyment; something which may happen some day after physicists have studied these phenomena in detail.

Even without such matters, for which we must await the advance of psychological science, much can be done, there is no question, to increase the pleasure which the average listener can get from the best of the programs now broadcast; a best which is really very good indeed and probably as good a way as any to begin and to try out in your listening the closest approximation which is convenient to the seven rules printed above.

Practical S-W Super Design

(*Continued from page 203*)

when one is very much interested in pulling in an extremely weak signal.

If one wishes to raise the sensitivity of this set still more, the 100,000-ohm cathode resistor of the second detector can be changed to fifty or even twenty-five thousand ohms.

Also note that the second and third i.f. tubes have an upwardly graded negative control grid bias, in line with latest recommendations of Ballantine.

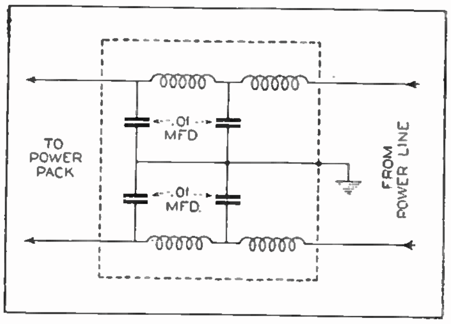


Figure 13. A line filter recommended for connection between power line and power pack to keep down noise

A small two-point switch (not shown in the circuit design) connects the antenna either to the band selector or to the extra winding on the coil of the first detector. When first calibrating the set, connect antenna to that coil of the first detector and inasmuch as this detector will then tune very broadly you can easily pick up stations using the dials of the first detector only with that of the oscillator. When you have stations spotted in this manner, then shift antenna back to band stage and it will be easy to find the first two dial settings. Thus you use the set normally as a two-dial set, but if you have interference, just shift over antenna and tune the first two dials and the interference will be no more. The first dial will then tune quite broadly, the second very sharp, the third slightly broad and the oscillator or fourth will tune right to a razor edge.

No attempt has been made to give detailed dimensions of all parts of this receiver, as it is believed that anyone who may build this set will probably wish to incorporate some ideas of his own in the actual construction.

It was found after this receiver was finished that the tube shields could be removed without causing the set to break into oscillation. However, this would leave the receiver open to pick up a lot of interference directly through the grids of all the radio-frequency tubes. So leave the shields on. Any short-wave receiver of high gain is always very susceptible and sensitive to interference caused by any "sparking" contacts in the immediate vicinity of the receiver whether the sparks originate in defective timer systems of automobiles or of lamp-socket switches being turned on and off in the lighting system near by.

In all a.c.-operated short-wave receivers, the last-mentioned interference will tend to find its way into the receiver through the power pack even though the power transformer has a grounded electrostatic shield between the primary and the secondary. In extreme cases of this sort it is necessary to shield the leads going from the power pack to the receiver, ground the shield of the power pack and install a shielded power line filter in the line before it enters the power pack. Figure 13 shows such a filter. The four chokes are made by winding one hundred turns of No. 12 double-cotton-covered copper wire on one-inch diameter fiber rods. The condensers must be the mica by-pass type to be absolutely safe in the power line.

For those who may wish maximum micrometer adjustment for close tuning in the oscillator circuit, I have found the following stunt to be very effective. It is not contained in this receiver but is easy to install if desired. Mount a small coil socket in the shield can near the oscillator coil. Place in this socket a coil similar to the oscillator coil. Connect a midget condenser of good quality across the terminals of this extra coil, and arrange to have the knob of this small condenser on the front panel. After one has tuned in a signal that has very close interference, then adjust the midget condenser for least interference. This condenser coil combination is just like an absorption wavemeter, as it is inductively coupled to the main oscillating coil. The effect is double. It can cause the oscillator frequency to shift slightly as well as "sharpen up" the oscillator frequency.

Finally, this receiver can have the condensers ganged if you want to go to a little extra work. The problem is really simple if you only want to cover say a 1500 kc. band. Small trimmer condensers can be installed in each of the four va-

(*Continued on page 239*)

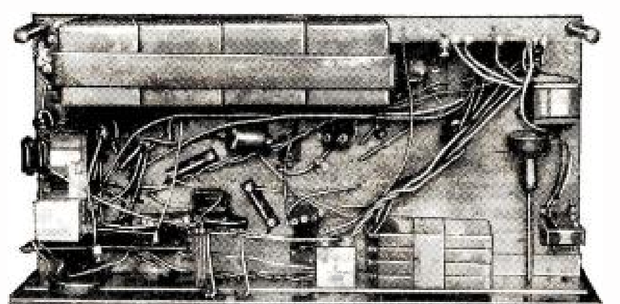


Figure 8
The bottom view with the i.f. shields in place held fast by a metal strap

Backstage in Broadcasting

(*Continued from page 225*)

for spot-news broadcasts. He explains that the carbon microphone is more easily carried about than the heavy condenser type and that results from outdoor pick-ups were quite good. Herb also tells us of a novel pick-up idea he used during the Kentucky Derby broadcast. It seems that the CBS engineers desired to pick-up some crowd noise and cheers as a colorful background for the word description of the turf classic. Microphones were placed in the grandstand, but the crowd was unusually quiet and cheers were lacking. But Herb was prepared for this situation through his experience of the previous year. Additional microphones were "planted" in the section of the track reserved for Negroes and the plentiful noise and cheers from this point served as adequate background.

BACKSTAGE in broadcasting, there is a huge army of radio experts whose names rarely reach the ears of listeners. These radio men go about their duties quietly and efficiently and, although their names are never mentioned over the air, it is their efforts that make it possible for programs to be broadcast.

O. B. Hanson

In consideration of the responsible and important roles these men inaudibly play in the field of broadcasting, this department will present brief biographical and personality sketches of engineers, program directors, studio managers and others who constantly strive to better the standards of radio programs. The first subject of this group is O. B. Hanson, NBC manager of plant operation and engineering.

Hanson was born in Huddersfield, England, thirty-seven years ago and arrived in the United States at the age of one year, when his family settled in Broad Brook, Connecticut. But Hanson spent only seven years on these shores before he was sent back to England to study for eight years at the Royal Masonic Institute at Bushey, Hertfordshire. Back in America at the age of sixteen, he was forced to give up his idea of becoming an architect by the death of his father. He worked for a typewriter company at Hartford and took a night course in drafting, electricity and automotive engineering. He also served as relief operator in several Hartford movie houses. The Titanic disaster in 1912 brought radio to his serious attention and resulted in his joining amateur circles, building his own equipment and operating an amateur station. He attended the Marconi school in New York, obtained a commercial license and shipped on the "S. S. Stephano," later transferring to the "S. S. Bermudian." He returned to the "Stephano" in 1916 as chief radio operator and was on the ship when it was torpedoed by a German submarine off Nantucket Light in October of that year. Two years later, Hanson joined the Marconi Company at Aldene, New Jersey, where he worked for four years in the testing department. He was promoted to chief testing engineer and a short time later joined WAAM, Newark, where he installed the transmitter and developed programs. He joined the staff of WEAF in 1922 and was put in charge of field operations. When the NBC was formed in 1926 and WEAF was transferred from the American Telephone and Telegraph Company, Hanson was promoted to his present position which has greatly increased in importance as the network grew.

THE trend of broadcasting the past few years has tended to minimize the importance of announcers' roles on programs. Once the announcer had to talk extemporaneously. He had to be creative. Announcing was more than a job—it was an art. Today, announcers are merely vocal instruments for the presentation of prepared manuscripts. An announcer's performance no longer reflects his personality. It is true that some announcers can *read* manuscripts better than others—but the old spirit and thrill of *announcing* has almost completely passed into oblivion. With the exception of sporting events and other spot-news broadcasts, there is little on the air today that reminds listeners of the older days when announcers had to *talk* instead of *read*.

Recently we visited Ted Husing, Columbia's star announcer, when he was engaged in a spot-news broadcast at a flying field in New York. Here again was the color of old-time announcing. Ted had no manuscript. He had to create his own expressions—and create them fast. He had to make the most of every situation. When the flying exhibition reached a dull spot, Ted had to continue with live conversation to hold the interest of listeners. Why must this type of *creative* announcing be reserved for spot-news events? If program directors inject the idea into studio programs, air presentations will not only be more interesting but announcers will climb out of the stereotype class into which they have unfortunately fallen.

S-W Super Design

(*Continued from page 238*)

riable condenser cans to bring the four condensers into line.

However, one-dial control is not worth while at this stage of the advancement of the art, and personally I prefer the separate control.

Today, as I "sign off" this story, I have just finished listening for one full hour to "Radio Roma" with W8XK's powerful wave ½ degree away and no interference. This was the program in which Mussolini spoke to America.

The Schoolmaster's Radio Voice

(*Continued from page* 195)

student and teacher," Dr. Goldsmith remarked, "either through the spoken or written word, or through the picture or graphic symbol, education in the organized sense would be well-nigh inconceivable. It is true that in the broadest sense life itself is education and that those things which happen to each of us in the course of our mundane travail are informative and potentially available to build up both knowledge and wisdom. But organized education—the education of schools, colleges and universities—of necessity depends upon the creation of experiences and the display of information in a systematic and interesting fashion."

Dr. Goldsmith stated that engineers who produce the communications equipment cannot do much more for educators, who must work out their problems for themselves.

Educators Must Study Field

"In all seriousness," Dr. Goldsmith said, "the warning note may be sounded that unless and until educators, after a careful study of the possibilities of various forms of communication, decide how to apply them to educational uses, they will not be successfully so applied. Educators must work out their own salvation in these new fields, utilizing the tools which have become available and determining for themselves the specific educational capabilities of these devices."

Sir John C. W. Reith, in addressing the Council, again warned of the labeling of programs as "educational."

"The attachment of the adjective 'educational' to any matter is apt to weigh heavily against its acceptance," he said. "People object to any open proposal to educate them. A pontifical attitude, or still more the suspicion in ordinary people's mind that it exists, is perhaps the greatest danger that radio education has to face. It is no normal indifference that has to be overcome, but definite aversion in those very educable elements that you wish to reach."

"Pseudo-Science" Attacked

The presentation of "pseudo-scientific" programs over the air was attacked by Watson Davis, managing editor of *Science Service.* He severely criticized the broadcasting of astrology lectures.

Henry A. Bellows, vice-president of the Columbia Broadcasting System, representing the National Association of Broadcasters before the assembly, asserted that educational institutions will not use time on the air given them.

"Most stations have more unsold time on their hands than they know what to do with," Mr. Bellows said. "They offer to turn it over, without charge, to educational institutions in the generally vain hope that they will make sensible use of it. I have no hesitation in saying that the state universities could have, without cost to them, five times as many hours on commercial broadcasting stations as they are now using, and win the undying gratitude of the broadcasters to boot, if only they were equipped to put on reasonably interesting programs.

"As for the public schools, most broadcasting stations periodically beg the school authorities to make use of their facilities in vain. Even our regional governing bodies, garrulous as they normally are, turn suddenly shy when it comes to making use of free radio time."

Education vs. Instruction

When interviewed by the writer, John W. Elwood, vice-president of the National Broadcasting Company, was of the same opinion as Dr. Goldsmith and Mr. Bellows on the point that educators must themselves be educated in how to properly use the medium of radio.

"Education vastly differs from instruction," Mr. Elwood said. "Education should make listeners do reading and work of their own accord rather than simply follow the study requirements outlined by a teacher."

Mr. Elwood pointed out that education is a municipal, state and national subject and each angle offers a different viewpoint. For this reason, he said, local educational broadcasts to suit the known needs of a locality may be better applied than national network presentations. He also mentioned the rarity of acceptable educational material for the radio supplied by educational institutions and associations.

A New Medium

"When educational groups approached us," Mr. Elwood said, "and asked that we present educational series, we requested them to bring us programs that would meet approval. If they did so, we promised to give them time and facilities to go on the air. That promise still holds good.

"The reason there is no great number of educational programs on the air is that no educator or group of educators has made a sufficient study of the work to warrant their network educational programs.

"Here we have the oldest profession—teaching—and the newest communication means—radio—in an attempted alliance. There must be a closer study of each other before they are joined.

"There has been a great cry about education not getting enough time on the air—but it's just a cry. From what I've observed, educators know nothing about radio and don't know how to use it. They must learn to design programs from the standpoint of the medium itself, because radio instruction is vastly different from classroom instruction. One must be educated in the use of radio before being educated by it."

Mr. Elwood said another problem was presented by the fact that teachers, underpaid as the matter stands, have no additional time to give to radio. Mr. Elwood emphasized his statement that the

(*Continued on page* 241)

The Schoolmaster's Radio Voice

(*Continued from page 240*)

NBC stands ready to give time on the air and full co-operation to educators who can design satisfactory programs.

Edwin P. Alderman, president of the University of Virginia, who is chairman of the NBC advisory council educational committee, stated in his annual report:

"Radio, of course, must keep in mind its limitations as well as its potentialities. The school and the classroom, as we have known them, will never be supplanted, but may well be enriched and amplified. Radio should attempt to teach nothing that can be better taught in the classrooms. Where radio gives what can be received in no other way—the great orchestras, the great events. the great teachers of the world, it will be most successful."

Educational Programs

The NBC has offered, over a long period, educational programs of its own creation and sponsorship. Printed schedules of these presentations have been distributed to educational groups. The Walter Damrosch series of musical appreciation periods has perhaps the widest scholastic co-operation of any NBC feature. This series will be resumed in the fall.

The Columbia Broadcasting System. which last spring completed the second season of the "American School of the Air" programs. reported that a surprisingly large response was obtained from adult listeners. The series chiefly consisted of music and dramatizations.

Frederic A. Willis, educational director of the CBS, commenting on the series, said:

"There is little doubt that the standard of public appreciation for fine programs is increasing rapidly, if one can accurately judge the value of education by radio and the interest shown in it by the American public from the thousands of requests we have received for the continuation of these programs."

The Institute for Education by Radio which is sponsored by the Ohio State University and the Ohio State Department of Education has also done much to advance educational broadcasting.

School Equipment

Throughout the country schools have been equipped with centralized radio systems as well as standard receivers.

A survey of the work done to date and a digest of opinions of leaders in the fields of education and broadcasting reveals that much is yet to be accomplished before radio and education are closely joined.

Secretary Wilbur's Advisory Committee on Education by Radio lists the following as major problems:

1—Discovering what constitutes good presentation in teaching by radio.

2—Ascertaining the most favorable hours.

3—Determining the proper proportions of informational and esthetic material.

4—Obtaining listener reaction accurately.

5—Determining the effectiveness of formal radio instruction.

6—Ascertaining the value of radio talks as compared with correspondence courses. extra-mural lectures and other university extension activities, or as a supplement to them.

7—Deciding upon the advisability of getting college credit for radio courses.

Building a Radiovisor

(*Continued from page 235*)

the symptoms should be examined. For the benefit of the novice the following list of symptoms, diagnoses and cures is given:

Television lamp glows on reverse side. —Rubber-covered leads wrongly connected to receiver or power amplifier. Reverse the connection.

Television lamp fails to glow.—Insufficient output voltage. This symptom is not possible when the radiovisor is used in conjunction with the Jenkins Television Receiver.

Excessively bright screen. lacking in shadows.—An indication of excessive voltage applied to television lamp. A suitable high (variable) resistance should be placed in the plate circuit of the power tube or in series with the neon or television lamp.

Signals tuned in cannot be reproduced. —Off-standard signals are being picked up such as 45 or 48 line pictures. These cannot be reproduced on the standard scanning disc of sixty lines revolving at twenty complete frames per second. Forty-eight line discs may be secured for tuning in such stations as still transmit 48 line images. For the most part, a 60 line 20 frame per second picture is considered standard in television circles.

If the reader has followed the instructions given in this article and the one previously published in RADIO NEWS concerning the building of the shortwave television receiver, he has constructed a very good television receiving station. He may expect good images within a radius up to several hundred miles. depending on local reception conditions. with regularity. A number of enthusiasts report that they received regular images from the New York. Boston and Washington stations. Others have reported having seen these stations up to twelve and fifteen hundred miles. At the present time a number of new stations are waiting to be licensed by the Federal Radio Commission and as these are to be located in widely different parts of the country the time is near at hand when television programs will reach even the most remote parts of the country. At present stations are located in Boston. New York. Long Island City, Passaic, Chicago, Washington and on the West Coast.

Mr. Engineer—Are You Becoming a Back Number?

(*Continued from page* 205)

Engineering Index Service of this country, released to subscribers in convenient card form. Various technical journals publish brief, specialized abstracts in their pages. A limited number of radio articles are reprinted at regular intervals by a well known commercial data service.

Abstracts and references are most valuable and accessible when transcribed on index cards and filed according to some subject classification such as that referred to above. If desired, only those items of particular interest to the reader or group need be indexed in this way. It is possible that a card index-abstracting service which would fill the need and eliminate copying and classifying, will be available in the future and the matter is being studied by the Institute of Radio Engineers.

Once some such form of index has been assembled, it is a relatively simple matter to find references dealing with the required subject almost immediately. If the sources are at hand, they need only be opened to the page mentioned. If not, they may be consulted at many large libraries. Translations and photostat copies of articles may be secured from the Engineering Societies Library, 39th Street, New York City, at a reasonable cost.

Besides the great number of technical journals, there are other valuable special periodicals of interest to the radio engineer. The Official Gazette[4] of the United States Patent Office, published weekly, gives the claims of all current patents issued, including, of course, many radio patents. There are in addition, several private patent services which release information at regular intervals covering only radio and associated patents. Some technical journals also review a number of patents for their readers. Those patents which prove to be of interest may be ordered in complete form from the Government. News letters, technical data and "house organs" often contain much valuable information, and if so, should receive the same consideration and care as other periodicals.

The periodical literature has been of paramount importance in accelerating the progress of the radio art. It will without doubt figure even more importantly in future developments as time goes on. It is believed that both individual radio engineers and their employers who desire the optimum benefit from this literature, will do well to consider and act upon the following suggestions if the matter has not already received attention.

For Individual Radio Engineers

1. Affiliate with your professional engineering society so that you may receive its proceedings regularly. Carefully read and preserve them for future reference.
2. Personally subscribe to as many technical journals as you can afford, selecting those which best fit your individual needs and inclinations. File them chronologically.
3. Review each month current abstracts which cover radio literature, patents and the like.
4. As you come across contributions which affect your work or special interests, make a note of them and organize a file or bibliography of these references, for it will soon prove to be of great personal benefit. Aim to make this file complete but not burdensome.
5. Encourage your employer to provide the periodical facilities outlined below—in keeping with his means, of course.

For Employers of Radio Engineers

1. Provide as many as possible of the following periodicals for your engineering employees:

Proceedings and journals of technical societies whose work closely affects your own department and plant.

Technical and trade journals.

Technical bulletins, data and house organs released by governments, educational institutions and manufacturers.

Special services (relating to patents, legislation, etc.)

2. Organize an index system so that material on hand can be located quickly. Expand this index to include the whole radio literature, making use of abstracts and references. Limit the index, if you like, to subjects of special interest to your firm and business. Designate someone, preferably with technical training, to take charge of this work and supervise whatever library you assemble. Make it easy for your employees to acquire information which they need in their work.
3. Lend your earnest support to a reliably sponsored movement for making available a complete bibliography on the whole radio art.

The elaborateness with which such plans are followed depends on individual circumstances. It is felt, however, that even the smallest organization can tangibly profit from these ideas.

4—Obtainable from Superintendent of Documents, Government Printing Office, Washington, D. C. Price $5 a year.

Your Vacuum Tubes

(*Continued from page* 234)

much as a ten volt change in the plate voltage. In other words, an electron on the grid will have the power of ten electrons in the plate circuit. The amplifying action or amplication factor varies in the different types of tubes in general use from about three in the power tubes, to a factor of several hundred in the screen grid tube. This amplifying property of the vacuum tube in which electrical conditions in the circuit connected to the grid of the tube are exactly reproduced and magnified many fold in the plate circuit is the basis of the hundreds of important and wonderful technical applications of the vacuum tube.

Talking Movies for Schools

(Continued from page 211)

chronization (in the case of sound on disk), and overlapping frames. These latter should be matched up the first time the film is rewound. They may be marked during the first showing by sticking a small paper marker in the take-up reel at the point where they are observed.

Each time the film is rewound it should be carefully inspected for scratches, tears, poor splices and oil spots. If these are taken care of when first observed, the chances of trouble during projection are greatly minimized.

There are many fine points in the technique of running a sound picture which contribute to the satisfaction of the audience. The entire picture must be shown with smoothness and absolute continuity in order to appear realistic. It is considerably more difficult to obtain this result with sound movies than with silent ones.

Assuming that the system has been checked as outlined above, the proper procedure for showing a picture is as follows.

First thread up the projector. With sound on film, there should be no trouble with synchronization since each equipment has full instructions for the proper loops between aperture plate and sound gate.

(Continued on page 244)

Radio News Technical Information Service

The Technical Information Service has been carried on for many years by the technical staff of RADIO NEWS. Its primary purpose is to give helpful information to those readers who run across technical problems in their work or hobby which they are not able to solve without assistance. The service has grown to such large proportions that it is now advisable to outline and regulate activities so that information desired may come to our readers accurately, adequately and promptly.

Long, rambling letters containing requests that are vague or on a subject that is unanswerable take up so large a portion of the staff's working time that legitimate questions may pile up in such quantities as to cause a delay that seriously hinders the promptness of reply. To eliminate this waste of time and the period of waiting, that sometimes occurs to our readers as a consequence, the following list of simple rules *must* be observed in making requests for information. Readers will help themselves by abiding by these rules.

Preparation of Requests

1. Limit each request for information to a single subject.
2. In a request for information, include any data that will aid us in assisting in answering. If the request relates to apparatus described in RADIO NEWS, state the issue, page number, title of article and the name of the device or apparatus.
3. Write only on one side of your paper.
4. Pin the coupon to your request.

The service is directed specifically at the problems of the radio serviceman, engineer, mechanic, experimenter, set builder, student and amateur, but is open to all classes of readers as well.

All questions from subscribers to RADIO NEWS will be answered free of charge, provided they comply with the regulations here set forth. Non-subscribers to RADIO NEWS will be charged a nominal fee of $1.00 for this service. All questions will be answered by mail and not through the editorial columns of the magazine, or by telephone. When possible, requests for information will be answered by referring to articles in past issues of the magazine that contain the desired information. For this reason it is advisable to keep RADIO NEWS as a radio reference.

Complete information about sets described in other publications cannot be given, although readers will be referred to other sources of information whenever possible. The staff cannot undertake to design special circuits, receivers, equipment or installations. The staff cannot service receivers or test any radio apparatus. Wiring diagrams of commercial receivers cannot be supplied, but where we have published them in RADIO NEWS, a reference will be given to past issues. Comparisons between various kinds of receivers or manufactured apparatus cannot be made.

Only those requests will be given consideration that are accompanied by the current month's coupon below, accurately filled out.

SEPTEMBER, 1931
Technical Information Coupon
RADIO NEWS Laboratory
350 Hudson 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 and enclose $1.00 to cover costs of the service.
- ☐ I wish to become a subscriber to RADIO NEWS and enclose $2.50 to receive the magazine regularly for one year, and to receive this valuable technical information service free of charge.

Name ....
Address ....

Talking Movies for Schools

(Continued from page 243)

In any event this distance should be 14½ inches or about twenty frames on standard 35 mm film. Since the film runs at 90 feet per minute, a little variation from this standard will not be noticeable to the listener. With sound on disk each print has a frame marked "START" in the leader. This should be in the aperture when the pick-up is placed at the starting mark of the record.

It is desirable to frame the picture on the screen before starting the projector because the operator has plenty to do without watching the framing when starting a reel. When threading the projector the framing lever should be in a central position and the intermittent sprocket should have just completed a pull-down cycle. When the projector is threaded it should be run (either by hand or with the motor), for a few frames to make sure that the film is properly seated and that all the loops are the proper length. Next, light the arc, first making sure that the dowser is closed. Check the illumination on the aperture by opening the dowser for a second.

Set the fader on zero and make sure that the "disk-film" switch is in the proper position. Then turn on the head amplifier and exciter lamp.

Turn on the projector motor and as it comes up to full speed open the dowser. Note that the picture is on the screen O. K., and bring the fader up to the proper position for the right auditorium volume. Do not depend on the monitor horn for this level. It should be determined during the rehearsal in so far as it is possible to determine it in an empty house.

While the picture is showing, the operator should watch the screen and keep one hand on the fader in case it is necessary to control the volume. Care should be exercised here. however, as nothing is more disconcerting to an audience than a constantly changing level in the auditorium. If the film has many splices it should be carefully watched so that if a break occurs the machine may be stopped as quickly as possible.

When the Film Breaks

If the film breaks, close the dowser immediately. and then stop the motor, bringing the fader to zero. Re-thread the projector. and temporarily splice the film on the take-up reel with a paper clip. Do not use pins as they may injure someone when the film is being inspected.

To shut down at the end of a reel reverse the procedure for starting. When two machines are being used. it is important to determine beforehand, the proper cues near the end of reel No. 1 for the various starting operations of machine No. 2 for showing reel No. 2. It is very important that this shifting or "fading" from one machine to the other be made so as not to interrupt either the picture or the sound.

Proper care of film is an important factor to the success of projection and sound reproduction. The fundamental rule in this connection is to anticipate the difficulties that may occur, by careful routine inspection, and repair the weak points before they jeopardize the quality of the show. Remember that a sound print is a very delicate piece of equipment requiring precise adjustment, and subject to considerable wear.

Gross defects such as poor splices, torn sprocket holes and tears in the film itself can be detected during rewinding. However, the unaided eye will not be able to detect minute scratches on the sound track which produce a "machine-gun effect" on the speakers. The best way to detect these faults is while the film is being run off during rehearsal.

The general rule for correcting defects in a film is to remove that part of the film. The only objection to this method is that the removal of too many frames might interfere seriously with the continuity of both the picture and sound. That is why it is important to get the defects while they are small and also why it is important to stop the projector as quickly as possible when a film breaks during a showing. If any great amount of film has to be discarded the only alternative is to replace that portion with new print or to buy an entire new print.

Proper Splicing

The proper splicing of any motion picture film is an operation requiring considerable care. Any up-to-date projection room should be equipped with a splicing block. This enables the operator to align the ends of the film, and match up the frames. The splice should always be made on the frame line i. e., never remove less than one frame from a film. There is no excuse for repeatedly showing a picture which must be reframed during the show.

Unfortunately it is impossible to match up the sound track in the same manner that the frames are matched. A good clean splice will go through the sound gate without doing any damage, but it will always create some disturbance in the speakers. This difficulty may be overcome by painting an opaque triangle on the sound track at the splice. The best material for this purpose is Zapon Concentrated Black Lacquer No. 2,002-2, manufactured by the Zapon Company, Stamford, Conn. The size and shape of this triangle is important. Figure 5 (A, B and C) shows the correct and incorrect methods.

When splicing film to be synchronized with sound on disk it is essential to keep the film the original length. Accordingly, whenever frames are removed they must be replaced with the same length of blank leader. If the film is damaged so that the exact amount removed is uncertain, this can be checked by the numbers on the frame. Each series of 16 frames are progressively marked, "1," "2," etc., beginning with zero at the starting mark. These numbers should not be confused with the scene numbers. The latter are preceded and followed by a dash such as —93—.

(Continued on page 245)

Using Tuned Audio Circuits

(*Continued from page 201*)

controls mounted upon the audio amplifier if the on-off switch is incorporated with the volume control which is perfectly feasible, though it is not so shown in the photograph.

The large hole seen at the lower left of the gang condenser shield is for disconnection of the oscillator lead to the gang condenser, which is necessary in alignment. For a complete description of this aligning process, see page 656 of the January, 1931, issue of RADIO NEWS. The alignment process for the 716 being exactly like that of other current-day superheterodynes.

The Layout Below Deck

Looking at the right-hand or tuner section of Figure 2, the placement of parts is quite clear and distinct. The 600-kc. oscillator trimmer condenser assembly is seen just to the left of the drum dial. The position of the four shielded coils is perfectly clear, as is the location of the tube sockets, resistors, chokes and bypass condensers. A terminal strip provided with a metal cover for protection is located on the back of the tuner chassis. The power supply leads from the amplifier, which can be seen in Figure 2, are brought over in a cable. A twisted pair running from the two output binding posts at the rear of the tuner to two others at the left of the amplifier (Figure 1) are also seen, this being all of the interconnection between the tuner and amplifier which is essential for operation, though it is assumed that where the two units are installed in a console, additional leads will be brought out from the 683 amplifier so that the tone control rheostat and switch shown in the amplifier can be located with the control knobs of the tuner. The control shafts on the tuner and on the amplifier are long enough so that they will project properly through the standard 1/4" front panels found upon the present-day console cabinets.

Tone Control

The 683 audio amplifier involves a new development, inasmuch as it employs a tone control system which permits of the bass or lower audio frequencies being lifted considerably above the average amplification level of the amplifier, leveled off to its average level, or considerably attenuated, all by means of a variable tone control adjusted by a single knob. Likewise the higher audio frequencies can either be lowered or raised by means of a switch in the amplifier. The net result of this compensation is that the variation of the response characteristics of the human ear for different frequencies at different volume levels can be completely compensated for, and, in brief, exactly the same quality of tone obtained from the amplifier at very low volume settings, such as would be used for background music in home entertainment, as can be had at medium or high volumes.

The 68 amplifier, it is assumed, will be fed out of a -27 linear power detector, since it has been designed expressly for use with the 716 tuner. Its input terminal feeds directly into an audio transformer employing the Clough system of tuned audio amplification bass note accentuation. In the tuned primary circuit of this transformer is included a .001-mfd. condenser shunted by a 1/2-megohm rheostat; this combination constitutes the first tone control. Adjusting this rheostat allows the low audio frequencies below 100 cycles to be accentuated to about 15 db. or attenuated.

This transformer feeds into the first audio tube, the principal function of

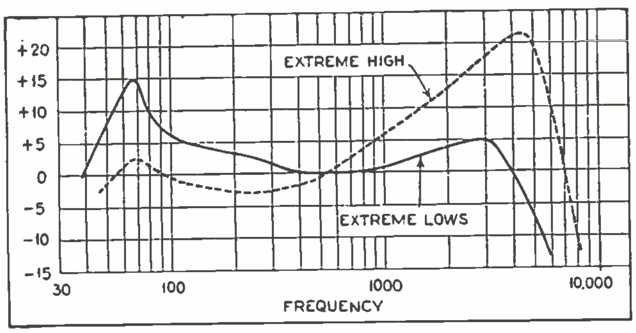


Figure 6. Showing the effect of the two-tone controls on fidelity. Through their use the characteristic can be shaped to the requirements of any ear or may be varied for different types of programs

(*Continued on page 246*)

Talking Movies for Schools

(*Continued from page 244*)

The frame number has no such marking.

An approved metal cabinet should be provided for the storage of all film. The only exposed reels at any time should be the one in the machine and the one on the re-wind table. This preserves the film and reduces the fire hazard to a minimum, since in the approved projection booth the only inflammable material present is the film. Such a precaution is very desirable for all film and absolutely essential for the highly inflammable nitrate film.

Even when all fire precautions are taken there is still some chance of fire. Such emergencies should be covered by approved fire apparatus. These requirements vary for different installations. In all cases the booth should be provided with automatic fire-proof shutters and some form of fire-fighting apparatus. In that case, even if both exposed reels of nitrate film become ignited, no very serious damage can result other than the loss of the film.

Using Tuned Audio Circuits

(*Continued from page 245*)

which is to permit the inclusion of the high-frequency tone circuit in the amplifier and to make up for any loss in gain due to the two types of tone control circuits employed. This tube also feeds into a Clough system push-pull audio transformer with tuned primary which in turn feeds the pentode output tubes in push-pull. In the plate circuit of the first audio tube is included a tuned circuit consisting of a capacity and inductance resonated at the higher audio frequencies to increase the impedance of this circuit at the higher frequency, resulting consequently in a very considerable boost on the order of about 22 db. at the higher audio frequencies in the neighborhood of 4,000 cycles. A switch is seen shunting this tuned circuit, which, when closed, throws it completely out of circuit and results in attenuation of the higher audio frequencies such as is desirable in locations showing a very high noise level, in the reception of very weak stations, or where the personal taste of the user favors an accentuated base response in certain music. The output tubes feed directly into an output transformer located in the amplifier chassis in order to prevent any loss of high frequencies due to the capacity of the cable which would be necessary to connect the plate of these tubes to the output transformer were it located in the speaker assembly.

The Power Supply

The power supply consists of a large transformer furnishing "A", "B" and "C" power for all tubes and the secondary of which feeds directly into a -80 rectifier which in turn feeds into a two-section filter—the first choke consisting of the speaker field and the second being a high-inductance choke. A third high-inductance choke is included only in the plate feed circuit to the first audio tube. The purpose of this choke being not so much to provide additional filtration as to insure the proper operation of the tone control circuit by preventing any possible leakage of the audio-frequency signal through the power supply. Three 4-mfd. semi-self-healing dry electrolytic condensers are employed in the filter together with the additional filtration provided by the by-pass and isolating condensers in the tuner and amplifier.

Without going into the more involved technical details of the audio amplifier, suffice it to say that with its accentuated high response in use a clarity of speech and musical overtones is obtained which is really remarkable. This is likewise true on music when the bass control is turned well up for bass accentuation, and all this holds particularly true when the volume of the combination is turned to a low level as for home entertainment, for, when this is done, both the bass and treble notes can be accentuated to a point where, due to the poor response characteristics of the human ear at low volumes, they appear at perfectly normal levels to the ear.

The mechanical layout of the amplifier can be clearly seen in Figures 1 and 2. In the large housing at the rear of the chassis are included the power transformer, one filter choke, and the dry electrolytic filter condensers. The lugs of the power transformer may be seen projecting through the chassis, and the location of the two audio transformers, the remaining filter choke and the speaker input transformer are also clearly seen, as is the location of the large, round choke in the high-frequency booster circuit.

The two tone controls—one a rheostat and the other a switch—are seen at the top of the chassis. They can either be left in this position in operation or shifted over the tuner chassis for a symmetrical layout of controls in a console assembly. On the bottom of the amplifier chassis are seen two terminal strips with their protecting covers, one carrying the power supply connections for the tuner and the other the field and voice coil terminals for the speaker. The speaker is a specially compensated type of Jensen 10½" electrodynamic speaker showing a considerable rise in response at the higher audio frequency which is necessary for the special tone control system employed.

Sensitivity, Selectivity and Fidelity

Figures 4, 5 and 6 depict the sensitivity, selectivity and audio fidelity of the 716 tuner and 683 amplifier. Figure 4, the sensitivity curve, indicates that the sensitivity runs from .37 microvolts to .57 microvolts absolute throughout the entire broadcast band, the curve being noticeably flat and the gain ratio being approximately 1.5 to 1, which for all practical purposes is considered as uniform sensitivity throughout the broadcast band.

The 1000-kc. selectivity curve appears in Figure 5 and it seems to be almost identical with that of the preceding 714. This is true, although as a matter of fact the image-frequency selectivity as well as the adjacent channel selectivity of the 716 is better than that of the 714.

Tone Quality Under Control

The two curves of Figure 6 have been purposely taken on the audio amplifier only, in order to illustrate graphically the effect of the dual tone control system. The solid line shows the audio curve from detector to speaker with the high-note switch in low position so that the highs are pretty well cut down and with the bass boosted up to a maximum. This curve and the dotted line curve are anything but flat, but it must be borne in mind that both these curves are shown without speaker compensation since the measurements were made into a constant load rather than directly into the voice coil of a speaker, the impedance of which rises with the frequency and which would contribute in consequence even more high-note amplification than is shown in Figure 6. Likewise is side-band attenuation in the r.f. and i.f. amplifiers not shown

(*Continued on page 247*)

Prize "Ham" Receiver

(*Continued from page* 193)

last audio stage, with the speaker, a jack switching arrangement is employed. It consists of a 10,000-ohm Carter Imp potentiometer. The moving arm and one side of the potentiometer are connected to the phones, while both sides of the potentiometer are connected direct in plate circuit. By turning the arm of the potentiometer an intensity of signal can be obtained in the headphones from zero up to full maximum. When the phone plug is withdrawn the potentiometer is shorted, thereby removing the resistance in plate circuit when the speaker is operated alone.

The placing of the variable resistances and potentiometer in the audio unit stage shield is as follows:

The left upper one is the 10,000-ohm anti-blast potentiometer, R14, and the upper right is the 100,000-ohm regenerative and c.w. oscillator plate resistance, R9. The lower left, under the base, is the 6-ohm rheostat, R16, and the lower right one, under the base, is the 200,000-

(*Continued on page* 248)

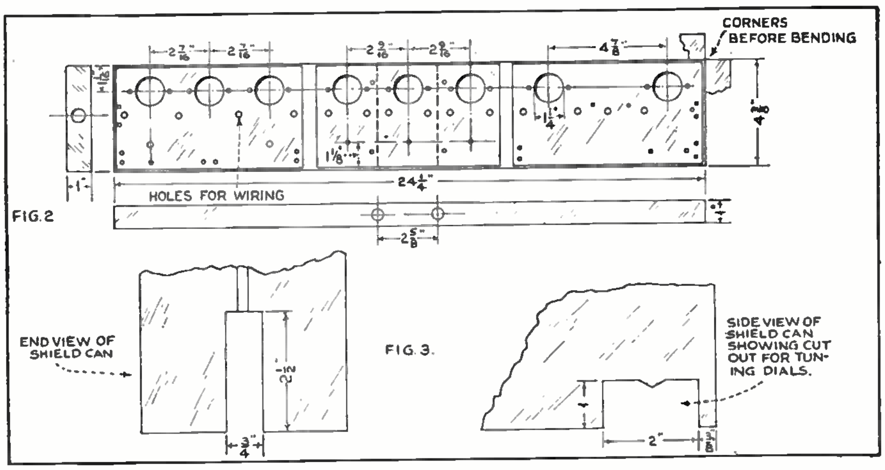


Figure 2. Layout and details of the metal base and shield bases. Figure 3. Details of cut-outs for terminal strips and tuning controls. These apply to two outside shield cans

Using Tuned Audio Circuits

(*Continued from page* 246)

in Figure 6. Considering the solid line curve, it is seen that the bass response is boosted up some 15 db. at 70 cycles over what is obtained at 400 cycles when the bass control is turned full up—and this all without any perceptible a.c. hum in operation! The result is that the deeper lower tones in music can be reproduced with the fulness and roundness which are more than pleasing to the ear favoring bass accentuation.

The dotted line curve shows the response of the amplifier with the bass control turned all the way down. and the high switch thrown to accentuate the high note response. It is seen that 4000 cycles is up approximately 21 db. as against the 400-cycle response, and it must be borne in mind that further compensation tending to raise this point even further exists in the speaker. On the other hand. sideband attenuation of a very considerable order exists in the i.f. amplifier and the net result is that if the two curves of Figure 6 were redrawn to represent antenna to ear fidelity rather than second detector to speaker fidelity. the response curve with the high switch turned up for high note accentuation and the base control turned down for bass suppression would be substantially flat from 40 to 1000 cycles and then rise fairly rapidly until a 4000-cycle note is about 10 db. up from a 400-cycle note, this making for an unusual clarity of speech and brilliance of musical programs. By turning the bass control up. the bass tones can then be raised about 15 db. if desired—and this is particularly desirable when the 716-683 combination is operated at very low volumes in the home. By throwing the high tone switch to the low position. the response will be substantially flat from 400 to 1000 cycles and will then fall off very rapidly until it is down approximately 15 db. at 4000 cycles, this making for suppression of background noise, in extremely noisy locations or on stations that are weak and down close to the noise level.

In summary. the overall fidelity curve of the 716-683 combination can have either the bass or treble response raised or lowered. together or independently. the bass by means of the continuously variable control. and the treble by means of the 2-position switch.

The cut-off above 4500 cycles is, as can be seen from the curves of Figure 6. extremely sharp, this cut-off being intentional in order that absolute 10-kilocycle selectivity may be attained.

Prize "Ham" Receiver

(*Continued from page* 247)

ohm potentiometer, R6, used for volume control.

One of the distinct advantages of using separate unit shield cans is that it allows the operation of the receiver with one or more cans removed. Another advantage is great accessibility.

In putting the receiver into operation—should a driver not be handy—tune the intermediates to some low-wave broadcasting station, if you have one near you, and then familiarize yourself with the operation of the receiver with all cans removed. In setting the intermediates to a York City and vicinity, due to crowding of stations. If the intermediate amplifier is tuned on, or very near, a strong broadcast harmonic lying between 185 and 200 meters, the harmonic will cause interference by forcing itself past the first detector. The solution, of course, is to set the intermediate amplifier frequency in the clear. If interference is still present, the following described stunt will greatly help matters. Instead of using the fixed resistor, R1, in the antenna grid circuit of the first detector, use several untuned coils whose natural resonance lies well in

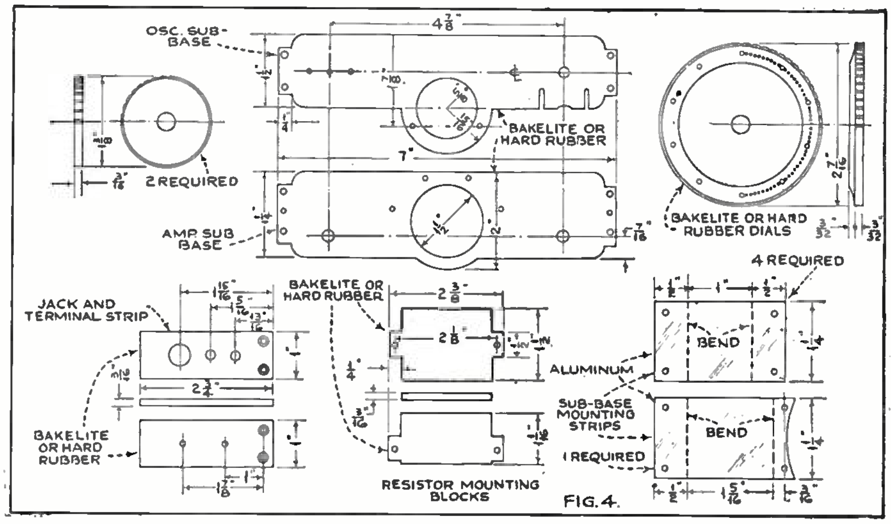


Figure 4. Details of the fittings, mountings, dials, etc.

broadcast wave, remove the oscillator tube which allows operation as a tuned radio-frequency amplifier unit.

If "B" batteries are used, it is advisable to hook a 60-watt electric light bulb in series with the negative "B" lead as a precaution against shorts if the shield cans are removed while the receiver is in operation. Of course, with the filament switch off, this danger is eliminated.

The cost of building the receiver will be in the neighborhood of twenty-five dollars, which the writer considers quite reasonable for the size of the layout. Of course, advantage was taken of the wholesale prices offered by most all radio supply dealers.

RESULTS. If the reader expects a long discourse on unheard-of reception, he is doomed to disappointment. However, the receiver will give equal, if not better, signal strength with less background interference, in conjunction with improved tone quality, than any other type or design of short-wave receiver the writer has used.

Alternate Input Circuits

The untuned grid first detector was employed to reduce the number of controls of the receiver to an absolute minimum.

In this part of the country I have not been bothered by the type of interference that is, more than likely, present in New the center of the 20-, 40- or 80-meter bands. These coils can be wound on an old type glass grid-leak (Figure 7), after removing the resistance strip from the inside. The winding can be single or double layer, or, if necessary, bank-wound. These coils can then be snapped into place in the same mountings that now hold the antenna resistor. Of course, their inductance, or number of turns, will have to be found experimentally.

Another and still better solution, if one does not object to another tuning control, would be antenna adapter, condenser tuned and using plug-in coils, with a switch to change the antenna from the secondary to the primary on the plug-in coil, as shown in Figure 8. This adapter can be built up by using a shield can one-half the length of the stage shields used in the set, thereby keeping down the ponderous appearance. The tuning condenser can be built up and mounted like the oscillator condenser, C1.

As to repeat points. The oscillator beat, in normal operation, is around 1579 kc. from the incoming signal. This places the repeat points far enough apart so that they will cause little trouble, particularly if either the antenna adapter or the coils in place of R1 are used. However, the beat oscillator will strike harmonics, developed by the second detector, when it is oscillating, but these are not serious.

As to oscillator radiation. By using

(*Continued on page* 249)

Prize "Ham" Receiver

(*Continued from page 248*)

this type of pick-up, coupled to the screen-grid of the first detector, radiation is cut to almost nothing in comparison with control-grid pick-up. Total shielding also helps. If a tuned antenna adapter is used, totally shielded, I believe that the oscillator will force very little energy on

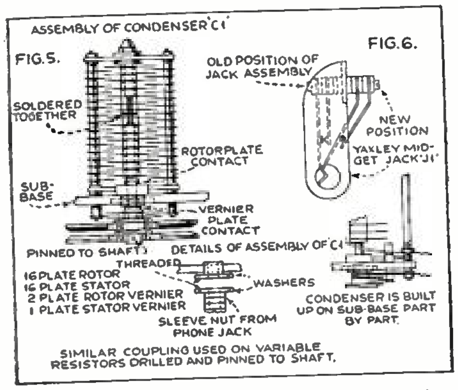


Figure 5. Details of the tuning and vernier condensers, assembled from the parts of two condensers, as described in the text. Figure 6. Head-phone jack, reassembly

to the antenna, for its resonant point would always be 1579 kc., or more, from the resonant point of the antenna coil setting and always at a greater frequency.

List of Parts

L1, L2—Silver-Marshall type 131 short-wave coil set.
L3—Heterodyne pick-up coil. hand wound (see text).
L4—Pilot No. 10 universal r.f. choke.
3L5, L6, L7, L8, L9, L10—Twin coupler type .00035 B. C. L. radio frequency coils with primaries rewound (see text).
L11—About 30 turns No. 28, or smaller, wire for feed-back coil (see text).
L12—No. 277 Silver-Marshall choke coil with bakelite case removed.
L13—Secondary of Ford spark coil with iron core removed (see text).
C1—Special tank condenser for tuning oscillator (see text).
C2, C3, C4—Hammarlund equalizing condensers, type EC70 or EC80.
C5, C6—Muter .00025-mfd. grid condensers.
C7—.5-mfd. Aerovox filter condenser, type 261.
C8—1-mfd. Aerovox filter condenser, type 261.
C9, C10—.006-mfd. fixed condensers.
C11—.001-mfd. fixed condenser.
C12—.006-mfd. Sangamo fixed condenser.
C13—.01-mfd. Sangamo fixed condenser.
C14—.0005-mfd. fixed condenser.
C15—.01-mfd. Aerovox tubular condenser to tune audio filter.
C16, C17—1-mfd. by-pass condenser.
R1—100,000-ohm antenna resistor.
R2, R3, R4, R5—Pilot 15-ohm filament resistors tapped at 5 ohms.
R6—200,000-ohm Carter Imp potentiometer.
R7—2-meg. grid leak.
R8—10-meg. grid leak.
R9—100,000-ohm Carter Imp plate variable resistor.
R10, R11—100,000-ohm plate resistors in series.
R12—100,000-ohm plate resistor.
R13—.25-meg. grid resistor.
R14—10,000-ohm Carter Imp potentiometer.
R15—.5-meg. grid resistor.
R16—6-ohm Carter Imp rheostat.
J1—Yaxley midget 2-circuit, 2-spring jack.
J2, J3—Carter pin jacks.
J4—Yaxley single-pole, double-throw switch.
J5—Yaxley single-pole single-throw filament switch.
Pilot tube sockets are used throughout, eight 4-prong and one 5-prong.
A 5-wire cable is used for connection to power supply.
35 feet push-back hook-up wire.
Aluminum, sheet-iron and hard-rubber panel for shielding and sub-bases (see text).

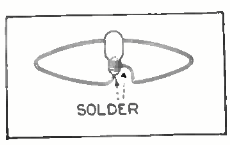
Junior Transmitter

(*Continued from page 199*)

condenser all the way across the dial with the flashlamp near the coil. It should glow at only one point, when in resonance with the oscillator and buffer stages. Naturally, adding the intermediate causes an increased signal in the monitor.

With the first three stages working, test the grid terminals of the 510 sockets with a neon lamp or a pencil point. Equal

Figure 8. Neutralizing indicator. Any flashlight bulb with a three-inch turn of wire will serve



brilliancy of the neon on both sockets, or a spark of equal intensity indicates that r.f. is evenly distributed in the secondary and both push-pull tubes will do their full amount of work.

Neutralizing the final stage is simplicity itself. Adjust the two condensers until the lamp does not glow when placed over the plate tank coil. Of course, the filaments must be turned on when neutralizing, but the plate voltage is not applied.

The final stage is adjusted to cut-off in the same manner as the preceding stages and the set is then ready to go on the air. In this transmitter the antenna tuning condensers are left outside the set and are mounted on the wall with the antenna ammeters. If you are using a Zepp feed, you will probably find that one of the antenna condensers in parallel with the coil will work best on 3500 kc and for the lower bands the condensers in series. This must be tried out to meet local conditions.

The key is connected in the center tap

(*Continued on page 254*)

What's New in Radio

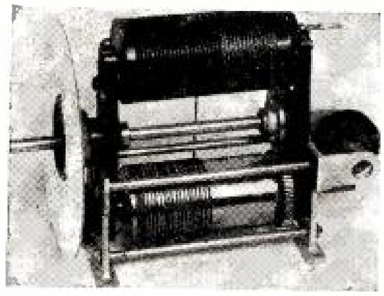
(*Continued from page 229*)

able address system is so designed that it may be set up and ready for use in five minutes.

Maker—Macy Manufacturing Corp., 1449 39th St., Brooklyn, N. Y.

Short-Wave Tuning Coil

Description—The new Vari-Coil is an entirely new tuning device for short-wave receivers. It consists of a bare copper stranded wire wound off or on a bakelite drum from a bare brass drum. As the wire is wound on the bakelite drum, capacity is added by the tuning condenser. The condenser and drum are driven by



the tuning dial through a worm and gear, so that inductance and capacity are varied simultaneously, keeping the correct L/C ratio at all times. It is suitable for use in a superheterodyne oscillator and is adaptable to numerous radio circuits. It is equipped with a turn-counting dial and panel window.

Maker—Arthur J. Hurt & Co., 550 Clayton St., Denver, Colo.

Compact All-Wave Converter

Description—The all-wave converter model No. DX-4 may be easily and quickly connected to any radio broadcast receiver so as to provide short-wave reception. The device is designed to take efficient advantage of all the tubes in the broadcast receiver. Three -24 screen-grid type tubes are employed in the radio-

frequency amplifier, modulator and oscillator stages. The -27 type tube is used as a rectifier. The converter includes four plug-in coils, and a built-in power supply. Tuning is accomplished by a single dial. The complete unit is contained in a walnut finished cabinet of modernistic design.

Maker—Polo Engineering Laboratories, 125 W. 45th St., New York City.

(*Continued on page 252*)

Radio Transmission Under the Polar Ice Cap

(*Continued from page 191*)

existed, they may have aided greatly. Dr. Brooks points out, in the migration of Eskimos from one continent to another and in such adventures of exploration as the supposed discovery of North America by the Norsemen four centuries or so before Columbus. And, if such periods of open Arctic Ocean ever were real, their records will be found, geologists confidently expect, in the layers of material accumulated on the ocean bottom and which the Wilkins expedition hopes to sample.

In all these scientific plans the availability of radio communication is an important item. The submarine will be equipped, it is announced, with adequate radio apparatus both for reception and transmission. Short waves will be used chiefly for transmission. Amateurs are already planning to listen carefully for these Arctic messages. Schedules and arrangements will be made, it is announced, by the American Radio Relay League. A special station has been licensed and set up in New York under the call letters WRH, for the purpose of maintaining continual communication with the Wilkins expedition.

Communication Possibilities

Presumably communication will be possible, at least under some conditions, even when the submarine is underneath the ice, since messages already have been exchanged between shore stations and radio-equipped submarines underneath other oceans. However, if difficulty is experienced in such sub-glacial radio communication, arrangements are available by which temporary antennas can be erected on the ice when the submarine pauses for observations and communication conducted in this way. The experience of Admiral Byrd's expedition in the Antarctic already is sufficient proof that radio communication in polar climates is not only possible but is often better than elsewhere over the earth's surface.

Day by day or week by week the important discoveries of the expedition will be reported, it is expected, to waiting scientists in the world's laboratories. These can be checked immediately with other observations of magnetic phenomena and so on, made elsewhere on earth, just as was done with many of the daily records of the Byrd expedition. Suggestions or instructions from the scientific laboratories can be communicated, also, to the observers with the Wilkins expedition, so that other matters can be looked into at once. Thus the value of the observations probably will be many times greater than were it necessary for the expedition to remain completely isolated during its Arctic trip.

The possible value of the expedition is not confined, however, to the mere obtaining of additional scientific information. There is a practical aspect also and one which is likely to grow more and more important as time goes on. One of

(*Continued on page 251*)

Radio Communication Under the Polar Ice Cap

(*Continued from page* 250)

the great commercial routes of the future must lie, it is probable, across this Arctic ice waste and one of the important objects of the sub-ice exploration is to discover whether this commercial route may best lie above the ice by means of airships or below it by means of submarines.

Examine a globe of the earth instead of the usual flat maps and you will see that the shortest line between the rapidly developing markets of the Orient in Japan and China and the industrial regions of the United States lies almost across the Pole. Colonel Lindbergh is reported to be considering this route for pleasure jaunts in aircraft. However this may be, there can be little doubt that mails, valuable freight and hurried passengers will be traveling by this route before many decades.

Danger of Fog

Crossing of the polar ocean by aircraft already has been proved possible, but these pioneer journeys have shown two very serious obstacles. One of these is fog, because the polar ocean is perhaps the most fog-bound place in the world. Second is the tendency of these Arctic fogs to freeze on the wings of airplanes or on the envelopes of airships as coatings of ice; a tendency which proved a serious obstacle on the voyage of the *Norge* and which probably contributed importantly to the wreck of the ill-fated *Italia*. It is conceivable, Arctic geographers point out, that the route across the Pole underneath the ice will be far more practicable for regular commerce than the route through the air. The critical matter, it is probable, is the existence or non-existence of a land barrier. Some of the evidence from Arctic currents and Arctic weather is believed to favor the existence of such a body of polar land. Other evidence is opposed. Nothing of the sort was seen on the expeditions of Perry, Byrd or Amundsen. One of the tasks of the Wilkins' expedition will be to report, if possible, whether or not such polar land exists.

If it does exist, it may provide a landing field of enormous value to future trans-polar commerce of the air. If it does not exist it may turn the balance in favor of trans-polar commerce under the sea.

The existence or absence of a polar continent would be important, also, to the science of meteorology. A large part of the weather which afflicts or benefits the continents of the western hemisphere is brewed in the Arctic Ocean or on its borders. Most of the cyclonic storms which follow each other across the United States every few days begin, it is believed, on the western border of the Arctic Ocean north and west of Alaska. One of the chief needs of improved weather forecasting, weather experts insist, is the availability of daily or hourly weather reports from the fringes of the Arctic Ocean and, if possible, from one or more locations toward its center. It has been suggested that floating weather stations may be set up resting on great concrete pans set on the ice and capable of keeping afloat even should the ice plane collapse. These stations that might be in communication with weather stations elsewhere by radio would be provisioned from time to time by aircraft or submarine.

Another of the scientific problems which the Wilkins' expedition may help to solve is the practicability or impracticability of such floating weather stations.

In any event, short waves emerging this summer from the Arctic vastnesses may carry to those fortunate enough to catch them interesting messages of adventure or scientific discovery, perhaps of tragedy; for no one can deny that the venturesome voyage of the new *Nautilus* involves terrific dangers that few stay-at-home individuals would be prepared to face. Possibly some day some amateur at his key and headphones will catch a feeble, interrupted message; the last that the new *Nautilus* will send. Like many scientists before them, the adventurers of the Nautilus take their lives in their hands.

A tragedy, everyone will hope, may be avoided by the skill and careful planning of Sir Hubert Wilkins and his crew. Even should it happen, however, the availability of radio probably will save to the world invaluable results which otherwise might be lost. No one knows what important discoveries have been made by the Arctic explorers who never returned. One of the greatest gifts to modern scientific exploration is radio, for this means that the important scientific results obtained day by day in such a dangerous task may be sent back safely and preserved regardless of what happens to the expedition itself.

Voltage Divider Design

(*Continued from page* 215)

current. Since 90 volts are applied to all three r.f. tubes the total plate current drain is 9 milliamperes and since the one grid bias resistor is used to furnish grid bias to all three tubes it will be necessary to take into consideration the total plate current used in operating the three r.f. tubes. The formula E/I will give us the required value of the resistor. Consequently we have E or 6 volts, and I which is .009 ma.

6/.009 = 666 ohms. Commercially a resistor of 666 ohms is not available unless made special. Therefore, a resistor nearest the required value should be used.

If only one -26 tube was used in the r.f. amplifier, with identical values of voltages applied, we would have E/I or 6/.003 = 2000 ohms.

The voltage drop across each half of the center-tapped potentiometer need not be taken into consideration when tubes with low plate current are used, but should be taken into account when tubes of the -12A type or larger are used.

The value of the resistor for the first audio stage is E/I or 6/.003 = 2000 ohms. That for the -71A tube with 180

(*Continued on page* 253)

Automatic Volume Control

(*Continued from page 222*)

in these sets adjusts, not the amplification, as in the older models, but the output volume. The correct amount of amplification necessary to provide this volume, regardless of original signal strength, is automatically applied.

It can be easily seen why the tuning of these sets is apparently very broad, for up to a certain limit, the automatic volume control furnishes fairly constant volume at some distance off resonance, even though the signal strength a short distance from the resonance point may be tremendously decreased. If, however, another signal now appears near the first one, the tuning will apparently sharpen considerably, due to the combined signal strength of the two stations acting upon the volume control to reduce the amplification.

It is often extremely difficult to log local stations with any degree of accuracy because of this apparently broad tuning. In this case it is suggested that with the local-distance switch set at local and the volume reduced to bare audibility, the logging will be greatly simplified. It is particularly important to have the switch set at local because this reduces the set's response to the signal to much more narrow limits.

In DX work the correct way to adjust the set is to tune it to a vacant place on the dial and raise the volume by means of the manual control knob until the noise level or background noise can just be heard. Then this control will most likely require no further adjustment for the rest of the night.

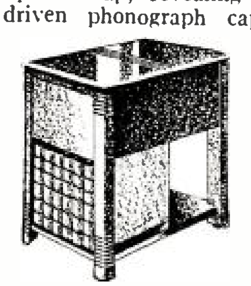
LEONARD NACHEMOV,
New York, N. Y.

What's New in Radio

(*Continued from page 250*)

Armchair Phonograph

Description—This new phonograph device provides a means whereby any standard modern radio may be converted into a radio-phonograph combination. It is so designed that it appears to be an attractive end table, but actually the front half of the top lifts up, revealing an electrically driven phonograph capable of



playing standard records up to 12 inches. The bottom shelf is designed to contain the record books. The motor is equipped with a control for speed regulation. The connection between the armchair phonograph and the radio is made by means of a single connecting cord.

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

INDEX TO ADVERTISERS

Voltage Divider Design

(*Continued from page 251*)

volts plate applied, with 43 volts bias, drawing 20 milliamperes plate current, and taking into account the voltage drop across half of potentiometer is worked out as follows: A 100-ohm center-tapped potentiometer causes a drop equal to I × R or .010 × 50 or .5 volts. Since the required grid bias is 4 volts we have a .5-volt drop across potentiometer which leaves 42.5. Therefore, the bias resistor must produce a drop of 42.5 volts. The value of this resistor would be given by E/I or 42.5/.020 = 2125 ohms.

In the indirectly heated cathode tubes such as the -27 and -24 the grid bias is obtained through a system such as that shown in Figure 5. By looking at the diagram it can be seen that the grid bias resistor is connected between the cathode and ground.

It may appear to some readers that the grid bias resistor could be connected between the center-tapped resistor and ground as is done in directly heated cathodes (where filament is the electron emitter). This, however, cannot be done since in the directly heated cathode the plate current returns to B— through the filament, while in the indirectly heated cathode such as is employed in -27 and -24 type tubes the plate current returns to B— through the cathode which is the electron emitter. It can be seen at once that no plate current flows in the heater of the -27 and -24 type tubes. Therefore, the grid bias system employed with a directly heated filament cannot be used with tubes using an indirectly heated cathode. The value of the grid bias resistor is calculated in the same manner as for directly heated filament tubes. The formula E/I will then give us this value.

For example, if a -27 tube is operated with 180 volts on the plate it will draw 5 milliamperes plate current when a grid bias of 13.5 volts is applied to the grid. The grid bias resistor will then have a value equal to E/I or 13.5/.005 = 2700 ohms.

There is still one more subject on the design of voltage dividers upon which we have not dwelt, and that is the selection of suitable resistors designed to carry the current that flows through them. Resistors are rated in watts which they are able to dissipate. The formula for wattage rating is $W = I^2R$. To find rating of resistor R in Figure 1 we take the current flowing through the resistor R, which is 75 ma., square it and multiply the result by 2666, which is the resistance of resistor R. Therefore .075 multiplied by 2666 = 14.99 watts. Thus we can see that resistor R in Figure 1 dissipates 14.99 watts. A resistor dissipating 15 watts will get quite hot. Therefore to figure a fair measure of safety into the divider it would be wise to multiply this figure by two so that the resistor operates in a moderately hot condition, but if it is desired the results of $I^2 \times R$ may even be multiplied by 3 or 4 so that the resistors will just become warm when the power pack is in operation. The wattage rating of the remaining resistors is figured in a like manner.

Nothing has been mentioned thus far about by-passing the various resistors in the voltage divider. For the time being it may be enough to recommend by-passing condensers of between .1 and .5 mfd. for grid bias resistors and between .5 and 1. mfd. for by-passing plate circuit resistors. Correct by-passing is a study in itself.

Mathematics in Radio

(*Continued from page 237*)

product of the circumference of its base by its altitude.

NOTE: A right cylinder has its elements perpendicular to its bases.

Designing Fixed Resistors

The design of fixed resistors shows the application of geometry to radio as it is essential that the designer calculate the effective surface areas of the various resistor tubes.

It is remembered that the current carrying capacity of a wire is limited by the amount of heat it will radiate and it is evident that for a resistor carrying relatively large currents, a greater surface area is required than for smaller currents. The output resistors in the power pack of a radio filter unit, the grid bias resistors, especially those for the power amplifier tubes, and various plate resistors all require that the heat dissipation be ample.

Many of the resistors are in the shape of cylinders, as this lends itself to ease of manufacture and provides a large surface area for proper radiation. Referring to Figure 5, let us assume that a layer of resistance wire is wound on a tubing, such that the outside dimensions are 1 by 4 inches respectively. From geometry, it is recalled that the lateral area (surface area) of a cylinder is equal to the product of the circumference of the base by its altitude. We thus find a total surface area of 12.6 square inches. Now, it is customary to allow about two watts per square inch of radiating surface for safe dissipation, and we find for this tubing that approximately 6.3 watts can be allowed.

Let us assume that an output resistor is required to have a resistance of 6000 ohms and to carry safely and continually a current of .08 of an ampere (80 milliamperes). The watt is expressed as the product of the square of the current and the resistance, which gives us a value of 38.4 watts. Allowing 2 watts per square inch, we find that a surface area of 19.2 square inches is required. If a tubing 1 inch outside diameter is used, it is found that a resistor about 6.1 inches long will give us a radiating surface area of 16 square inches.

The Junior Transmitter

(*Continued from page 249*)

of the power amplifier stage, although this is not the only system of keying an m.o.p.a. It is the simplest and usually works as well as the more complicated methods, being used at a large part of the

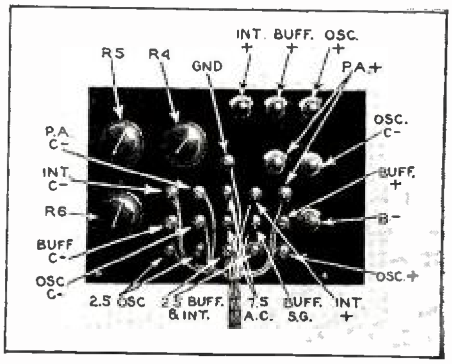
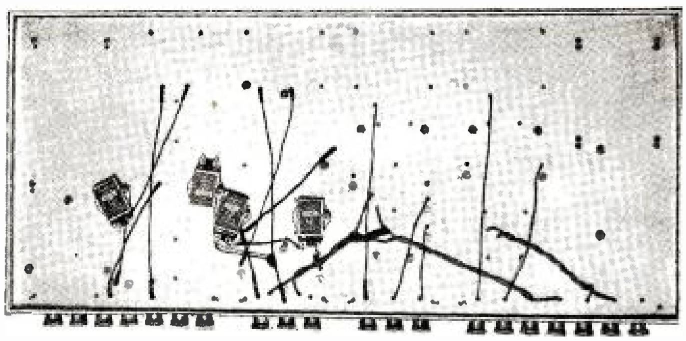


Figure 10. (Above) The layout and markings for the control panel of power supply unit.



Underside of base after completion of wiring

amateur stations. The key click filter should not be forgotten—it is as necessary in this set as in the self-excited one described before.

After you have finished this set and have it working, dress up your station. Centralize your controls, keep your log book in a handy place and *use it*. The log book may save your license some day.

We next tackle crystal control and frequency doubling. We are going to show you how to double from an 80 meter crystal down to 20 meters without buying anything more than a UY socket. Watch for it!

List of Parts—Power Supply

V1, V2—-81 rectifier tubes
V2—Perryman 280-M mercury vapor rectifier
T1—General Radio 565-B power transformer
T2—Wholesale Radio LW45 power transformer
T3—National F227 filament transformer
RFU—General Radio 527A filter unit
L1, L2—Wholesale Radio KT45 filter chokes
C1—2 mfd Flectheim HV condensers
C2—Mayo E16 electrolytic condenser
R1—General Radio 437 adjustable center tap resistor
R2—Ward Leonard 507-65 25,000 ohm bleeder resistor
R3—Ward Leonard 507-140 15,000 ohm voltage divider with two extra clips
R4, R5, R6—Centralab fourth terminal potentiometers
F1—2 ampere fuse and receptacle
F2—10 ampere fuses and receptacles
S1—Snap or toggle switch, porcelain base
S2—Yaxley A-720 jack switches

Unkeyed Parts

One 7"x10"x3/16" panel
One 12"x25" wooden baseboard
Three UX sockets
Sixteen binding posts—Eby or similar marked type.

In the list of parts for this transmitter, in the August issue, the name of the manufacturer of the aluminum cabinet and shields was omitted. These parts are made by Blau, the Radio Man.

Radio Physics Course

(*Continued from page 218*)

Figure 7 reveals many interesting things about our common musical instruments. The piano, organ and harp produce the greatest range of fundamental frequencies, ranging from about 16 to about 4096 cycles per second on the physical scale of pitches. All of the other instruments have more limited ranges lying within these values.

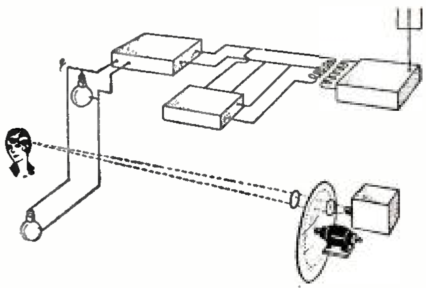
Some of the instruments like the bassoon, the bass viol and the bass tuba produce sounds lying entirely in the low frequency range. Others like the violin, flute and piccolo cover the high frequency range. The tenor banjo, trombone, saxophone and trumpet produce sounds in the middle range of frequencies. The bass drum and traps (Figure 6), and the snare drums, tom-toms and cymbals have no definite musical pitch and are used only to bring out the rhythm and add novelty effects.

The great body of a symphony orchestra is composed of an assembly of practically all of these instruments. Therefore, if we are to be able to satisfactorily broadcast and reproduce the music from such an orchestra, our electrical apparatus in both the transmitting and receiving stations must be capable of dealing with the complete range of frequencies of all of the instruments.

Latest Radio Patents

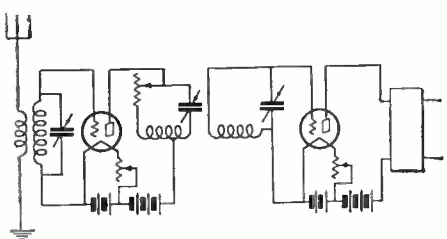
(*Continued from page 279*)

1,796,030. TRANSMISSION AND RECEPTION OF PICTURES. RAY D. KELL, Scotia, N. Y., assignor to General Electric Company, a Corporation of New York. Filed Apr. 25, 1929. Serial No. 358,078. 7 Claims.



1. A picture-producing apparatus including means for scanning a field of view including a movable object, means arranged to generate electrical impulses dependent on the shade of the successive elemental areas of said field, and means operable after the first complete scanning of said field to permit the transmission of only the electrical impulses corresponding to those elemental areas of said field, which have changed shade subsequently to the previous scanning.

1,801,352. ELECTRICAL COUPLING SYSTEM. FREDERICK A. KOLSTER, Palo Alto, Calif., assignor to Federal Telegraph Company, San Francisco, Calif., a Corporation of California. Filed Mar. 23, 1926. Serial No. 96,690. 14 Claims.



1. In a radio-frequency amplifying system comprising amplifying means having input and output circuits, means for coupling another circuit to said output circuit in a differential relation, said coupling means comprising inductances responsive to the amplified energy for controlling the proportional amount of energy transferred at different frequencies, means for selectively tuning said coupling means, means connected in series with said selective tuning means for controlling the ratio of energy transfer for a given frequency without affecting the tuning of the coupling means and connections from said output circuit to points intermediate said inductances and between said tuning means and said controlling means.

1,794,418. RADIO RECEIVING CIRCUIT. RALPH KIMBALL POTTER, New York, N. Y., assignor to American Telephone and Telegraph Company, a Corporation of New York. Original application filed Dec. 4, 1926, Serial No. 152,659. Divided and this application filed Sept. 20, 1928. Serial No. 307,168. 8 Claims.

1. The method of receiving radio signals which follow both a direct path and an indirect path in a single vertical plane between the point of transmission and any point of reception, which consists in receiving the direct and indirect signals from a single source at two points substantially in a common vertical plane with a point of transmission, combining the signals received at the two points over the one path in such phase relation that their vector sum is zero, and combining the signals received at the two points over the other path in such phase relation that their vector sum is positive.

Balancing Trimmers

(*Continued from page 227*)

excellent trimming condenser, the capacity of which can be readily varied by shortening or lengthening."

Interference Locator

(*Continued from page 227*)

scale voltmeter and an intensity meter. The voltmeter is connected across the filament circuit and is provided with a pushbutton for making the connection to the "B" batteries to read plate battery voltage. The intensity meter is connected in the output circuit of a rectifier supplied from the secondary of an output transformer. The intensity meter is provided with a switch for cutting it in or out of the circuit, and with a shunt to multiply its range by three. An input jack connected to the primary of the first audio transformer allows the use of the audio-frequency amplifier only if necessary.

The accessories include a sectional resonance pole 7 feet 1 inch in length and an audio-coupling unit for use with the audio amplifier, or for use as an r.f. pick-up unit where space will not permit the use of the pole.

The net weight of the instrument, ready

Figure 5. The interference locator mounted in an automobile and ready for service. However, it is sufficiently light and self-contained to be readily carried in tracing down the source of trouble

for operation, is 35 pounds. Further information may be secured by writing to the manufacturer.

Radio-Science Abstracts

(*Continued from page 224*)

Low-Frequency High Power Broadcasting as Applied to National Coverage in the United States, by William H. Wenstrom, Proceedings of the Institute of Radio Engineers, June, 1931.

With P. P. Eckersley's general theory derived from north European practice as a starting point, the possibilities of broadcasting in the United States on frequencies around 200 kc are examined from the viewpoint of national coverage. It is shown that Eckersley's curves can be applied approximately to the American terrain, and that as a first approximation seven low-frequency transmitters radiating at maximum power levels between 1000 kw and 10,000 kw may be expected to cover practically the entire country with true broadcast service. Objections to and advantages of such a structure operated as a supplement to existing broadcast facilities are discussed.

Editor's Note—A series of four articles by Lieutenant Wenstrom covering this subject is concluded in this issue of RADIO NEWS. *The earlier articles appeared in the April, June and August issues.*

The Effective Height of Closed Aerials, by V. I. Bashenoff and N. A. Mjasoedoff, Proceedings of the Institute of Radio Engineers, June, 1931.

In this article formulas are given for the calculation of the effective height of coil aerials with non quasi stationary distribution of current. Aerials of triangular, rhombical, rectangular, and pentagonal forms, suitable for use in radio beacons, are treated, and the method of taking account of the distribution of current along the aerial found by experiment discussed.

Graphs for facilitating numerical calculations using the formulas are given together with examples illustrating their use. Special attention is given to the determination of those forms of aerials in which the wire is most advantageously placed for obtaining a maximum of effective height.

Bibliography of Radio Wave Phenomena and Measurement of Radio Field Intensity. Prepared by the Bureau of Standards. Proceedings of the Institute of Radio Engineers, June, 1931.

This compilation covers all branches of the subject indicated by the title and includes references to material published in some sixty domestic and foreign publications. It will prove an invaluable reference source to all those interested in radio transmission and methods of measuring field strengths. The bibliography is unusually complete covering some fifty pages in the proceedings.

A Short-Wave Adapter

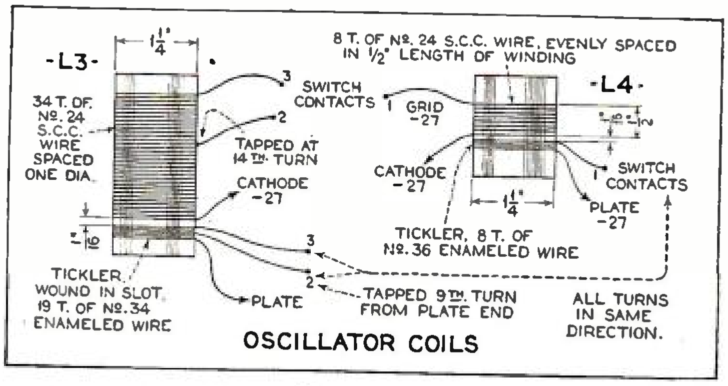
(*Continued from page 213*)

dial should be taken where no broadcast station tends to heterodyne the short-wave programs. Different dial settings of the radio set will bring in the short-wave stations at different places on the unit dial.

When logging stations. log the radio set dial reading also. The tuning range intermediate frequency or higher setting on the dial of the radio set; for example, 550 kc.

The old type Wood Supersonic unit can be re-wired to correspond with the new wiring diagram and give better results. With the new power pack which is designed for the old unit a very good oper-

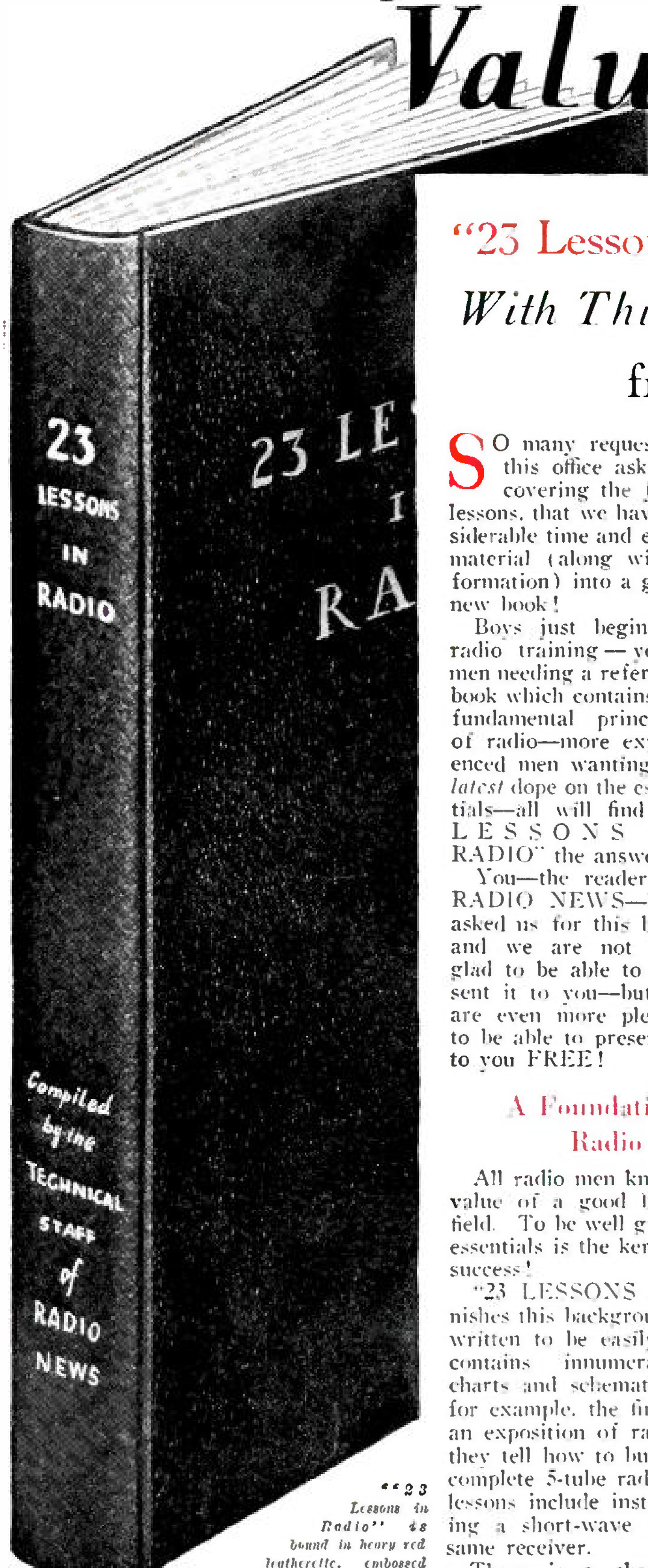
Constructional and winding details of the oscillator coils



of the unit can be raised or lowered by using either extreme end of the broadcast receiver dial setting. If the high wave end of the radio set dial is used, be sure that the set you have has sufficient sensitivity at that point. Some radio sets lack power at the high-wave end of the tuning range. With the dial setting of 795 kc. specified above, the unit has a tuning range of from 13 meters to 110 meters. This upper range of wavelengths may be extended by using a lower ating job can be made by changing it from d.c. operation to a.c. operation.

I will be very glad to correspond with any reader who is having a little difficulty with his old or new job. If you live at the end of South America, please do not ask me to reply "via aera" unless you enclose the postage equivalent. I agreed to send a reader down in South America two issues of RADIO NEWS "via aera" and soon found out that if I did that very much I would be supporting air lines.

You Asked Us for this Valuable Book



"23 Lessons in Radio" is bound in heavy red leatherette, embossed in gold. The above photograph is actual size.

And NOW It's Ready!

"23 Lessons in Radio" *Yours* FREE!

With This New Money-Saving Offer from RADIO NEWS

SO many requests have come into this office asking us for a book covering the Junior Radio Guild lessons, that we have at last, with considerable time and effort, compiled this material (along with some other information) into a great new book!

Boys just beginning radio training — young men needing a reference book which contains the fundamental principles of radio—more experienced men wanting the *latest* dope on the essentials—all will find "23 LESSONS IN RADIO" the answer!

You—the readers of RADIO NEWS—have asked us for this book, and we are not only glad to be able to present it to you—but we are even more pleased to be able to present it to you FREE!

A Foundation for All Radio Men

All radio men know the tremendous value of a good background in this field. To be well grounded in the first essentials is the kernel which develops success!

"23 LESSONS IN RADIO" furnishes this background. It is not only written to be easily read, but it also contains innumerable illustrations, charts and schematic diagrams. Just for example, the first few lessons are an exposition of radio principles, and they tell how to build, step by step, a complete 5-tube radio receiver. Later lessons include instructions for building a short-wave converter for this same receiver.

There is a chart explaining the standard radio symbols used in schematic diagrams—a chart of the International Morse code—and a thousand other things which make this book a thoroughly comprehensive training for the radio set builder, the experimenter, the service salesman, and the dealer.

A Few of the Subjects Covered in "23 LESSONS IN RADIO"

- Elementary Radio Theory
- How the Detector Tube Works
- Construction of a two-stage audio-frequency amplifier
- How the Radio-Frequency Amplifier Works
- How To Build a "Converter" which changes your 5-tube broadcast receiver into a Short-Wave receiver
- Principals of transmitting and receiving
- Complete Chart of Standard Radio Symbols
- How To Build R F Tuner
- How To Build a 3-stage resistance coupled audio-frequency amplifier
- The How and Why of B-Power Units
- Breaking into the Amateur Game
- How to build a code test outfit
- Circuit, constructional and operating details of a Low-Power Transmitter
- How the Vacuum Tube Works
- Battery construction and how they work
- How to Analyze Receiver Circuits

And Now You May Have This Book FREE—Just Sign the Coupon TODAY!

"23 LESSONS IN RADIO" *is not for sale anywhere!* But by subscribing through this special offer, you receive not only this great book FREE, but you also receive two whole years of RADIO NEWS for only $4, a saving of $2, over the single copy price. *Besides, you do not need to pay the entire amount now!* Simply fill out the coupon below and send it to us with $1! We will immediately mail your "23 LESSONS IN RADIO" and your first issue of RADIO NEWS. Then you may pay the balance later as we bill you, in easy installments of $1 a month for 3 months. Renewal or extension of current subscriptions accepted on this offer, but payment must be made now, as specified above, not when subscription expires.

RADIO NEWS, Dept. 2409
381 Fourth Avenue, New York, N. Y.

Enter my subscription for two years of RADIO NEWS and send me the book "23 LESSONS IN RADIO"—all for only $4.00. I am enclosing $1.00 herewith, and will pay the balance, $1.00 a month, for the next three months. (One extra issue—25 months in all if you send the full amount with your order.)

Name ....

Address ....

City .... State ....

If renewal check here ☐

Are you a Serviceman ☐ Engineer ☐ Dealer ☐ Experimenter ☐ Radio Technician ☐?

SM

The Finest Radio Receiver in the World

716 Tuner and 683 Amplifier

For three consecutive years past, the Silver-Marshall 710, 712 and 714 broadcast tuners have been outstandingly the finest money could buy. And now comes the 716, finer than all its famed predecessors, and giving an order of sensitivity, selectivity and tone never before approached—even by Silver-Marshall engineers.

Over a short period of time the 716 and 683 combination should log nearly every station in the Call Book. Seventy stations in twenty minutes is no trick at all.

In the 716, two tuned circuits preceed the first '51 r.f. tube, utilized in such a manner that their effective selectivity is actually greater than that of the previous 714 tuner. A third tuned circuit is before the '24 first detector and the fourth in the '27 oscillator circuit. All coils and the special gang condenser (which gives unusually great dial separation between low-wave stations for these four circuits) are shielded to prevent radiation and unwanted pickup. The two-stage i.f. amplifier uses '51 tubes and three siamese or dual-tuned transformers, of extreme selectivity, feeding into the '27 second linear power detector.

The 683 Amplifier employs a totally new and revolutionary dual tone control system by means of which the treble or bass can be raised at will, leveled off, or lowered, independently of each other. This, with the 716 tuner, results in a clarity of both speech and music at high or low volumes never before attained in any radio.

If you want the finest receiver that money can buy, this combination is what you are looking for.

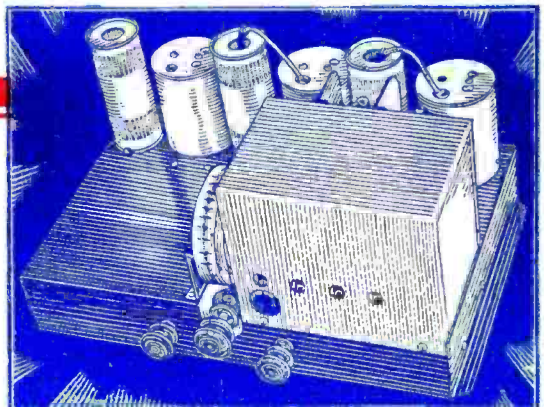
Tubes required: 3—'51's, 2—'27's, 1—'24.

716 Vario-Mu Superhet Tuner

The 716 tuner as described above, completely factory wired, tested and RCA licensed. Size 16½'' long, 10½'' deep (exclusive of controls) 7¾'' high. Shipping weight 25 lbs. ..... Price $69.50 LIST

683 Push-Pull Pentode Amplifier

The 683 amplifier is intended primarily for use with the 716 Tuner. Supplies required B, C and heater currents. Designed to use with 855B Speaker (800 ohm field). Tubes required: 1—'27, 2—'47's, 1—'80. Size 12" long, 9½" deep, 9" high. Factory wired and tested, RCA licensed .... Price $69.50 LIST



716 Tuner Only

Engineering Features

10-Tube Superheterodyne

3 New Vario-Mu Tubes

2 Push-Pull Pentode Tubes

Sensitivity of *Less* than One-Half Microvolt per Meter

Absolute 10-Kilocycle Separation

Two Separate Tone-Controls

Double-Unit Construction

An Analyzed, Developed, Perfected Stenode Radiostat Principle of Side-Band Attenuation Coupled with Audio Compensation, is employed.

Write for *New* General Parts Catalog

The new Catalog gives detailed data on a complete new line of chassis, kits, amplifiers, replacement parts, etc. Everything from a short-wave converter without plug-in coils, to a new line of transformers.

SILVER-MARSHALL, Inc.
6405 West 65th Street • Chicago, U. S. A.
Canadian Division: SILVER-MARSHALL of CANADA, Ltd.
75 Sherbourne Street, Toronto

SILVER-MARSHALL, Inc. Dept. R-N 3
6405 W. 65th Street, Chicago, U. S. A.

☐ Please send me full details on the S-M 716 and 683 (enclosed you will find 2c).

☐ Please send me FREE your new General Parts Catalog.

Name ....

Address ....