San Francisco November, 1923

RADIO

25c

In This Issue---

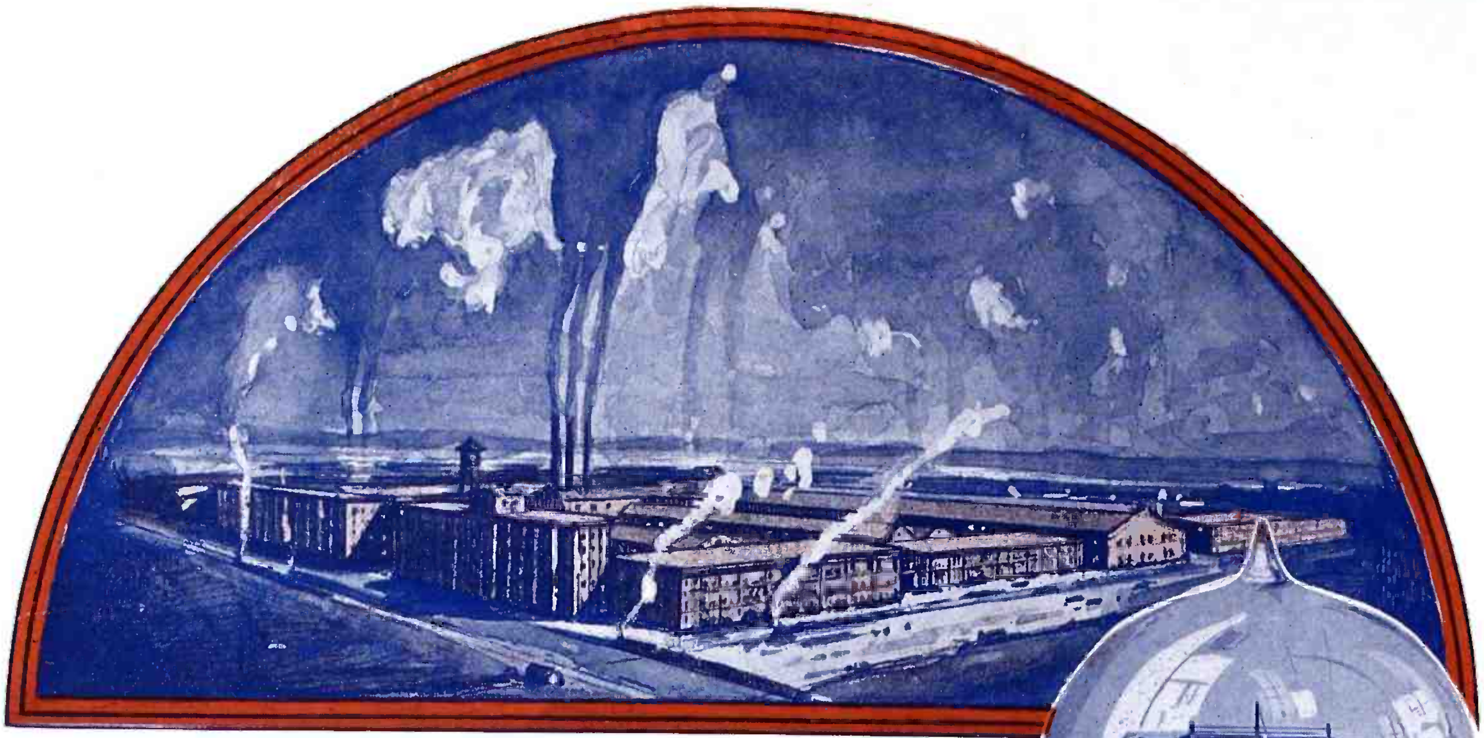
The Abelé Receptor
Lloyd Jacquet

Reflexing One Tube
E. Jay Quimby

A Simple Radio Phone
Samuel G. McMeen

How to Make a Loud Speaker—Stuart Hendrick

Complete List Calls Heard by Mix till September 20th



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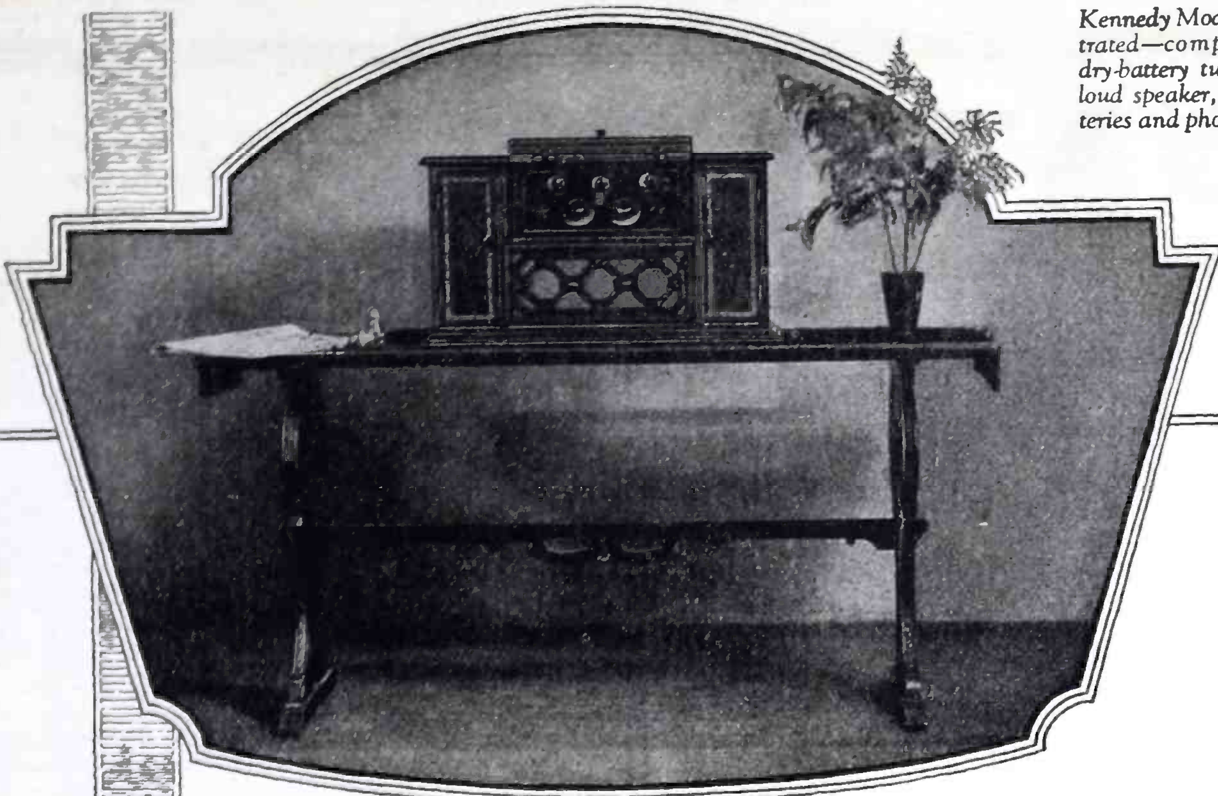

Kennedy Model X—illustrated—complete with 3 dry-battery tubes, built-in loud speaker, all dry batteries and phones, $285.00

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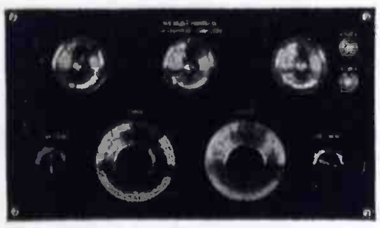

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KENNEDY

The Royalty of Radio

RADIO

Established 1917 as Pacific Radio News

Volume V for NOVEMBER, 1923 *Number 11*

CONTENTS *for* NOVEMBER, 1923

RADIO is Published Monthly by the Pacific Radio Publishing Co., Inc., Pacific Building, San Francisco, Calif.

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European Representatives: Compagnie Universelle De Representation wt de Commerce. Rue des Fortifications, 69, Anvers, Belgium.

Advertising Forms Close on the First of the Month Preceding Date of Issue.

Issued Monthly, 25c a copy. Subscription price $2.50 per year in the U. S., $3.00 per year elsewhere. Instructions for change of address should be sent to the publisher two weeks before the date they are to go into effect. Both old and new addresses must always be given.

Entered as second-class matter at the Post Office at San Francisco, Calif., under the Act of March 3, 1879.

Forecast of Contributions for December Issue

Brooke Sawyer gives the results of his successful experience in building eight "ham special" receivers with the Reinartz circuit. Six Zee Jay describes some adaptations of his tuner as given in March RADIO. H. T. Gallaher also describes some improvements that he has made in this excellent circuit.

Jesse Marsten has a complete account of the theory and operation of various types of battery chargers. A. Reisner warns against the dangers of over-insulation. Samuel G. McMeen in "Certain Inductance Considerations" gives valuable tables for ready calculation of inductance values. This article might well be termed the arithmetic of tuning.

Those about to erect a transmitting aerial can gain some good ideas from Charles K. Fulghum's discussion of power losses.

The subject of crystal detectors will be brought up to date in articles by Paul Oard and D. B. McGown.

Don Lippincott furnishes the key to an understanding of electric current filters, what they do, how they do it, and how they are made. This is probably the first time that this subject has been satisfactorily handled in elementary form.

Edward T. Jones gives some simple directions for increasing the wavelength of your receiver in order that stations with the high wavelengths may be heard on sets designed for 360 meter reception.

D. B. McGown will continue his series on "Home Radio Shop Practice" with an article on winding various parts. The same general subject of shop practice will also have a contribution on the use of taps, drills, and machine screws in assembling radio apparatus by H. A. Highstone.

Florian J. Fox, in the course of his three part serial on the radio transmitter, discusses the various sources of plate voltage and details the construction of a transformer and rectifier.

Among the shorter articles, Frederick J. Rumford describes a convenient method for testing the genuineness of a UV-199 or C-299 vacuum tube, Maurice Buckbinder discusses the principles of detector tube operation and Chas. F. Filstead describes a simple battery switch.

M. B. Sleeper tells all about the Grimes Inverse Duplex Circuit, what it is and how it can be used.

Samuel Jones, the eccentric radio operator made famous by Volney G. Mathison, once more appears on the scene in "The Woman-handler." This is one of the best stories that Mr. Mathison has written, and that's saying a lot.

Herman A. Fischer has a unique design for short and long wave receiving apparatus, which was unavoidably left out of the November issue, but will be published in the December number.

Broadcasting Pays Its Debt to Amateur Radio

The early experimental work of the Radio Amateur has made possible the radio concerts which thousands now enjoy.

"If an artisan wants to do his work well, he must begin by sharpening his tools."

—*Confucius.*

To make worth while DX Records one must first acquire a thoroughly efficient receiver.

Doctor Mu

GREBE RADIO

The GREBE "13"

A Real Receiver for Relay Men

Sharper Tuning   Greater Range   Quieter Operation

This Instrument is a short wave development of the GREBE Broadcast Receiver, especially adapted to meet the requirements of long distance work on 80-300 metres.

It is significant that A. H. Grebe & Co., Inc., so closely linked with amateur radio since its earliest days, should be the one company to build such an instrument for the relay man.

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This Receiver successfully combines Regeneration and Tuned Radio Frequency Amplification. In the non-oscillating condition, it builds spark signals to greater volume—in the oscillating condition all spark signals and practically all "mush" notes are suppressed.

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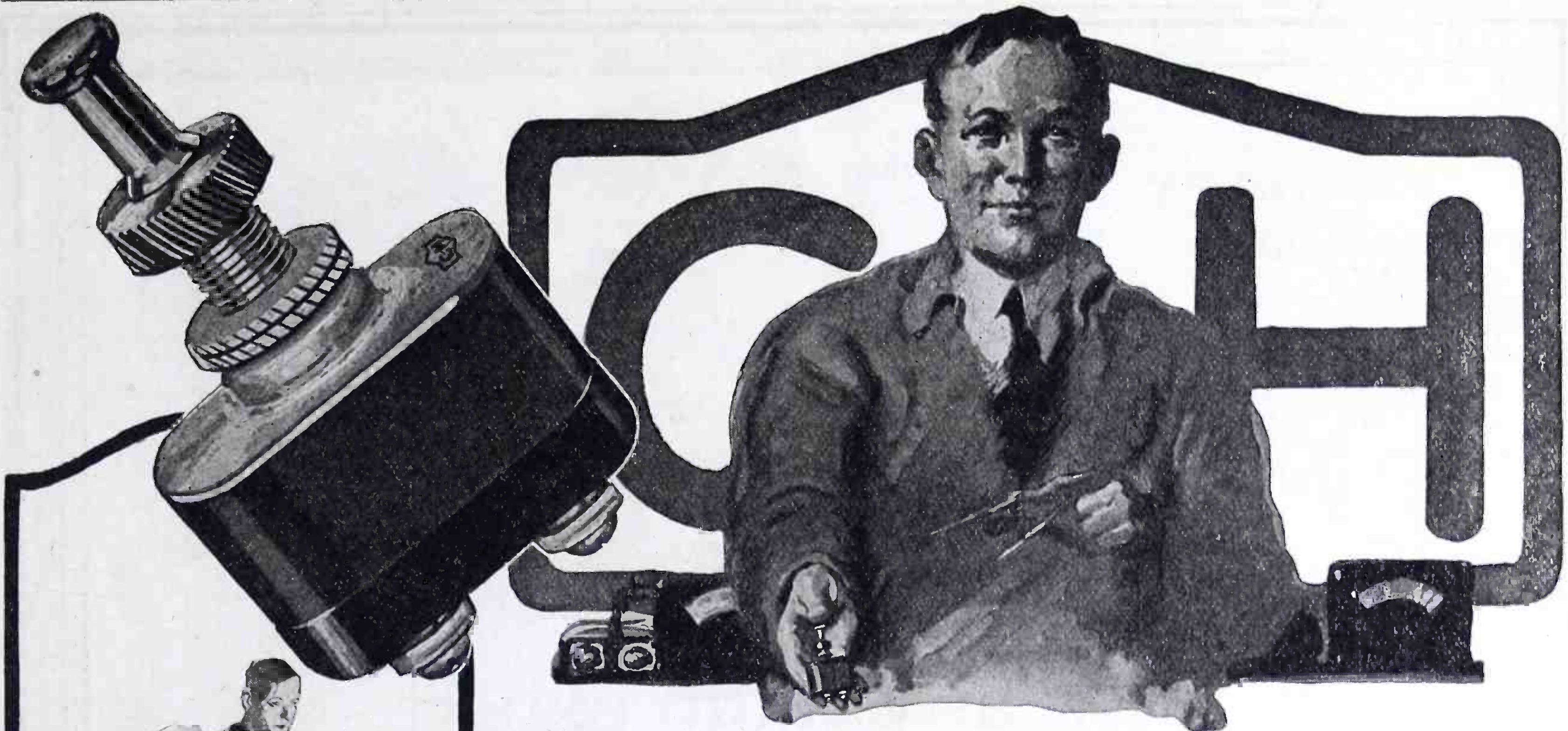

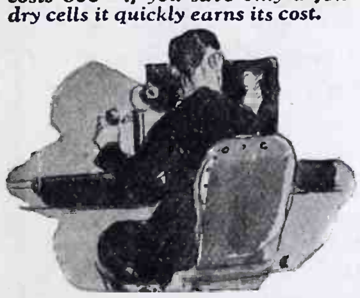

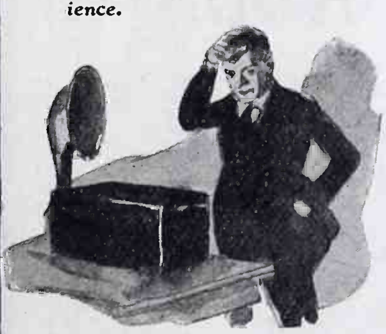

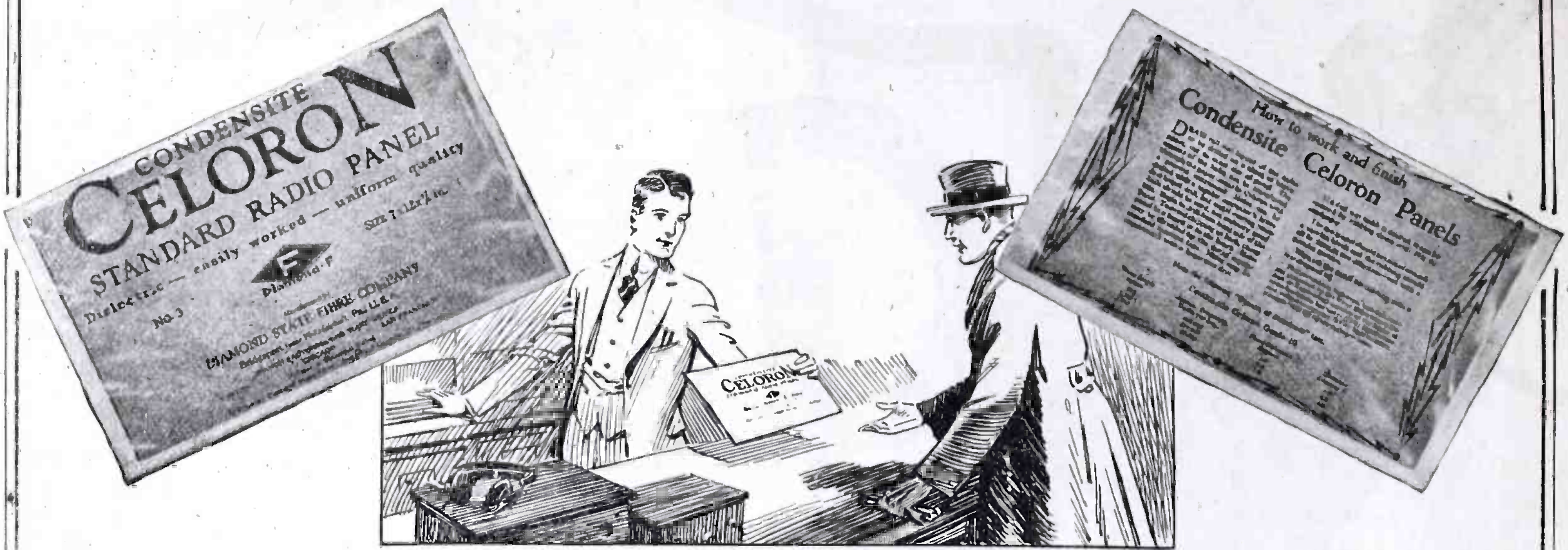

Ask any radio expert

THE first duty of a radio panel is to give satisfactory insulation, as any radio expert will tell you. The wise fan selects his panel with special care and insists on having one that supplies the proper insulation resistance.

Celoron Radio Panels provide satisfactory insulation under all conditions. They have high dielectric strength and great surface and volume resistivity, and do not warp or crack when exposed to moisture.

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Select from the following standard sizes the panel that suits your needs:

1—6 x 7 x 1/8	5— 7 x 18 x 3/16
2—7 x 9 x 1/8	6— 7 x 21 x 3/16
3—7 x 12 x 1/8	7— 7 x 24 x 3/16
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If your dealer cannot supply you, ask him to order, or write direct to us. Indicate by number the size you need. We also furnish Celoron in full-sized sheets and in tubes, and can cut panels in special sizes if desired.

This booklet free

Write for a copy of our booklet, "Tuning in on a New World," which contains a list of the leading broadcasting stations in the United States and Canada, an explanation of symbols used in radio diagrams, and several efficient radio hook-ups. It will be sent to you free on request.

To radio dealers: Send for special dealer price list showing standard assortments

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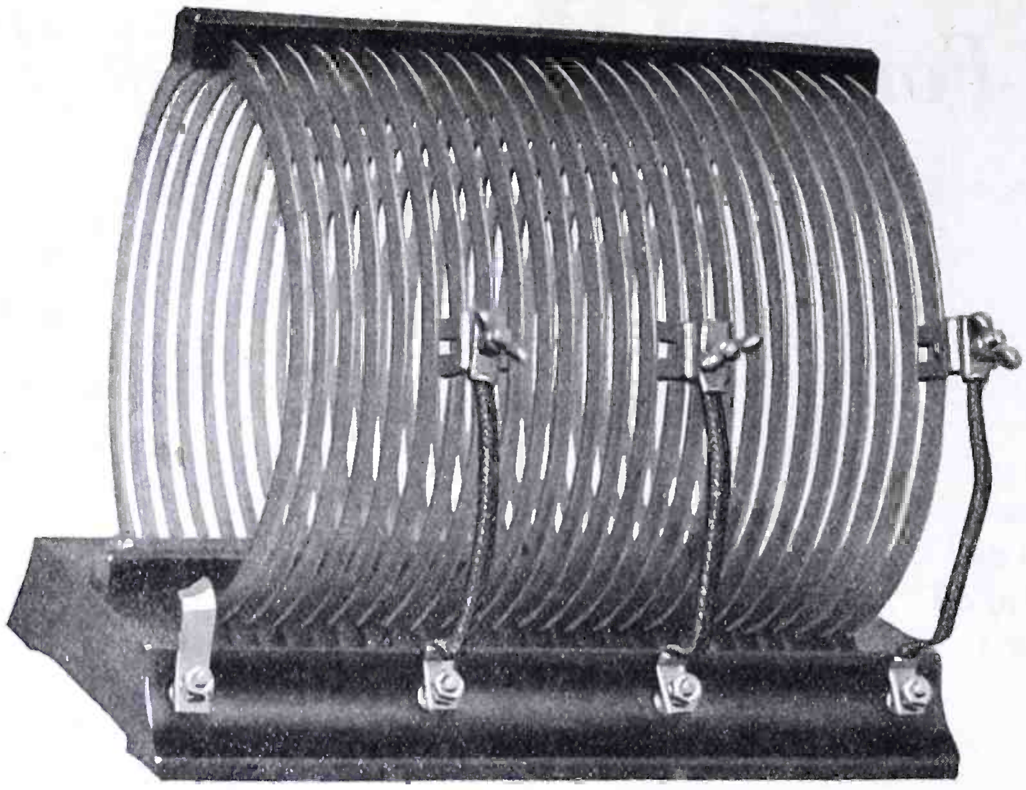

An Oscillation Transformer
for tube or spark transmitting sets

This neat and compact unit, sturdily built, was developed primarily for use with Radiotrons, but may be used successfully in either a tube or spark set to *conductively* couple the closed and open oscillating circuits. Two of these transformers may be utilized to *inductively* couple the closed oscillatory and the antenna circuit. This unit has a very low resistance and is designed to withstand the potentials developed in circuits utilizing Radiotron power tubes.

The transformer consists of 25 turns of .06"x$\frac{3}{8}$" copper strip, nickel-plated, with edges rounded, mounted on a polished black wooden base, and four binding posts for making connections. To three of these are secured flexible conductors, each equipped with a convenient clip for selecting tap points on the copper strip.

Dimensions overall: $7\frac{7}{8}$"x$6\frac{1}{4}$"x$9\frac{3}{8}$"

$11.00

This symbol of quality is your protection

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November 1923

RADIO

Established 1917

Vol. 5, No. 11

Radiotorial Comment

THE radio fraternity has three primary degrees: the novice, the amateur and the commercial. These are known respectively as the "B.C.L." or broadcast listener, the "ham" or amateur, and the "op" or commercial operator. There are higher degrees, such as that of radio engineer, which might be conferred by a university but are too often unjustifiably assumed

Initiation into the mysteries of radio is given to all who seek it. But where millions have qualified to the degree of "B.C.L.", the "hams" can be numbered in the thousands. The amateur gets more pleasure and benefit from radio than it is possible for the mere "B.C.L." to ever secure. He plays the game for the pure love of it, the name itself being derived from the Latin *amare,* to love.

RADIO is primarily the amateur's magazine. It contains information whereby any "B.C.L." can so perfect himself as to be advanced to the "ham" degree.

The great mass of "B.C.L.s" are unorganized, whereas most amateurs belong to a radio club. The "B.C.L." should do likewise. He will learn much by association with the amateurs and they will welcome him into their ranks. If there is a radio club in your neighborhood, join it by all means. If not, why help to start one.

For the young men, also, there are many benefits to be derived from experience as a commercial operator. There is no better nor more economical means for seeing the world and gaining the knowledge of world affairs that is essential to success in life. While it is not to be recommended as a life career for all, yet there are many good men who find it congenial and profitable.

All these three degrees are good preparation for the degree of radio engineer, for whom there is a great future. Radio is destined to become more and more important in doing the world's work, and those men who take it up as a profession can be assured of a brilliant future. Radio is emphatically here to stay and is certainly worth while.

A MAGAZINE, like a man, makes no progress without a purpose. Each must gain the vision of a purpose toward which all efforts must be directed and fully dedicated in order that closed doors be opened and the seemingly impossible become fully attainable.

The purpose of RADIO is to teach. Its mission is to make clear the theory and practice of radio so that it can be understood and applied by anyone having a high school education or its equivalent. To do this in simple form is sometimes difficult because much of the existing information about the subject is locked up behind the doors of technical terms that can be understood only by technical men.

Twenty years ago the same situation existed as regards the gas engine. But the popularization of the automobile has made the man on the street familiar with the theory and practice of the internal combustion engine. It is not necessary for him to take a course in thermodynamics in order to know the how and why of the gas engine, nor should it be necessary for the layman to take a course in calculus and advanced electrical theory in order to know the how and why of a radio set.

Of course there are many people who operate an automobile without knowledge other than that certain results follow certain operations, that pressing the self-starter button starts the motor and that pressing the accelerator feeds more gas, just as many people who operate a radio set only know that lighting the filaments and setting the dials at predetermined points bring in the music. But certainly these kind of people do not get the satisfaction that they would if they knew why and how these things happen.

And so RADIO is the key that unlocks the door to this knowledge.

Of course it must be realized that what is gained in simplicity is lost in exactness of statement. The results are frequently qualitative rather than quantitative. But they suffice for the great majority and those who have the qualitative knowledge are then ready to get the quantitative.

Occasionally an article is published with algebraic, geometric or trigonometric equations. Although these can be skipped without loss of the meaning expressed by the text, we earnestly advise all serious readers to brush up on their elementary mathematics so as to have a foundation for their study of radio. With this end in view, it is planned to publish simplified explanations of essential operations so that those who have not enjoyed the benefit of a mathematical education may be able to know at least what is meant by the symbols employed.

Mathematics is a language in itself. Its symbols stand for physical ideas. It is a condensed form of short-hand writing, one short equation expressing what would require pages to explain in "plain United States." It usually can be translated into English, especially if supplemented by drawings, but in the translation much of the original thought and its power as a tool in attacking problems are lost.

How Radio May Repay Its Debt to Science

By John Stone Stone

These prophetic remarks were part of the address by the author on the occasion of the presentation of the 1923 Medal of the Institute of Radio Engineers to him at San Francisco by Colonel J. F. Dillon. They are most inspiring in their suggestions of future applications of the vacuum tube.

LOOKING back over the history of radio communication, as I remember it, from the early experiments of Hertz to the latest developments of the art today, there is one feature of its evolution that impresses me more than any other. I find that the art of radio communication differs from other electrical arts in that the early growth of these latter has depended almost wholly on empirical developments, while the advances in the art of radio communication, even from its earliest days, have been almost exclusively through the astute application of the principles of the pure sciences. It is this fact that accounts, I believe, for the rapidity with which the art of radio communication reached its advanced achievements.

For this reason radio communication is under a greater debt to the sciences than is any other of the electrical arts. In looking forward I am not therefore so much concerned to see startling advances in the art or profound modifications of its processes as I am to see it repay its debt to science. That this is imminent we may feel reasonably sure, and though I have not the hardihood to attempt to predict the exact nature of its contribution to science, I may nevertheless venture to point out that the audion, or three electrode vacuum tube amplifier, is a veritable electrical microscope whose power to magnify electrical effects is enormously greater than the visual magnifying power of the corresponding optical instrument. The microscope has made possible bacteriology, with its inestimably important applications to pathology and therapeutics. May we not reasonably expect therefore that in the near future, this prodigious magnifying power of our electrical microscope will be used to detect and measure the minute electrical impulses upon which all our physiological functions are predicated?

The pathologist may then learn not only that a certain function has failed, but also determine whether the electromotive impulse required to initiate that function was transmitted from the brain. Indeed, may we not look even further forward with the hope that by means of this electrical microscope of almost limitless magnifying and resolving power we may be able to detect and study the brain currents which accompany thought — the brain currents which may indeed be the stuff of which our thoughts are made.

JOHN STONE STONE
Pioneer in Radio and Recipient of 1923 Medal of I. R. E.

But aside from the audion amplifier and its possibilities in the field of science, there is the selectivity of our radio receivers which makes of them veritable long-wave spectroscopes. We all know that just as the microscope made bacteriology and its application to pathology and therapeutics possible, so the spectroscope made astro physics an exact science, and enabled us to determine the substances constituting the self-luminous heavenly bodies and to detect some of their hidden motions. But we also know that the heavens are pouring down on us all manner of electro-magnetic waves, and I should be much surprised if they did not bear a message as significant as that brought to us by the light waves from the same source.

There is nothing very difficult about designing a directive receiver which shall receive electric waves from any particular part of the sky to the exclusion of that from the rest of the vault. And as such a receiver is, by virtue of its selectivity, essentially of the character of a spectroscope, we have within easy reach, a means of hearing and understanding whatever of Nature's messages are being rained upon us from the sky. If such a directive receiver as that which I have indicated were pointed at the sun during a total eclipse it could scarcely fail to give interesting results.

THE Institute of Radio Engineers was organized in New York City in 1912, but most of you probably know little of the two organizations, the Society of Wireless Telegraph Engineers and the Wireless Institute which coalesced to form the Institute of Radio Engineers.

The Wireless Institute was organized in New York City in 1909. Its moving spirit and president from the date of its organization until it merged with the Society of Wireless Telegraph Engineers to form the Institute of Radio Engineers was Robert H. Marriott, who became the first president of the Institute of Radio Engineers.

The Society of Wireless Telegraph Engineers had its origin in Boston and Cambridge, Massachusetts among a small group of men who constituted the technical staff of the Stone Telegraph and Telephone Company.

In 1907 it occurred to me that it would be a distinct advantage to each of us if we crystallized our ideas about our work into scientific papers, and that it would be of great value to all of us to hear and discuss such papers. I therefore organized a society of wireless telegraph engineers within the staff of the Stone Telegraph and Telephone Company. We held regular meetings, usually at my house on Bay State Road, Boston. Many excellent papers were read and discussed, and after the adjournment of the formal meetings we had a light supper.

The value of this society to its members became so apparent that in 1908 it was decided to incorporate the society and to extend the privilege of membership to radio engineers generally.

A few weeks ago, while looking through my files for the year 1908, I found the certificate of incorporation of the Society of Wireless Telegraph Engineers, granted by the Commonwealth of Massachusetts, the petition for incorporation, the record of the first meeting after incorporation, and the by-laws of the society.

I have caused the first two documents to be framed and before closing these remarks, I am going to ask your chairman, Col. J. F. Dillon, to be so good as to accept these old records on behalf of the Institute of Radio Engineers.

You will recognize some of the names on these documents. They are: John Stone Stone, Roy T. Wells, Chas. E. Russell, Alex. P. Browne, Ernest R. Cram, Chas. C. Kolster, Geo. K. Woodworth, Ernest C. Robes, Oscar C. Roos, Frederick A. Kolster.

The Abelé Receptor: A French Receiver

By Lloyd Jacquet, 2OZ

Just as American amateurs swear by their Reinartz tuners, the French place their confidence in the Recepteur Abelé. As it employs several interesting features which make it well adapted to short wave reception, it is certainly worth trying out.

EVERY radio amateur worthy of the name is acquainted with the Reinartz tuner. It is a standby in many American stations. Few of us, however, know about the "Abelé Receptor," which is to the French amateur what the Reinartz is to the American.

The Abelé receptor was conceived by a French signal corps officer, M. J. Abelé, just before the war ended. Hence, it is older than the Reinartz circuit. It received its first trial in the trenches, has since then spread throughout France and Belgium, and has been adopted as "the" receiver by those amateurs.

It should first be mentioned that the Reinartz and Abelé receivers are not exactly similar. While the Reinartz was essentially designed for short wave reception, the Abelé receptor was studied for a wavelength range of 1500 to 25,000 meters. Until a short time ago the European amateur was restricted to receiving only. Most of the amateur apparatus was designed for receiving the trans-Atlantic power stations, and this is the reason for the excessive wavelength range. We must acknowledge, however, that the European "ham" is a past master at the receiving game. That's all he's been able to do for the last twenty years!

The Abelé receptor employs, as does the Reinartz, ideas which are well known, and which have been patented a long time ago; capacitative coupling, tuned impedance coupling, shunt condenser, etc., but the Abelé combines these principles in an unusual and interesting way.

Essentially, the receiver makes use of capacitative coupling through a tube, as well as electromagnetic and electrostatic feed-back. It has some distinct advantages not possessed by any other type of receiver with which we are acquainted.

In the first place, a vacuum tube is placed between the primary and secondary coils, L_1 and L_2 respectively. This has the advantage of introducing a one-stage radio-frequency amplifier in this part of the circuit. The amplification thus obtained will be greater if the distributed capacity of the coil L_2 is small, and if the ratio between its inductance value and the capacity of the circuit is high.

The introduction of this stage of radio-frequency amplification does away with all re-radiation into the antenna. The radiating into space of a continuous wave by an oscillating receiver is a nuisance which interferes considerably with receiving. In England, single-circuit tickler feed-back receivers are prohibited for this very reason.

Another advantage of this first tube is the limitation of feed-back effects between the primary and secondary circuits. Because of the valve action of the vacuum tube, no reaction of the secondary circuit will be transmitted to the primary. This allows tuning of the secondary circuit without affecting the primary, and vice versa. Its greatest advantage lies in the fact that the coil L_2 and variable condenser C_2, forming part of an oscillating circuit, may be directly calibrated in meters. This is a very desirable feature, which the operating amateur will be quick to appreciate. The primary may be made aperiodic, as in the Reinartz tuner, while the secondary remains tuned. This is invaluable as a pick-up circuit.

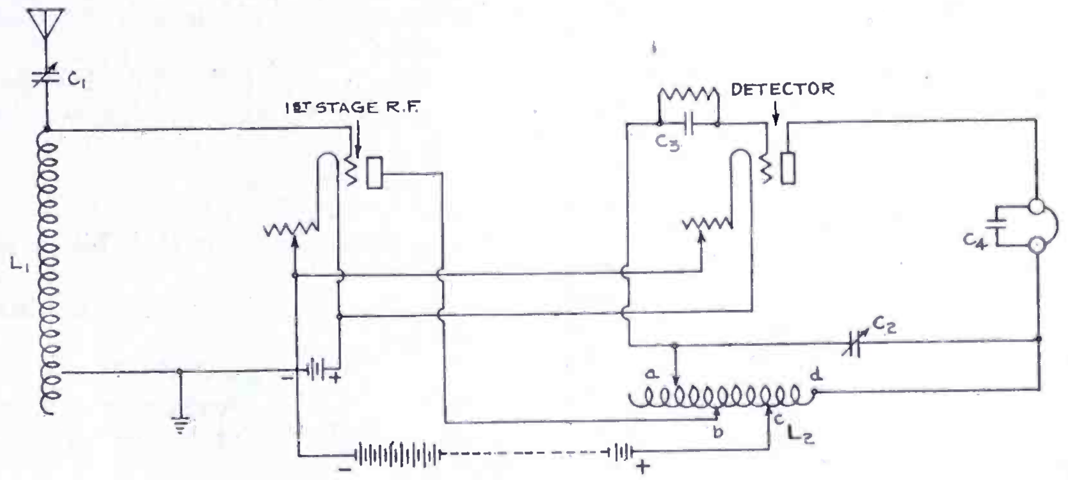


Fig. 1. Circuit of the Abelé Receptor

The secondary coil L_2 is used as a means of providing regeneration, and to secure a step of tuned radio-frequency coupling, with the use of variable condenser C_2. Thus, coupling and regeneration are secured through the use of but one winding. Current flows first through portions *b-c* of the coil, from the plate circuit of the first tube, and through portions *c-d* of the plate current of the second or detector tube. The first transformation: $\frac{ad}{bc}$ has a ratio of about 2 or 3, and need not be regulated with a great deal of care. The second ratio of transformation: $\frac{ad}{cd}$ is made much higher, somewhere around 10, and the adjustment must be made with a certain degree of accuracy so as to secure maximum amplification.

Few data are available for the construction of an Abelé receptor for short wave work. However, it is thought that by following the suggestions given below some interesting results might be secured by the amateur who likes to experiment.

Referring to Fig. 1, L_1 is the primary winding. It is similar in construction to the Reinartz antenna coil. It may

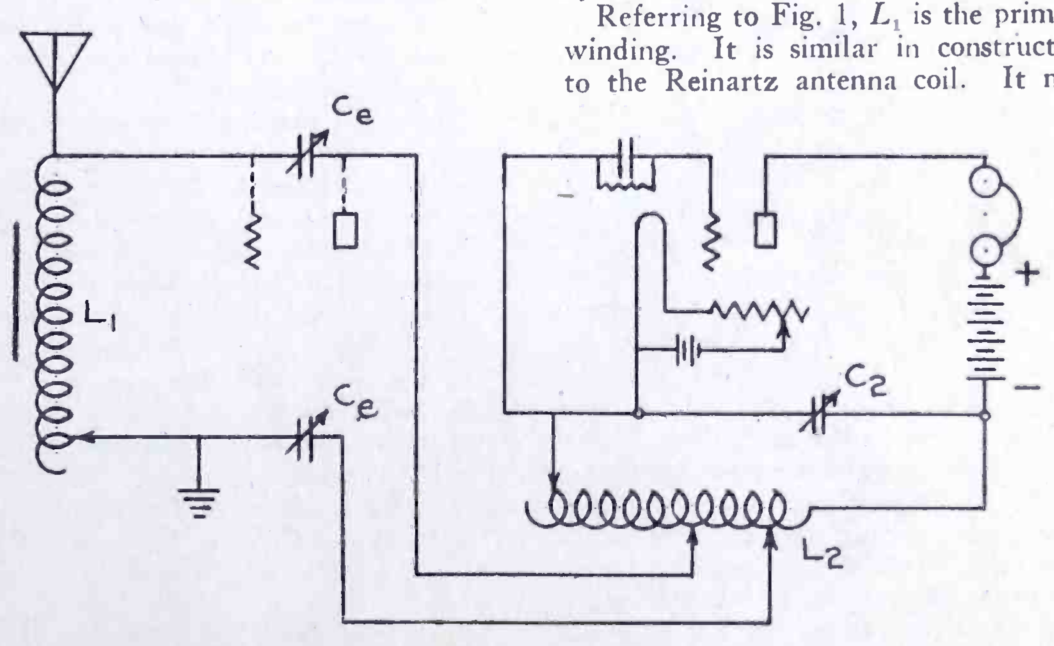


Fig. 2. How the Abelé Was Derived

(The capacity C_e in a capacitative-coupled tuner with primary L_1 and secondary L_2 is replaced by the capacity between elements of a vacuum tube with attendant advantages explained in text.)

consist of from 60 to 70 turns of No. 18 to 22 s.c.c. wire on a tube 3½ to 4 in. in diameter. The variable condenser C_1 is the usual antenna tuning condenser, and may be of .001 mfd. in capacity. This primary coil is placed at least 3 ft. away from coil L_2, and preferably at right angles to it. They may be placed in separate cabinets, and with their controls both within reach of the operator. The coil L_2, which serves several purposes, consists of 40 turns of No. 22 s.c.c. wire wound in a single layer of a tube 3½ to 4 in. in diameter. The winding is tapped every two turns. It is shunted with a variable condenser C_2 of approximately .001 mfd. capacity. This variable condenser must be of good make, and with minimum leakage. C_3 and C_4 are grid and phone condensers respectively, and are of the usual size.

Any type of vacuum tube may be used with the Abelé circuit. It makes use of the parallel *B* battery source of supply, and between 45 and 60 volts should be used here. The *A* battery will of course depend upon the tube.

The operation of the receiver is comparatively simple, and can be mastered in a few moments. First of all, the primary circuit is roughly tuned to the wavelength desired, by means of the variable condenser C_1 and the tapped inductance L_1. Taps *b* and *c* are located about in the middle portion of the coil, and *a* toward the beginning. Condenser C_1 is then adjusted until the secondary circuit is in resonance with the primary. This process will at the same time tune the plate of the amplifier tube, and it may be necessary to slightly detune it, or reduce the filament rheostat in order to stop the circuit from oscillating violently. Once signals have been tuned in, taps *b* and *c* should be properly located by experiment. It is also important that tap *a* should be in the proper place. Once these taps are adjusted, they need never be altered again, unless a new vacuum tube with different characteristics is placed in the amplifier socket.

In practice, the operation of the Abelé receptor reduces down to the tuning of the circuit L_2 C_2. Thus it is truly a uni-control receiver. By causing the detector to oscillate, it is possible to receive C. W. signals, without for that reason re-radiating through autodyne reception. Feed-back in all cases can be controlled by adjustment of variable condenser C_2.

As a universal receiver, for use of long waves, broadcast and amateur reception, the Abelé receptor is without a doubt a most interesting innovation. It combines all of the desirable features of sharpness of tuning, amplification through regeneration, no re-radiation, and efficiency on all waves. Will the American amateur place it next to his favorite receiver, and give it a fair try-out?

Bozo Learns About Women—and Batteries

(A "Sparks McAllister" Story)

By SEWELL PEASLEE WRIGHT

"A BATTERY *will* sweat!" declared Bozo, didactically. He tossed back the terrific mane of black hair that persisted in falling down over his forehead. "That is, any *old* battery will sweat, and that means that battery acid runs down along the sides and messes up whatever the battery is on." He paused and looked dejectedly around.

"Sounds reasonable," commented Wildcat, calmly. "As a matter of fact, something of the sort has happened to me, several times."

"Yeah!" grunted Bozo. "Me too. Once too often!" The look of dejection grew on his face.

"What's a matter?" inquired Wildcat, thumbing through the latest radio catalog, which he had picked up from Sparks' operating table. "Get in wrong with the powers that be?"

Bozo sighed, and nodded his head sadly.

"You know I had my set in my bed room——"

"'Had?'" interrupted Wildcat.

"Yeah, 'Had,'" Bozo assured him. "'Had' is right! But lemme tell you about it."

"My dog-gone battery isn't very new, although the plates are in pretty good shape, and it —— well, like I said, a battery *will* sweat. There's no getting away from that; and it isn't *my* fault, is it, if a battery does what it's supposed to do?" He looked around argumentatively, but Wildcat only grinned, and Sparks just nodded and sent a cloud of rank blue tobacco smoke rolling ceilingward.

"Well, my battery sweat a little, and somehow it kinda leaked down through all the papers I had under it, and got onto the rug ——"

"And now the rug's got pretty red spots all over it, eh?" chuckled Sparks.

Bozo snorted indignantly.

"Red spots, nothing!" he exclaimed. "*Holes*——that's what it's got!"

Wildcat and Sparks let go together; Bozo was so blamed *serious* about it! When the laughter subsided somewhat, Bozo managed to make himself heard.

"You guys may think it's a joke, but I don't! They made me take my set up in the attic, and that's raised the dickens with my ground lead and my wavelength, and when it gets cold I don't know what I will do! And all because that confounded battery had to go and sweat and ruin the rug. No sense in having a rug in a radio room, anyway."

"Bozo, my lad," said Sparks McAllister, gazing reflectively out of the window, "the value of all the carpets ruined by *A* batteries in the last three years would pay a year's interest on the money that Europe owes our Uncle Sam."

"We fought the war for a principle, and now it's the interest that's bothering us!" put in Wildcat, winking at Bozo. "Out!" declared Sparks. "Don't interrupt with those pre-C. W. jokes. Come down to date or keep quiet—preferably the latter!

"But, as I was saying, radio in general has been given considerable of a black eye by batteries that have made nice red spots on carpets——"

"Or burned neat round holes in 'em!" interjected Bozo, dolefully. "It's holes they make, I'm telling you; nice big round holes, so that the floor shows through——"

"I'll show you through the door, if you don't keep quiet when your elders are talking!" warned Sparks. "Now, as I was saying——"

"What *I* want to know," said Bozo, interrupting once more, "is whether you know anything about keeping batteries from sweating——sweating and making nice round holes in the carpets."

"I don't know anything that will prevent an old battery from sweating, I'll admit," said Sparks, "but——"

"Naw! It doesn't worry you! You're married, and boss of your own house, and if your battery wants to sweat, why let her sweat! What do you care? It's different though with a fellow who lives with his folks, let me tell you! Ain't that right, Wildcat?"

Wildcat nodded sympathetic assent. His folks had just made a new rule to the effect that his spark must be quenched at twelve o'clock —— not quenched as you and I understand quenching a spark, but more along the Websterian definition——and that put him in entire accord with Bozo's sentiments.

"I'll say there's a difference!" he agreed.

"A precious lot you know about it!" retorted Sparks. "You'd be surprised to see how a married man has to step around when the Missus speaks, but there! You'll learn some day!"

Wildcat and Bozo smiled unbelievingly.

"Catch me being bossed by a woman!" boasted Bozo.

"Let's not argue it!" suggested Sparks. "Better men than you two have met their Waterloo the day they said 'I do!', so you'd better pipe down.

"And listen, if you're really interested in knowing how to solve the sweating battery problem, I'll tell you about it. The whole secret is to let the battery sweat, but to *put something under her!*"

Continued on page 61

Reflexing One Dry Battery Tube

By E. Jay Quinby

Directions are here given for constructing a complete portable receiver with either a crystal or tube detector and one stage of both radio and audio-frequency amplification with a single tube. It will operate a loud speaker for local stations and bring in long distance on the head-phones.

CONSIDERABLE time has been spent in the author's laboratory developing a small portable set which will "get the most out of the least," and every effort has been made to eliminate all superfluous expense and trouble. The result is the set herein described, and anyone taking the brief time required to build it will be more than repaid, not only in the satisfaction resulting from its operation, but in the inevitable amazement at discovering that so much can be derived from so little. The set will actuate a loud-speaker on local stations, and will bring in distance clearly and strongly on the headphones. Local stations, when being received at maximum volume, will be found uncomfortably loud if the headphones are used, and it will be necessary to either switch over onto the loud-speaker or to cut down on the volume considerably. All batteries are contained in the cabinet, which is very shallow, and is provided with a carrying handle. Expense of operation has been reduced to a minimum, as the tube requires only .06 ampere on the filament, which is heated by a small battery that will operate for a month or two in ordinary service without replacement. A loop antenna may be used for local reception, or merely a piece of flexible lamp cord stretched on the floor, along the ground, or tossed up into the branches of a tree. It is not essential to use an actual ground connection—a counterpoise similar to the antenna wire may be used, stretched along the ground. However, a real antenna and ground produces much better results, and should be used wherever convenient.

The circuit is shown in Fig. 3, from which it will be seen that the single vacuum tube employed is used for double duty, amplifying the received impulses first at radio-frequency, and after these impulses have been rectified at the crystal detector, this same tube again amplifies them at audio-frequency, thus

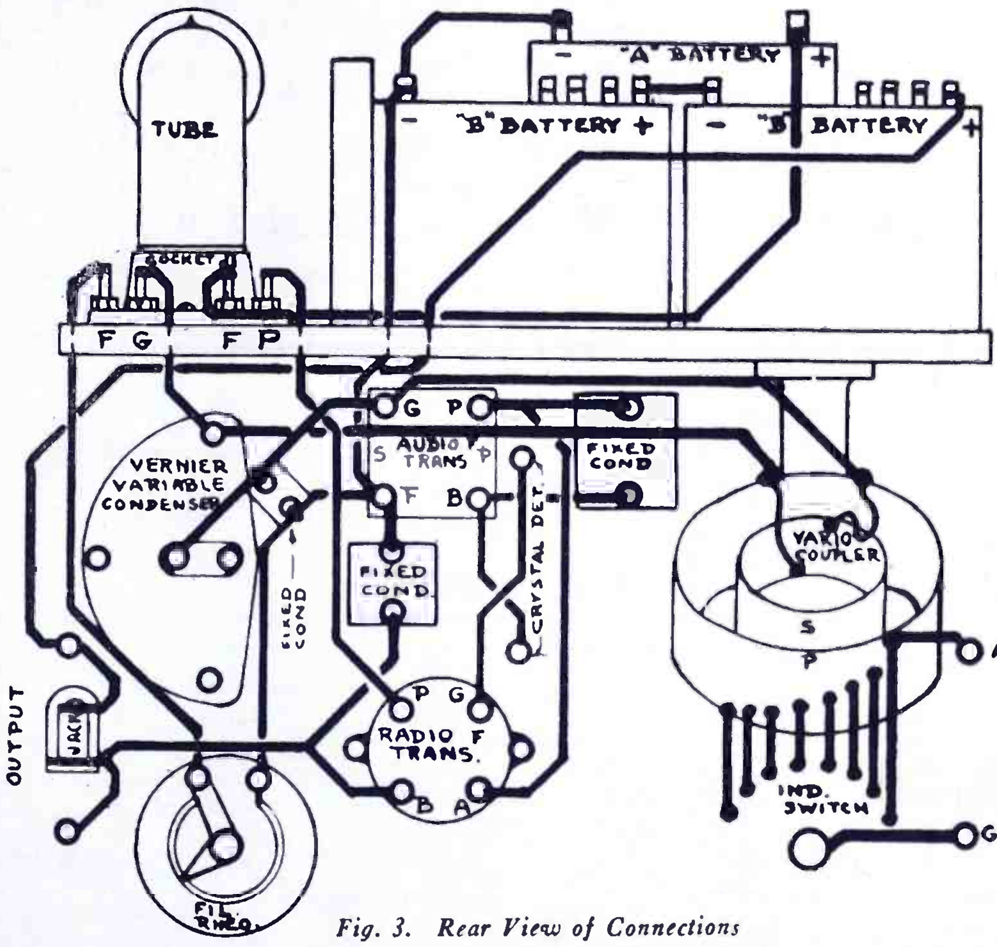


Fig. 3. Rear View of Connections

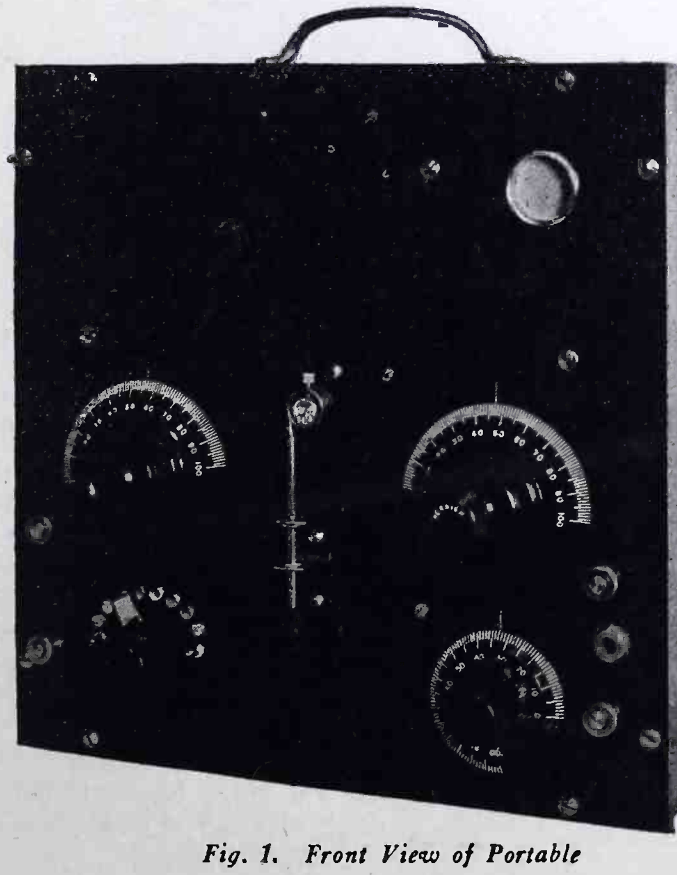


Fig. 1. Front View of Portable

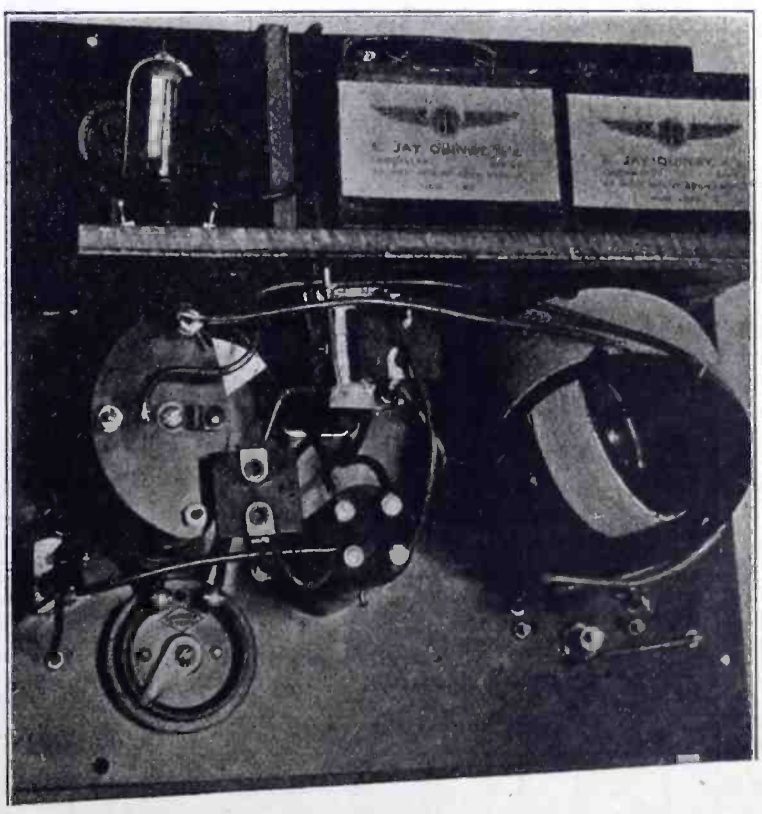


Fig. 2. Rear View of Portable

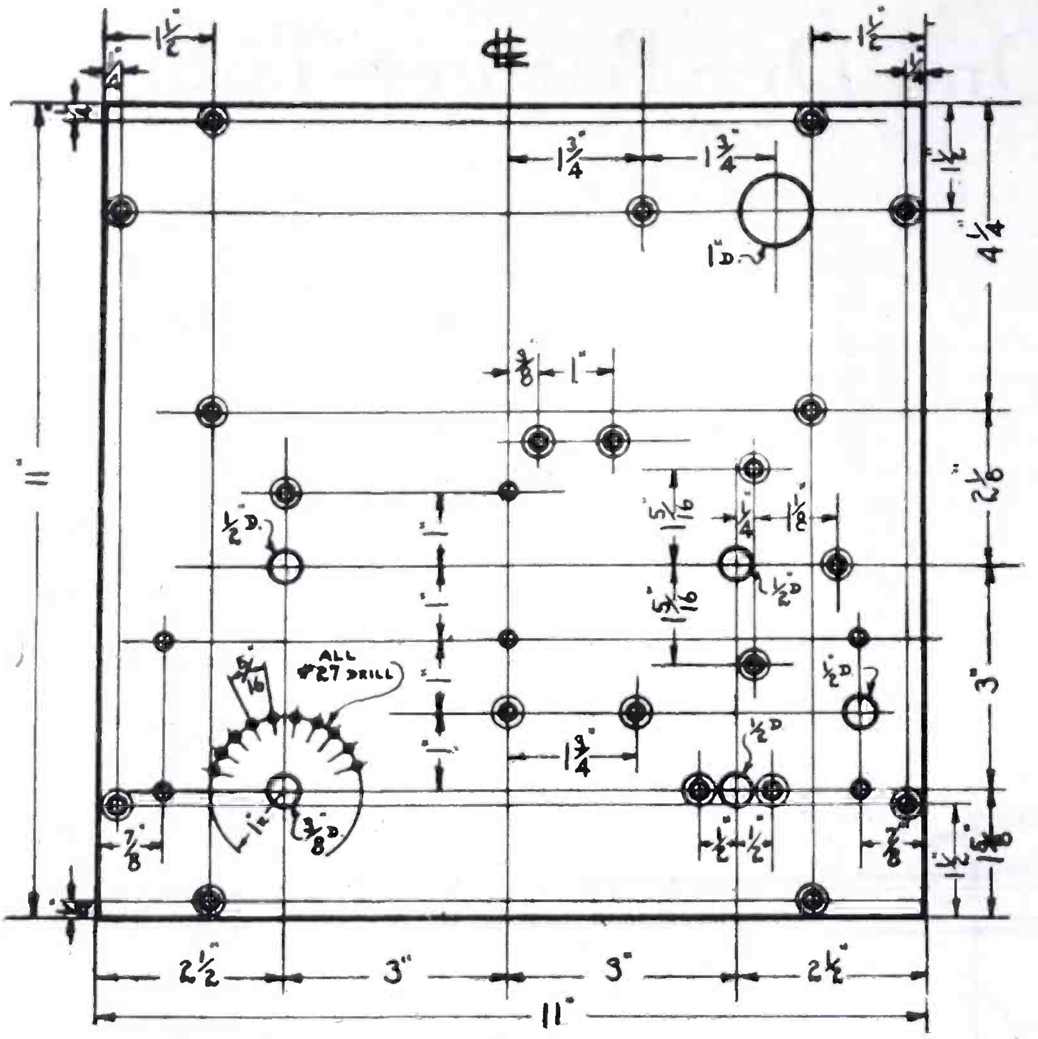


Fig. 4. Panel Layout

3/16-in. Bakelite. No. 20 drill for all holes unless otherwise specified. Double circles indicate holes countersunk for flat or oval-head screws.

PARTS—REQUISITION

Quant.	UNIT	REQUIREMENTS	TRADE NAMES
1	Panel	11" x 11" x 3-16"	Bakelite, Formica, Radion
1	Cabinet	11" x 11" x 4⅜" x ⅜"	Mahogany, Oak, Walnut
1	Variable Condenser	.00035 mfd. Vernier	Amsco, U. S. Tool, Pacent
1	Vario-Coupler	Pri. 50 T. No. 24 D. S. or D. C. with 7 equal taps.—Sec. 50 T. No. 24 D. S. or D. C. Two Layer Bank	Shamrock, Queens (either rewound) no shellac
1	Rheostat	30 ohms	Amsco, Reco.
1	Socket	For U. V. 199 or C. 299	Naald, R. C. A., Marco
1	Inductance Sw.	1" Radius	Amsco, Hayden-Fenton, Etc.
8	Switch Points	6-32 Thread, Nuts	Advance, Etc.
1	Fixed Condenser	.001 Mfd.	Dubilier-Micadon, Freshman
1	Fixed Condenser	.002 Mfd.	Dubilier-Micadon, Freshman
1	Fixed Condenser	.0005 Mfd.	Dubilier-Micadon, Freshman
1	Jack	Single Circuit	Pacent, Chelton, Federal
4	Binding Posts	6-32 Thread, Nuts, Non-Losable Tops	Fada, Etc.
2	Knobs-Dials	3" D. for ¼" D. Shaft	Tait, Pathé, Etc.
1	"A" Battery	4½ V.	Eveready No. 771
2	"B" Batteries	22½ V. Each	Eveready No. 763, Cyclone, Etc. (smallest size)
1	Detector Stand	Good Adjustment	Advance, Etc.
1	Detector Crystal	Sensitive All Over, Mounted	Foote Pyrite
12'	Ins. Tubing	Varnished-Cambric (not gelatine)	Mitchel-Rand, Mica-Insulator, use only best grade
15'	Connecting Wire	No. 18 Soft Drawn Copper	Amer. Steel & Wire, Etc.
1	Audio F. Transformer	Ratio 5-1	Jefferson No. 45, Cardwell, Amertran, Etc.
1	Radio F. Transformer	Reflex Type	Erla, Cardwell
8	N. P. Mach. Screws	Flat-head, 6-32 x ¾"	
6	Hex. Nuts, Brass	6-32	
8	Brass Wood Screws	⅝" No. 6, Oval-head, N. P.	
1	N. P. Bezel	1" D.	Erla
1	Vacuum Tube	Fil. 3 V, .06 A	R. C. A. "U. V. 199," Cunningham "C. 299"

Note:—Where "Etc." follows item, particular make is unimportant.

obtaining very high operating efficiency. Unusually clear reception is thus obtained, free from howls and squeals present in many regenerative circuits, and the distance-getting advantages of radio-frequency amplification, the clear detection of a crystal undistorted by regeneration, and the required volume of one stage of efficient audio-frequency amplification are all combined in this little single-tube receiver.

The parts required are listed herewith, and it will be noticed that more than one make of part is mentioned for each item in an effort to avoid partiality to the manufacturers and to make it easier for the radio enthusiast to get his bill of materials together out of local stock and thus save valuable time. The parts mentioned have been tried and proven for this circuit.

First, the panel should be punch-marked through a template, which can be made of ordinary heavy brown paper, laid out in pencil showing the centers of all holes required, and the size drill for each hole. This template is made by resting upon its surface the various units in exactly the position they are to occupy in the finished set, and sketching the location of the mounting holes in with pencil.

The relative location of the various parts should be as shown in Fig. 4, bearing in mind that this lay-out was made for the parts specified on this drawing, and that, if any of the substitutes listed are used, the location of the mounting holes will be changed. However, the centers of location for the various parts should be followed out as nearly as possible.

After all holes have been center-punched through the paper template, the next step will be drilling the panel, making sure to use the right size drills for each hole, and to carefully countersink the holes to proper depth where flat-head or oval-head screws are to be used. Next mount all the units behind the panel, fasten the shelf and partition to the panel, and the tube socket to the shelf, as shown in Fig. 2, and the set is ready to be wired.

The wiring diagram, Fig. 3, shows not only the connections to be made, but also the exact route to be taken by each connection, and, if carefully followed, will do much toward making the set as successful as the original models. Be sure to solder all connections well with a good hot soldering copper, using barely enough soldering flux to make a good smooth union, and be sure to wipe off all excess flux left on any parts or on the panel after the joints are finished. This can be effectively accomplished with a small camel's hair paint brush and a little denatured alcohol, and a dry cloth of fine flexible texture. Do not overlook the space between switch points on back of panel, where the acid

Continued on page 88

The Problem of the Radio Relay

By Raymond Francis Yates, I. R. E.

Here is presented a brief summary of what has been accomplished and suggested in the development of a mechanical relay for radio control of the movements of distant mechanisms. While not mentioned in the article, it brings to mind the fact that the vacuum tube itself might well be adapted to function as a relay.

THE time is approaching when broadcasting must bow to radiodynamics and be satisfied with a less conspicuous seat on the stage where the great drama of radio is being enacted. Broadcasting is an important thing to be sure; it always will be important, and as time goes on its usefulness will increase. But some day radiodynamics will rob it of a great deal of its present glory, for it is evident that we are reaching a point where the radio control of distant mechanisms will find intensive application. The long arm of radio will reach out to the ships at sea, to the aerial argosies that will darken future skies, and to the express trains that speed over glistening rails. Tesla once said that we will soon be sending crewless ships across the Atlantic and he cannot be accused of being a wild dreamer.

In the development of any new art there is usually one outstanding problem that obstructs the wheels of progress. In the case of radiodynamics this problem is the radio relay. A relay reduced to its simplest form is nothing more or less than a current-controlled switch which will allow an extremely weak current to control a heavier one. From this it would seem that the development of a sensitive relay for radio purposes would be a comparatively simple problem, but it is not. In fact, it has been such a stubborn problem that it has engaged the attention of many of our best radio minds and some notable work has been done. But there is still a berth waiting for the perfect relay which will be extremely sensitive in responding to a few microamperes, and which will be rugged enough to meet the strain that will be imposed upon it by commercial application. Here is a problem on which the serious radio amateur might well spend some time. Success would bring to him a comfortable fortune providing he knew how to protect his rights and exploit his findings.

To permit the reader to become more conversant with the problem, the writer will briefly outline some of the more important work that has been done. In Fig. 1 we see a non-magnetic form of relay which operates on the capillary principle and hence is called a capillary relay. In a small bottle or other type of glass container there is placed a small amount of dilute sulphuric acid. Dipping into this solution is a capillary tube with a bore of about ½ millimeter. Mercury is forced down into this tube to within a short distance of its lower end. The remaining length of the tube becomes filled with sulphuric acid solution, forming a mercury acid solution junction. Connection is made to the mercury and the solution by means of small platinum wires. When a very small current is passed through the device polarization takes place at the junction and this causes a change in the surface tension of the mercury. This change makes the mercury rise and fall in the capillary tube. So sensitive is the mercury column to this influence that one ten-thousandth of a volt is sufficient to move the mercury column.

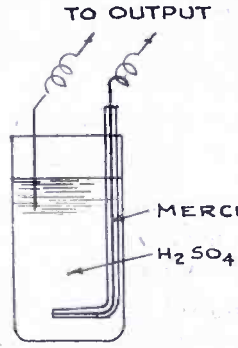


Fig. 1. Capillary Relay

As yet, means have not been found to apply the capillary relay in practice, owing to the difficulty of magnifying the motion of the mercury column. Meissner, in his book, "Radiodynamics" (Van Nostrand, 1916), claims that a motion of one-sixteenth of an inch would be necessary to establish the capillary relay as a workable and practical device.

Inertia is the Dr. Jekyll and Mr. Hyde of the science. Sometimes it is a benefactor and other times it is a nuisance. In the relay it is a nuisance; it is like an impudent jack-in-the-box, always poking its head up and jeering in the face of the would-be inventor. The little relay just described presents itself as an alluring possibility because of a small degree of inertia.

Some time ago the writer made some experiments on a new form of capillary relay which he believes holds out some promise. It is pictured in Figs. 2 and 3. *A* is a heavy brass casting threaded to take a telephone receiver. The receiver is put in place with its diaphragm, and between the diaphragm and the casting is placed a mica washer about one one-thousandth of an inch thick. This forms a chamber between the diaphragm and the brass casting about two inches in diameter and one one-thousandth of an inch deep. The brass casting is held in a hard rubber piece *B* which is provided with levelling screws. Connecting with the chamber there is a capillary tube *E*. The chamber is filled with mercury

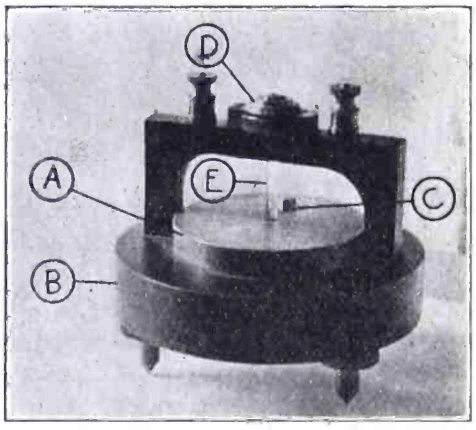


Fig. 2. Yates Capillary Relay

through the filling plug *C*, which is screwed down until the pressure on the mercury in the chamber is sufficient to force it a short distance up into the capillary tube, where it meets a platinum wire that is attached to the micrometer adjusting screw *D*. The latter member is graduated so that each mark represents a movement of the platinum of one one-thousandth of an inch.

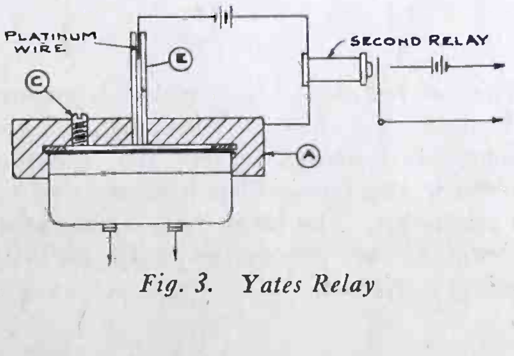


Fig. 3. Yates Relay

It is evident that the ratio of the surface of the mercury chamber to the surface of the mercury in the capillary tube is enormous and consequently the slightest change in the pressure caused by an electrical impulse passing through the receiver windings and acting magnetically upon the diaphragm will cause the mercury in the capillary tube to move an appreciable extent. In fact, this is simply a way of magnifying the motion of the diaphragm. It will also be understood that an impulse causes the diaphragm to be pulled toward the pole faces and the pressure in the chamber drops, causing the mercury which is normally in contact with the platinum wire to drop and open the circuit. This causes a second relay, operating on a reverse principle, to close the heavy current circuit. The second relay, of course, can be a very heavy instrument, since the capillary relay will pass appreciable quantities of current without causing the mercury to be heated to any great extent. Although this relay has been found to be fairly sensitive, it is somewhat sluggish in its action, due to capillary attraction, and the writer is now at work trying to find a capillary tube of just the proper bore to reduce its attraction to a minimum. At least the device is highly interesting.

The Finch relay, invented and developed by William G. H. Finch, I.R.E., is shown in Fig. 4, and it is

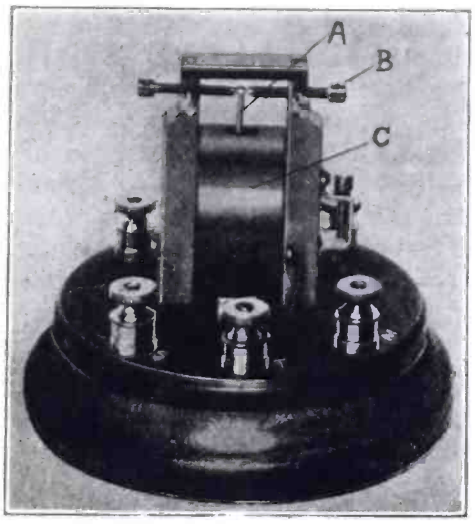


Fig. 4. Finch Relay

probably the most ingenious device of its kind in the world today. It is of the polarized type and designed to operate in connection with radio-controlled typewriters, where it is called upon to write as many as one hundred words a minute, a demand that makes it necessary for its armature to move with great

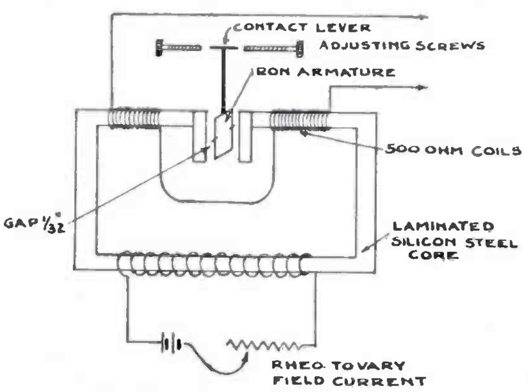


Fig. 5. Diagram of Finch Relay

rapidity. Fig. 5 is a diagram of the Finch relay, which gives a fairly good idea of its construction. Although it is purely an electro-magnetic device, its development has been carried to a high degree of perfection and it operated with high efficiency, responding readily to a current change of only .5 milliamperes. The contact arm of the Finch relay is of aluminum and very light. It moves freely in agate bearings, and the length of its stroke is readily adjusted as will be seen. Long service has proven the Finch relay to be a most extraordinary device and its perfection reflects a great deal of credit upon its inventor.

Aside from inertia, there is another bugbear with which the inventor of magnetic relays will have to contend. The writer refers to the counter e.m.f. that is produced in the relay windings when the circuit is opened and closed rapidly. These counter e.m.f.'s cause uncertain action of the armature when working at high speeds, and it was only with the most painstaking labor and experimentation that Mr. Finch and his collaborators were able to make the device insensitive to this influence. A diagram showing how the more simple type of Finch relay is connected to a radio circuit is given in Fig. 6.

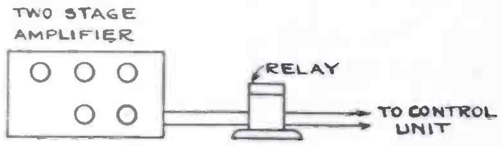


Fig. 6. Circuit Connection for Finch Relay

Brown, the English experimenter, has produced some ingenious relays, and one of his types is illustrated in Fig. 7.

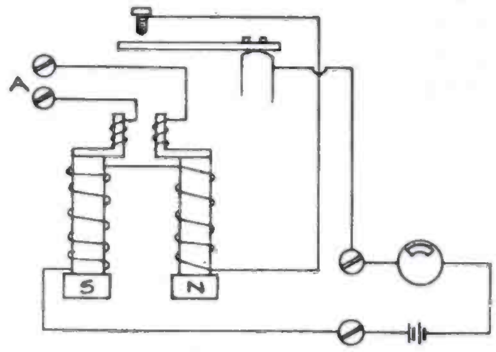


Fig. 7. Brown Relay

The input is connected to *A*. The operation of this device is so simple and evident that the writer does not believe it necessary to give further description.

Some time ago the Weston Electrical Instrument Company introduced a relay which is built upon the principle of a galvanometer, and the movement was similar to that employed in their student's type except that larger magnets were used. The delaying action of the spring in these types of relays makes them unsuitable for rapid makes and breaks but they are admirable for general control work where the intervals between the impulses are long enough. The device operates on a current of several microamperes.

Another kind of relay is shown in Fig. 8. This is known as the Lowenstein relay and it operates on a current of 1 microampere. There is a moving element which carries a coil of extremely fine wire in a contact which makes connection with a small pool of mercury when it responds to an impulse passing through the heavy windings. Two jewelled bearings carry the moving member and friction has been reduced to a minimum. The large magnets are kept energized by connection with a 110-volt d.c. circuit.

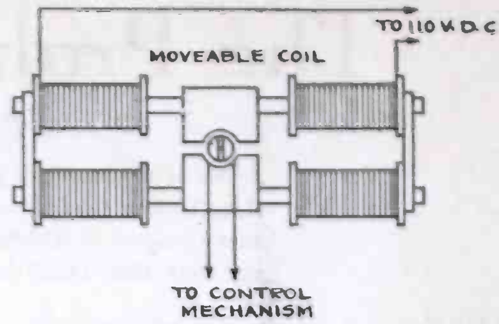


Fig. 8. Lowenstein Relay

Fig. 9 shows a device invented by G. Allstrom, and its operation is based upon the element selenium. It is claimed that it will respond to a current of one-two-hundred-millionth of an ampere. The output of the receiving set is fed to a powerful electromagnet and in front of the pole piece there is suspended a delicate armature carrying a mirror about the size of a pinhead. Upon this mirror a powerful beam of light falls and it is reflected off onto a box having a slit and containing a selenium cell. Normally the light reflected from the mirror does not strike the slit in the box. When an impulse passes through the electromagnet the mirror is moved and the beam follows it, moving to a position where it will pass through the slit in the box and strike the sensitive selenium cell mounted therein. The slow action of selenium would of course greatly interfere with rapid operation and if any of the experimental readers of this magazine would care to play with such a device the writer would advise them to obtain one of the new photo-electric cells, now being offered to the public by the General Electric Company. The inertia of these cells is much less than selenium and consequently they will respond more readily to the light changes.

There are numerous other relays that would take about four issues of RADIO to describe, but it was simply the writer's idea to give a short outline showing the trend of development, and at the same time hoping that he could impress the readers of this magazine with the importance of the problem, believing that some of the real hams of the experimental type will have a desire to do some work on it.

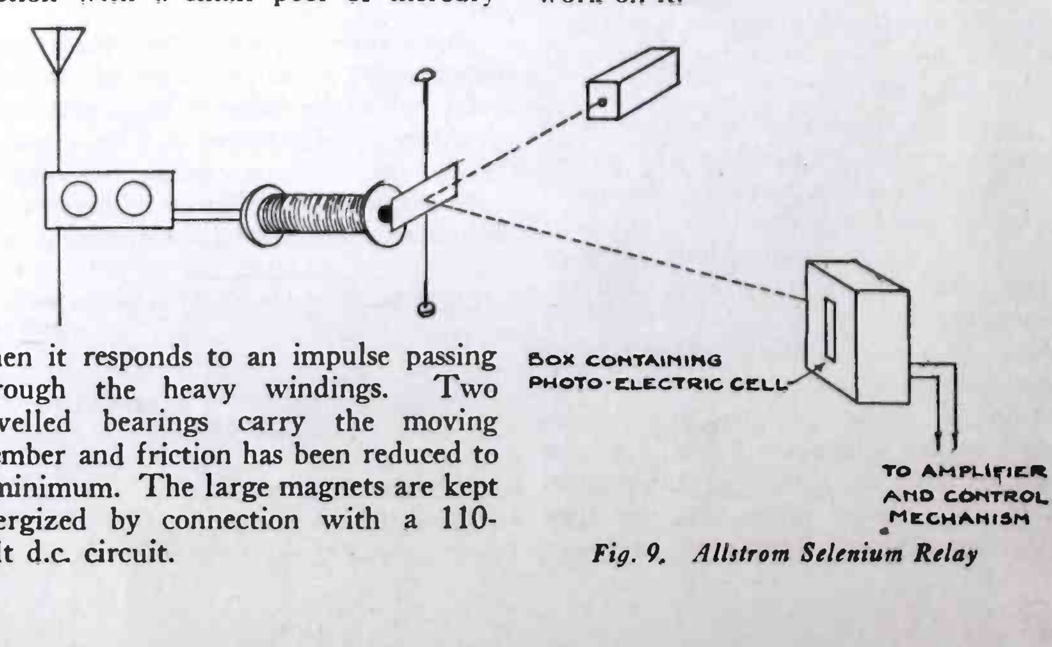


Fig. 9. Allstrom Selenium Relay

A Simple Radio Telephone

By Samuel G. McMeen

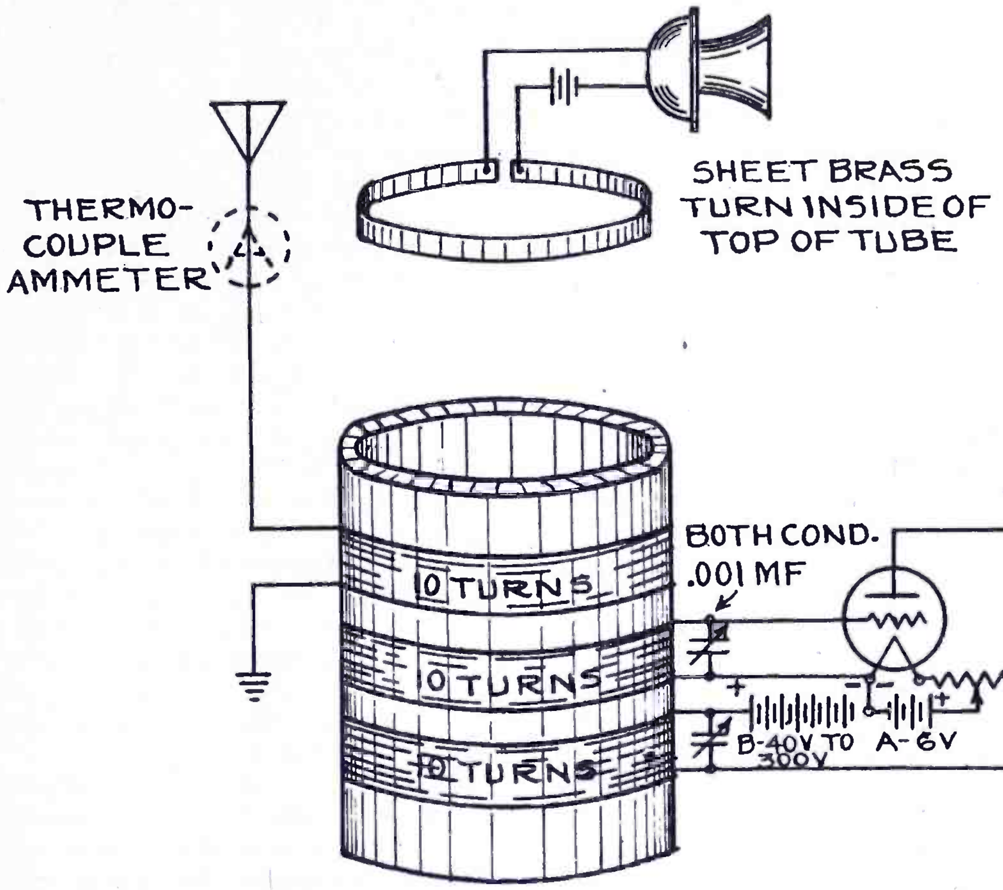
Simplicity, portability and compactness are seldom associated with a radio phone transmitter. But with the directions here given there is no excuse for anyone, with a license, not having this novel convenience. As it employs a five-watt tube it has ample range for experimental and many practical purposes.

THERE is a larger field for a simple radio telephone transmitter than has yet been occupied. One wonders why more such instruments are not utilized in construction camps in the inaccessible places of the earth, where parts of the camp are constantly moving about, and where the stringing of wires is not easy. Then, too, there are the cases of temporary need of communication, where the cost of erecting a wire is not warranted by the time it will be used.

One deterrent has been the widespread belief that all radiophones are costly to buy or out of the question to make. Yet thousands of sets of receiving apparatus are made by amateur workers every year, and the skill that can produce the one can do as much for the other. The difficulty perhaps has been a lack of conviction as to how simple a transmitting set really can be, and the unwarranted conclusion that it must be massive and complicated.

The arrangement here described has as its basis the premier of radio telegraphic transmitting circuits, and to it is added an element for the impressment of the voice waves on the radiated energy. It is not an element that can make claim to high efficiency, but certainly it represents nearest to zero in complication. We refer to the simple sheet brass ring or band shown at the top of the figure herewith. It is intended to encircle the inner, upper part of the tube on which are wound the three coils that make up the inductances of the set. The action of this band of sheet brass is most interesting. It is related only inductively to the other turns of the set. It is not even necessary that it be located very close to the other parts of the windings. Its purpose is to act like a partially short-circuited turn in a transformer, and to waste energy by turning it into heat. Indeed, the arrangement might be called a "waste system," or a "loss system," because the transmitting action is to produce a constant stream of energy and then deliberately to destroy a portion of the energy in the apparatus before its release into space, radiating merely the portion not so destroyed.

This destruction of energy—or, more accurately, its transformation into non-useful heat—goes on at a constant rate when nothing is being spoken into the microphone, but as soon as speech actuates the latter, the amount of loss in the microphone circuit varies, and in consequence there is a corresponding variation in the remainder, which is free to radiate and does so.



Simple Radio Telephone, Utilizing the Meissner Circuit and An Absorption Loop

The operating merit possessed by the whole device is a consequence of combining the excellent generating qualities of the Meissner circuit with the loss method of modulation, for the virtues of the one offset the shortcomings of the other. And in saying shortcomings we are speaking only of the scientific aspect of the matter. The results in speech transmission are very good.

As shown in the figure, the tube carries three windings, these being each of 10 turns. The tube is 4½ in. in diameter. The wire is No. 18 double or single cotton covered. The turns being so few, there would seem to be no reason why enameled wire would not do as well. These wound bands will thus be each ½ in. wide and are separated about ⅛ in. The whole winding will thus go on a tube little more than 2 in. long and leave free end-space for attachment purposes, if one is striving for compactness.

The exact amount of wire in the antenna coil is a function of the characteristics of the antenna to be used in each installation. Therefore it is well to tap the coil, so that if the whole amount is not needed it may be cut down to the point where the greatest radiation takes place. It is for the purpose of observing just when the greatest radiation occurs that we suggest in dotted lines the presence of a thermocouple radiation ammeter. Such a device is inexpensive, and a most satisfactory check on results.

The relation of the windings to the vacuum tube is shown clearly in the drawing, and, as always in the case of any circuit containing a tube, the plate voltage must be poled with the positive side toward the plate. The nature of this source of positive voltage is optional, and may be anywhere from 43 to 300 volts or more depending on what type of tube is employed. The guess is hazarded, however, that the worker who has not explored this exact realm will be surprised at the excellent ranges of the lower voltages that can be had from dry battery blocks. If a motor-generator is used for the plate voltage, it can be successfully smoothed out as to commutator noises by means of a small choke coil and an electrolytic condenser. The latter is the equivalent of many condensers of the usual 1 or 2 mfd. type.

The condensers for the grid and plate circuits are each .001 mfd. capacitance, though it is recommended that what is at hand be tried if somewhat less than that size, for, as operating with us, both these condensers are standing near the minimum and the radiation meter shows its maximum reading for a wavelength of 200 meters. We have also operated the set well with a plate condenser of .0005 mfd. and no grid variable condenser. This shows the leeway.

It should perhaps have been said before this that the set is intended to operate at the wavelength of 200 meters, adjustable by the condensers to a considerable degree. The changes necessary to get a still higher wavelength are merely in the grid and plate coils, which must be of more turns when the higher range is desired, say above 300 meters.

The source of current for the filament in the set under description is a storage battery. It has operated equally well with the filament energized by a small filament transformer, in which method no transformer hum was audible. We can think of no reason why one should not be able to do respectable transmission with the dry-cell type of tube, with consequent freedom from all current annoyances except occasional renewals. Considering the compactness of the set itself, there would seem to be little to be desired in that direction if such a plan were followed.

No grid-condenser or grid-leak forms a part of the circuit, though we observe such elements are always prescribed for the Meissner form of transmitting hookup. Very probably these elements would operate properly if chosen of the correct proportions but with the actual apparatus under description better results were had without either.

The microphone is of the type made especially for use with a local battery, i. e., it is of low resistance. Care should be taken as to this point if the device is bought especially for this purpose. If, however, a trial of the circuit is all that is wanted, and there is a microphone at hand and it is of high resistance, say 100 ohms or more, use it anyway, substituting several turns of No. 18 wire for the sheet brass turn inside the tube. The reason is that there should not be, for the best efficiency, too great a disparity between the resistance of the transmitter button and that of the absorption loop.

The inductance of the windings on a 4½ in. tube is almost exactly 20 microhenries each. If it is preferred to use a 4 in. tube the inductance will be about 5 per cent less with the same size of wire and the same ten turns. The condensers have ample range to care for the lessened inductance. If a 3½ in. tube is used, the inductance of ten turns will be about 15 microhenries, and it will be well to make 12 turns per winding, the inductance in such case being a little under 20 microhenries.

If the set does not oscillate at the first trial, when the connections have been checked, it may be necessary to reverse the grid and filament connections from the middle winding. This is because those connections may have been made originally in such a way that the influences of the grid and plate circuits are opposed with relation to the antenna winding. It is well, therefore, to leave the grid and filament leads from the winding long enough to allow this transposition if needed.

We remind ourself that at one point herein we spoke of the presence of the absorption loop changing the radiation from unity to four-tenths of unity. This was with no speech into the microphone. If speech is agitating the microphone carbon granules, the average resistance of that mass may be much higher than when they are at rest, varying considerably above and below the average with the vibrations of the speech. The ammeter reading therefore may not give more than an approximation to the actual radiation loss, but is nevertheless a valuable check on the results one is attaining.

For certain purposes a transmitting set may well be compact. In this regard it would be hard to outdo this arrangement. As we have used it the entire outfit is mounted on a base 6 by 9 ins., and 7 in. high. This includes the microphone, which in this case is mounted on a post at one corner of the base. The batteries are the only portions of the set that are not included in these dimensions.

The vacuum tube is a Western Electric VT2, which is of the amplifier-oscillator-modulator type. It is probably the equivalent, for the purposes of this use, of a 5-watt transmitting tube, and the latter can be used with good results. But if neither is at hand, try for results with a regular amplifier tube, using the plate voltage specified by the maker. It is surprising how much energy can be transformed into useful oscillations with the smaller tubes. We have regularly produced strong lighting of a wavemeter lamp with less than 100 volts plate voltage on an amplifier tube when used in the circuit covered by these notes.

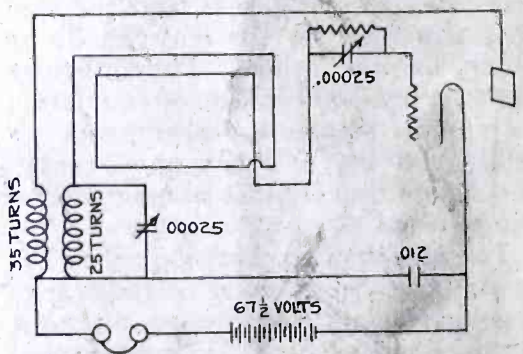
THE SIMPLEST SUPER

By L. W. Curtiss

EXPERIMENTERS who have been postponing the construction of a portable set because of the expense will be interested in knowing that my set cost me $5.10, excluding the cost of tube and battery. Its control is the acme of simplicity, all tuning being done with one variable condenser. It picks up stations 800 miles away on a 7½x10½-in. loop wound around the outside of the box and it fits inside a portable carrying case 10½x7½x3½ in.

The set is a simplified "super," as may be seen from the picture and the hook-up. The parts used are as follows:

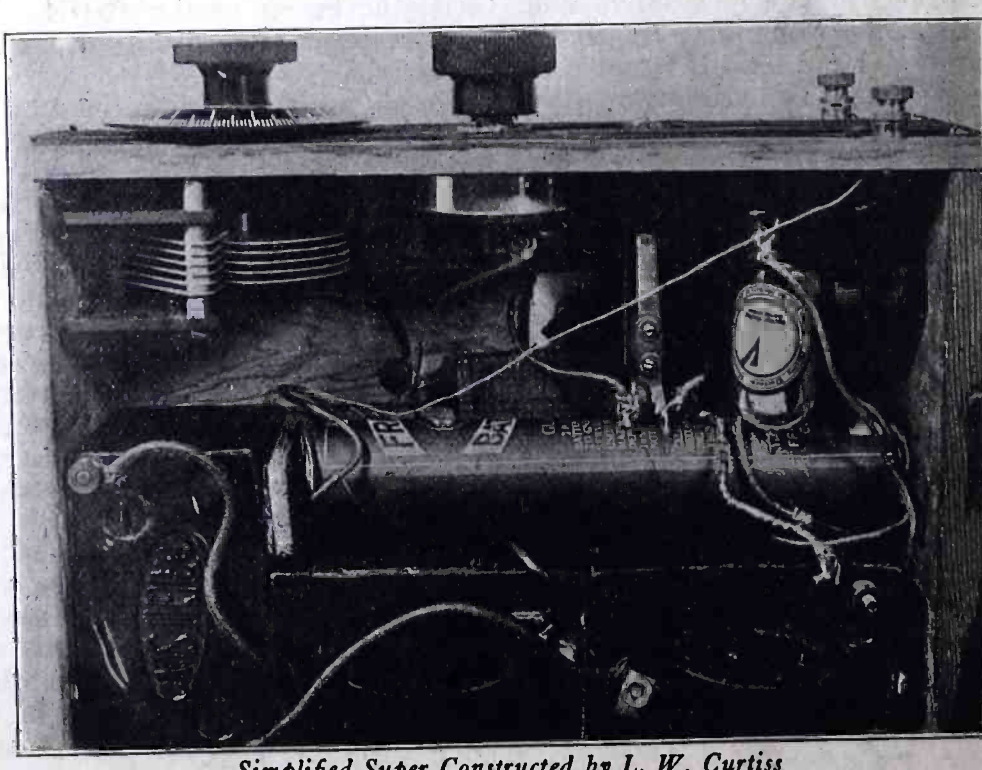
- 1 11-plate variable condenser with dial.
- 1 30-ohm filament rheostat with dial.
- 1 C-299 vacuum tube and socket.
- 2 binding posts (loop connection or shorting).
- 2 .006 mfd. Micadon fixed condensers.
- 1 Freshman grid condenser and grid leak.
- 2 4-in. spider coils (25 and 35-turns No. 26 wire).
- 3 22½-volt *B* batteries.
- 1 3-cell flashlight *A* battery.



Hook-up for Simplified Super

The hook-up is self-explanatory. If a larger condenser is used it must have a vernier, as the tuning is very sharp. To obviate the necessity of adjusting the filament rheostat every time the set is used a filament control jack is advisable, but not essential. The easiest way to get the correct setting for the condenser and grid leak is to cut a small slot in the

Continued on page 56



Simplified Super Constructed by L. W. Curtiss

How "Can" the Humming Bee

By Walter Emmett

Of the many wave filters proposed for eliminating undesired signals, here is a proposal that certainly should work, though, it must be confessed, at the cost of considerable complication. The first part of the article tells how to do it and the last part tells why it is done.

HOW does one get rid of the buzzes, squeals and chirps which guide the wandering radio citizen like the roar of the bleachers at the national game. Slowly and feverishly he tries to "flush" with his doughty revolver — I mean dial—the elusive carrier wave, but the echoes from the fans drown the voice of the umpire.

A combination of filters should be used as shown in Fig. 1. W_1, W_2, W_3 and W_4 are wave meters with dielectric losses equivalent to less than 1/20 ohm. This is absolutely necessary for sharp tuning without excessive loss of signal when weeding out undesired frequencies.

Condensers of .0005 mfd. are suitable for broadcast ranges. The wave meter coils are of 10 strand Litz or No. 28 D.S.C. wire. About 42 turns are used and over them are placed a sheet of thick letter paper on which is wound about 5 turns of the pick-up coils L_1, L_2, L_3. The pick-up coil L_4 has a triple winding of six turns wound in parallel on the wavemeter coil.

The receiver R has its antenna and ground posts shunted by pick-up coil L_4, whose coupling should be very close with the coil of W_4—the closer the better.

This is not quite so important in the case of W_1, W_2 and W_3, especially when more than one are used.

The three-wave traps W_1, W_2 and W_3 are called series traps, and W_4 is called a shunt wave trap. The series traps allow everything to go through them except the frequency to which they are tuned. The shunt wave trap does the same thing but is tuned to the desired signal, as it must reject this signal and thus push it into the receiver through the posts A and G.

If we want a signal of 360 meters, we set W_4 on 360 meters, and W_1 and W_2 on each side of this respectively, at equal wavelength differences, e.g. 350,370 or closer, if possible. W_3 can be used to reduce the QRM from some especially bothersome station and, if necessary, another series wave trap can be added to help. In this case the pair should work on either side of the QRM wave. The cost is about $4.00 per wave trap, if home-made.

It should be remembered that the series wave traps change the tuning of the set to all frequencies.

The shunt wave trap has the same effect to a far greater degree, but with one frequency excepted, i.e. it does not change the tuning of the receiver to the frequency to which W_4 is set.

It is possible to neutralize the capacity coupling acting between the pick-up coils W_1, W_2, W_3 and W_4 and the wave trap coils. This will sharpen up the tuning and will strengthen the desired signals which, in the above arrangement, are weakened to some degree.

To understand the method used in neutralizing capacitance between the pick-up coil L_1 of a wave trap as shown in Fig. 2 and the tuning coil L_2 we must study the effect of such stray capacitance; otherwise we shall not know when we have succeeded in neutralizing it unless we insert the whole wave trap in a radio-frequency amplifier and test out as is done on neutrodyne stages. There is nothing new in such a test.

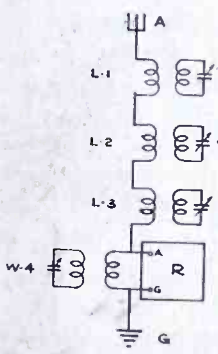


Fig. 1. Combination Wave Trap

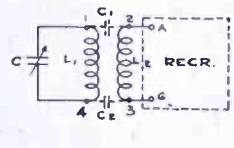


Fig. 2. Capacitance Coupling in Wave Trap

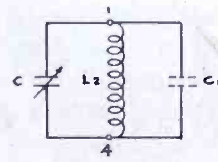


Fig. 3. Effect of Capacitance Coupling

We have in Fig. 2 a receiver with ground and antenna posts G and A, connected to points *2* and *3* on the pick-up coil L_1. The capacitance coupling between coils L_1 and L_2 is represented by two condensers C_1 and C_2 between points *1* and *2* and *3* and *4* respectively.

In Fig. 3 we see how these "effective" coupling capacitances are equivalent to a pair of condensers C_1 and C_2 in series and both shunted across the tuning condenser and coil C and L_2.

What effect has this stray capacitance? It has two: It broadens the tuning of the wave trap and it reduces the range of tuning. The tuning is broadened because the ratio of L_2 to C plus the stray capacitance, is smaller than when the "pick-up" coil L_1 is removed, and L_2C is tuned alone. The range of tuning is reduced because a fixed capacitance in shunt to a variable capacitance aways reduces the range of the latter.

To take an example: If the condenser zero dial reading C_n gives a capacitance of 8 micro-mfd. in C and the full dial reading C_m gives 512 micro-mfd., this constitutes a capacitance range of 1 to 64. The wavelength range would then be the square root of this or 1 to 8, because wavelength is always proportional to the square root of capacitance, other things being equal.

When the stray capacitance, which we may call C_o, is present, its effect is very important at small dial readings and very much less important at full dial readings. So we compare it with C_n, the zero dial capacitance of C. The ratio of C_o to C_n is called K, or the stray capacitance factor. If K is larger than 4 our conditions are very bad. In the present case K is only about .5, so that the stray capacitance is half the minimum or "zero" capacitance of C.

In all cases the stray capacitance factor K reduces the theoretical capacitance range R to a smaller practical capacitance range R_e. In some cases R_e is only 20% of R! So a long range condenser wouldn't pay in that case! The law governing this reduction is given by equation (*1*) derived some years ago by the writer.

$$(R_e-1)\ (K+1)=(R-1)\ \ldots\ldots(1)$$

There are obtainable simple cardboard instruments which read R_e in terms of K for a given R or the experimenter, who measures R_e as we are about to do, can immediately derive K, if he has the manufacturer's data for R. Knowing K, he immediately has C_o, which is usually hard to obtain.

The above remarks are pertinent to the problems of neutralizing the wave trap coupling of Fig. 2, since our tuning wavelength range is always the *square root* of R_e. Fortunately we have no excess wire or any tube capacitance in L_2 C to contend with and our sole problem is to cancel out C_1 and C_2. These are lumped together as C_1 in Fig. 4.

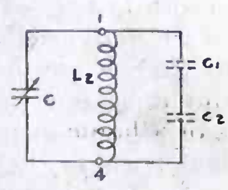


Fig. 4

One way of doing this is shown in Fig. 5, where the stray capacitance C_1 is

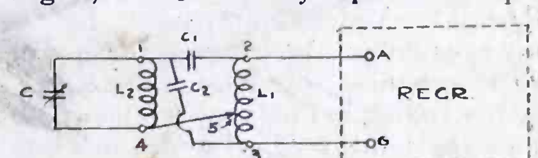


Fig. 5. Hazeltine Method of Neutralizing Capacitance Between Coils

taken from Fig. 4. We may use 6 to 12 turns of No. 28 S.S.C. for L_1 wound on a bed of one turn of thin bond shellacked

Continued on page 69

Radio the Conjurer

By B. W. Fordham

The romance of radio resides in its environment. Here are the memoirs of an old-timer to whom the call of the sea still beckons with its roving life of adventure. To read it gives added incentive to the young man to get that license and to the old-timer to get another scow.

"DO you know, I think that radio is simply marvelous." The fair creature who had so committed herself turned a pair of big questioning orbs from the costly "Mahogany III" broadcast receiver, with its multiple of tubes, its yawning loud speaker, and seemed of a sudden to feel a wee bit of the wonder of the thing. "They tell me you are a wireless man. Let's sit out this dance and you tell me all about how radio works. I am so interested," the dear thing gurgled nearly melting me with the pleading in her voice. How I did wish for a moment that there was no such thing as radio. How could I get out of the ordeal, escape the gauntlet of questions which volumes could not answer properly, yet were to be explained in the interval of one short dance. Most all of you "brass-pounders" have been in the same predicament. Lucky is the questioned one should something intervene to detract the attention of the innocent questioner, as it did in my minute of despair at the radio dance.

"Mahogany III" gurgled deep in his wooden throat, spluttered a time or two, then poured forth the beat of a snappy one step. Almost fiercely I whirled on my companion and away we sped. The only thing that entered my head at the moment was, "Radio is something like a telephone, dearie, the noise goes in one end and comes out at the other. Suppose that I should happen to call you up tomorrow. Would you be at the other end?"

Now there are many of you reading these lines who have at your very elbow those few bits of magic apparatus which bring to your ears the wonders of the radio broadcast. It is not of you nor of the radio with which you are familiar that I am intending to write. Radio does not bring to my mind scenes of a home-group gathered around a loud speaker, listening to a prima donna soaring in operatic airs, or the reading of the day's latest news.

When I hear that word there is a flashing, unconscious transition. RADIO—Wireless—Sparks. Before my eyes floats a loved remembrance of vast expanses of blue salt water, gently rolling in long easy swells whose tops are daintily edged with the white of water turned over by a cooling breeze. A great overturned cup of a sky, so deep in its blueness as to be almost black, unmarred by a sign of cloud. Perfect and unbroken is the line of horizon, drawn 'round with the trueness of a draftsman's compass. Above, almost straight overhead, a great blazing ball of fire, the guardian and the guide, the sun. The awing enormity of this vast sea, this distant sky, this far away but all important sun and right here in the center of all is a tiny thing of steel and iron, throbbing with the puny forces man has developed to contest the never ending spaces of water. Tied up to a dock or at anchor in a land-locked harbor, she is simply a ship, but out here alone in the center of a lonely world she is to us who dwell upon her, a home, a castle, a little world set apart and complete in all that is necessary for our present needs.

It is high-noon. A little above us, on the bridge, the skipper and his mates are taking their mid-day peep at Old Sol, for latitude. It is interesting to watch their earnest, intent faces. Accuracy is demanded here, the human error must be kept out, the eye must be keen, the hand on the arc must be steady and true. See the "Old Man" there, master of a roving tramp. There is no gold braid, no form-cut uniform coat on that pair of capable shoulders. A plain white officer's cap, set back on a head of crinkly, graying hair. A loose white shirt, well open at the neck, showing a throat and hairy chest burned brown by tropic suns. The wrinkles and furrows of care, so soon in coming to the brow of even the youngest master of a deep-sea vessel, are exaggerated now as he squints his eye and dips and sways his sextant.

"She is gone, boys; over the hump for another day."

Old Sol, our guardian angel, has ceased his climbing and started down on the second half of his daily journey. Already the skipper and his mates are in at their chart tables, reading the message that the rays of the sun have brought to them. With their rapid calculations the message is soon reduced to a little group of figures that to them mean a spot on this great trackless expanse of water.

But now there is work for me to do.

I turn for a last gaze at the solitude that hems us in. Our isolation is complete. Not a smudge breaks the line where sea meets sky. Not a sail, nor even a bird has followed to cheer the eye and remind us of the world we have left behind. We are alone, and it is with a creeping feeling of desolation that I step into the radio quarters, slip into my chair and picking up my "fones" light my tubes.

What a change! A new world this! Loneliness left behind. The barriers of blue glistening waters, of limitless but engulfing sky, are, in the snap of a switch, broken down. As my fingers swing the condenser, my ears pick up and my mind goes out to the chatter of distant friends.

Listen closely. Hear this deep-toned fellow, rambling along, the swing of perfect familiarity with his set and his "game" in every touch of the key. It is Morrow, on KNG. An old friend, but one never met face to face. Often have my ears delighted to the swing of his "tanker-fist" as we have passed in the night far down in the land of the Southern Cross, or off the treacherous Mendocino's shoals.

Again listen! Closer and clearer, another old friend. Edmunds, on KIA. What a peculiar series of convolutions he puts that "bug" of his through every time his high, familiar note hits the air. 'Most makes me laugh, but it is a warm feeling that comes to my heart each time our wandering courses bring his sine to my ears.

Listen to this boy with the quick businesslike snap to his key. It is Cohen on KIH, the old *Corning*. Makes me think of the night when his snappy sending was snappiest of all. It was when they did that salvage job, and pulled the big Shipping Board tanker off the jetty at Tampico. That was a busy night for Cohen, and a terrible one. All night long he could hear the clanging of signals from bridge to engine room. A norther was kicking up such a rumpus on the old Gulf Coast that the waves were dashing mast high over the stranded steamer. Cohen braced his knees under the table to hold himself in his seat, and never left his set, dashing off dozens of service messages to masters of other vessels standing by with assisting lines to help the *Corning* pull the tanker free.

The long night of frantic effort was successful. I can still see the grin on Cohen's face, when I met him a day or two later, up the Panuco River. The salvage was complete, and soon would come a good-sized check to help make up for the night of strife. Poor Cohen! 'Twas only a short time later that word, passed from ship to ship, told us that the salvage had caught fire in a New Orleans drydock and was a total loss. Poor Cohen; but boy, you stuck by the key like a good one and I hear that you are still going strong, with

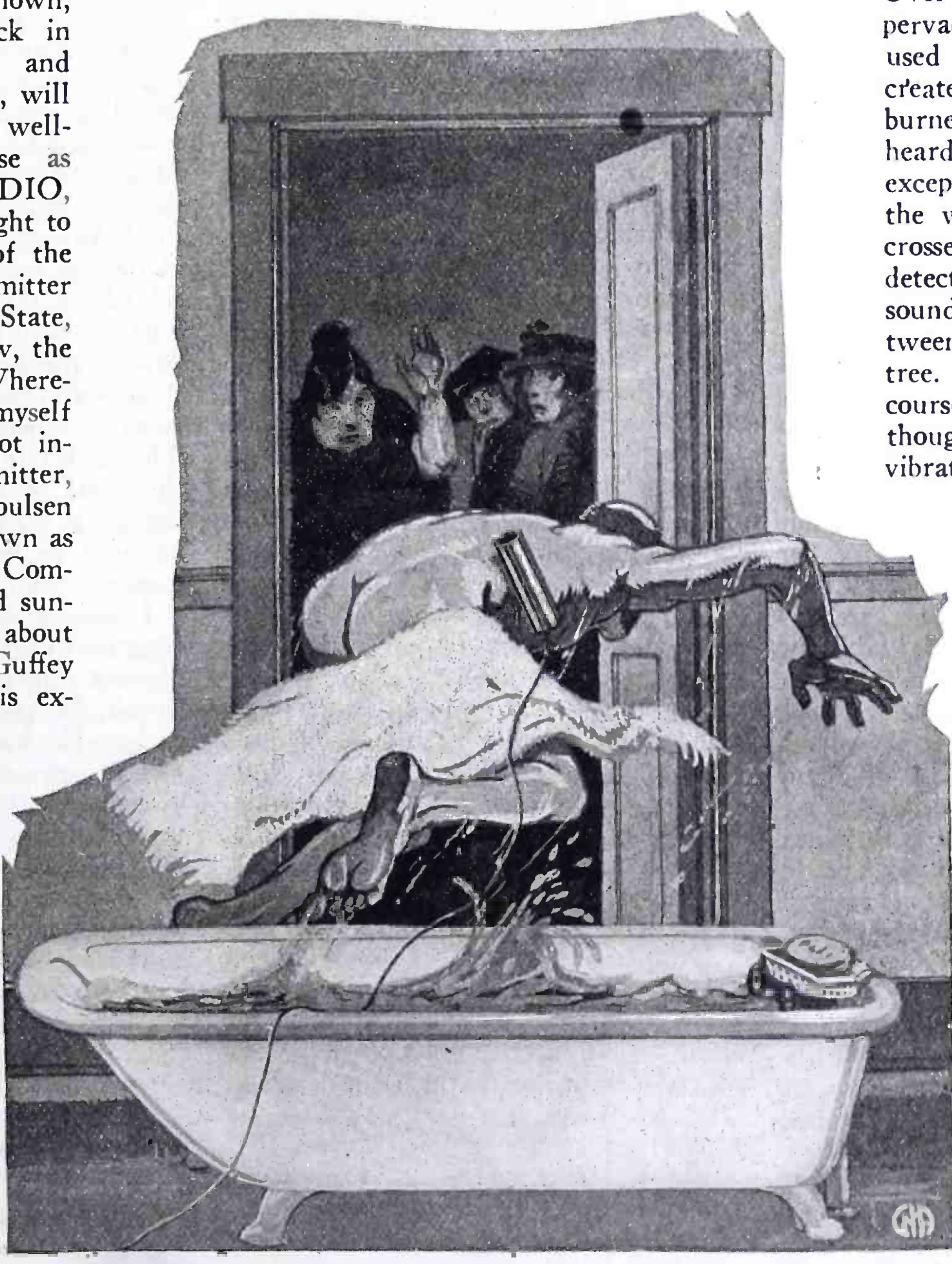
Continued on page 48

McGuffey's Arc Transmitter

By Paul Oard

Truth is sometimes funnier than fiction, especially if embroidered with fancy. Anyway there is enough truth in this story to give it human interest and enough fancy to make it humorous. This is a reminiscence. Just how much poetic license the author has taken with cold facts is not known. But it certainly is interesting, amusing and amazing.

IN starting this story, I unhesitatingly and without reservation place the entire blame for it on Valdemar Poulsen, patron saint of undamped wave transmission, and one of the pioneers of the wireless telephone. I imagine that Mr. Poulsen, or Herr Poulsen, or by whatever handle he may be known, sitting in his radio shack in Denmark, or wherever and whaton he may be sitting, will raise his eyebrows in well-expressed Danish surprise as he reads this issue of RADIO, and coldly question my right to drag him into my tale of the first amateur arc transmitter ever built in the Golden State, and for aught that I know, the entire United States. Whereupon I arise and defend myself thusly—if Poulsen had not invented the arc transmitter, thereby causing the old Poulsen Company, now better known as the Federal Telegraph Company, to erect various and sundry transmitting stations about the country, Thomas McGuffey would not have built his experimental arc transmitter at a period when all good amateurs were cutting their eye teeth on spark coils, Thomas McGuffey's father would not have been blown from the family bath tub, and the McGuffey cat would not have gone through an experience that would have thrown most cats into fits—cataleptic fits, so as to speak — and consequently this story would not have been written.



"McGuffey senior tumbled into the parlor"

Thomas McGuffey flourished in those good old days when 100 miles was a DX record, and your standing in the radio fraternity was enhanced if you operated a five-killowatt transformer efficiently enough to drown out the other fellow working on a three—those days when the Fleming valve was regarded with suspicion, and a magnetic detector was a mysterious thingumajig understood only by the favored few. He still flourishes, though not under that name. Too many embarrassments might result were I to name him properly. His wife might object. The company for whom he is chief radio engineer might object. The editor might refuse to publish the story—in fact almost anything might happen.

About this time, or a little before, mayhap, the Poulsen Company was establishing a number of stations along the Pacific Coast. Their transmitters at this time were of Danish manufacture—mounted on thick panels of hard rubber, with identifying instructions engraved in Danish. The transmitting condensers were made of tinfoil and paper, in the form of a book. The detectors were of the condenser type, the so-called Poulsen ticker. The aerials—the word "antenna" was a sort of a highbrow term and not generally in use—resembled very much two tents tied together bottom to bottom, which is about as near as I can describe them, suspended between huge wooden masts. Over their stations hung the all-pervading atmosphere of ether, used in the arc chambers to create the gas in which the arc burned. But few amateurs heard the mush of these arcs, except when in rare instances the waves of two stations got crossed and the good old crystal detector picked up what sounded much like a fight between two robins in a cherry tree. A little bit later, of course, some bright genius thought out the idea of the vibrating catwhisker laid across the mineral, and made a fairly successful ticker of the arrangement, but this has nothing to do with McGuffey's cat, nor with Mrs. McGuffey's catsup, although the cat and the catsup had a lot to do with each other, as shall be related further.

McGuffey's home happened to be within three blocks of one of these Poulsen stations. Listening-in one afternoon on his 75-ohm receiver, filched from the house telephone, and a silicon detector, McGuffey was paralized to hear the sound of a voice, quite clear and distinct. Now McGuffey had heard vaguely of the wireless telephone, but had put such talk down to idle gossip, and his first move was to assure himself that his aerial had not dropped across the telephone line that ran into the house. But, as investigation proved that such was not the case, he came to the conclusion that he was actually hearing the wireless telephone, and promptly hied himself to the Poulsen station. McGuffey had been yearning for some time to get inside that station, but opportunity had passed him by until now. With quaking heart he knocked at the door of the little wireless shanty that housed the Poulsen equipment.

The Poulsen operator, a new man just breaking in, proved to be quite affable. He verified McGuffey's contention that he had picked up a wireless telephone by inviting the elated young man in and revealing to his worshiping gaze as complicated and shining arrangement of wireless apparatus as he had ever thought of in his wildest dreams. It developed that he had been talking to Los Angeles, a distance of some four hundred miles. (Two years later I remember reading press dispatches that Marconi had succeeded in establishing communication with the wireless telephone, a distance of *thirty* miles, all of which goes to show that good newspaper men are not necessarily good wireless men.)

McGuffey and the Poulsen operator became pretty good friends. It was true that at that time the Poulsen Company were guarding their development work jealously, and their stations were supposed to be closed to the public, but McGuffey was such a green younster that the operator allowed him free access to the station. He helped him a little in code practice, and showed him how to rig up a tuning coil from a rolling pin and some scraps of insulated wire, an arrangement that made a great improvement over McGuffey's original arrangement. McGuffey had lost faith in tuning coils following his first constructional attempts along this line. He had made up very carefully a coil wound around a tin coffee can. It was true that he had carefully insulated that winding with several layers of insulating paper, but his results had been a little less than nothing. However, his new tuning coil brought in stations as far distant as Friday Harbor, about seven hundred miles away, to the intense jealousy of every other amateur in the city.

In McGuffey's heart there welled a great ambition. That was to rig up an arc transmitting station. Now, to date, McGuffey had never possessed even a spark transmitter of the humblest origin, a condition of affairs due as much to a depleted financial condition as anything else. Most of his wireless acquaintances had spark transmitters of one type or another, ranging from ¼-in. spark coils to 5 kw. transformers. The latter could be read all over the city when in operation by the simple expedient of turning on an electric light bulb and watching it flicker in dots and dashes.

The Poulsen operator of course would not tell McGuffey a great deal about the arc transmitter that graced his station. But McGuffey possessed that most valuable of commodities, that which has made the American amateur what he is today — optimism. Through devious ways and much mental concentration on the subject he had evolved on paper a promising diagram of connections. His methods in reasoning out the transmitter were not complicated. He knew that the arc used direct current, that it burned in a vapor of hydrogen, that one electrode was of metal and water cooled, and that a magnetic field was necessary around the arc flame, in order to keep it within bounds. Why the flame kept within bounds he didn't know, nor was he concerned with the principle of tuning the arc by means of proper values of inductance. Tuning a transmitter of any sort, for that matter, was Greek to McGuffey. Few of the fellows bothered with helixes. They cost money.

McGuffey realized his limitations in the matter quite keenly, but, as I have already remarked, what he didn't know did not act as a deterrent to him. He reasoned, as did, and do all good amateurs, that what he didn't know could be found out. He didn't take any of the other fellows into his confidence. Nor did he tell the Poulsen man about his plans. McGuffey didn't want the Poulsen Company suing him for damages. He proposed to build his arc transmitter, and talk *with* it, not about it. He set to work.

First, he needed an arc chamber. This he made out of a coffee can—the same one that had served as a core for his first tuning coil. This can was so made that one end could be forced into place so as to form an air-tight seal. Into this end McGuffey fastened his metal electrode, made of a piece of hollow tubing, plugged at one end, with a small rubber hose leading to the water pipe to supply the cooling medium. This also served to ground this electrode. Into the other end of the can McGuffey, after some labor, managed to fix an adjustable carbon electrode. The carbon he secured from a dry cell.

He met the problem of supplying the gas vapor by placing over the center of a can a small sight-feed oil cup, which he filled with ether. The ether he had obtained from a can which the Poulsen man had thrown outside, which was not quite empty. This oil cup could be regulated to feed a drop at a time on the arc.

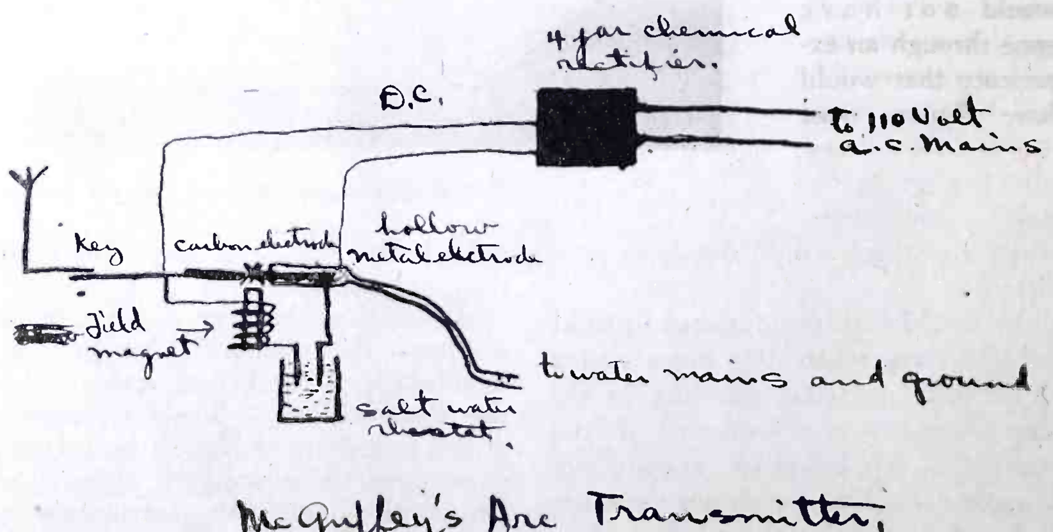
The problem of supplying a magnetic field gave McGuffey some trouble. He finally met it by securing a make-and-break gas engine coil of the type that is still used to a limited extent upon stationary gasoline engines. It is made up of an iron core over which are several layers of No. 14 gage magnet wire. By poking a hole in the side of the arc chamber and driving the core part way out of its winding, so that it came close to the arc electrodes, he was able to bring a magnetic field close to the flame. A salt water rheostat in series with the coil served as a variable resistance.

McGuffey met the problem of supplying his arc with direct current by constructing a chemical rectifier. His home was wired for 110 volts a.c. Into four Mason fruit jars (reliable standbys for all good amateurs) he placed a solution of bichromate of potash. Spirals of aluminum wire, and sheets of scrap lead served as the plates. The aluminum wire he secured from a piece of high-power transmission cable which just then was coming into vogue with the power companies due to its lightness. The junk pile supplied the lead. From the leads of the rectifier he secured a pulsating direct current supply, which he used to feed both the arc and the magnetic coil.

I present herewith an unexpurgated diagram of McGuffey's arc transmitter. Having inserted a telegraph key in the circuit, McGuffey called long and patiently. He had no hot wire meter, for such things cost money then as now, and he had not developed his technical skill to a point where a glow lamp was suggested.

After calling for about two hours, during which time the house meter hummed cheerfully under a drain of a lot more amperes than it was supposed to carry, McGuffey was called from his task by Mrs. McGuffey to do an errand.

Continued on page 58



McGuffey's Arc Transmitter, as sketched by McGuffey

The Design and Function of Inductance Coils

VARIABLE INDUCTANCES—Concluded from October Issue

By Jesse Marsten

Tapped Cylindrical Coils

The coil of Fig. 1 and the multi-layer coil of Fig. 5 illustrate the method of varying the inductance by tapping at intervals along the coil. Varying the inductance in this way requires the use of tap leads which are brought to studs on an insulating panel. This results in additional resistance: first, due to the additional wire in the tap leads; second, due to the studs being embedded in the solid dielectric, thus increasing the dielectric losses; third, due to the contact resistance between the studs and switch which makes contact with the studs. For single-layer solenoids this is the best way, however, to vary the inductance. In multi-layer coils this is bad practice for reasons given under the heading "Multi-Layer Coils."

Variometers

This is an extensively used type of coil, the principle of which is briefly as

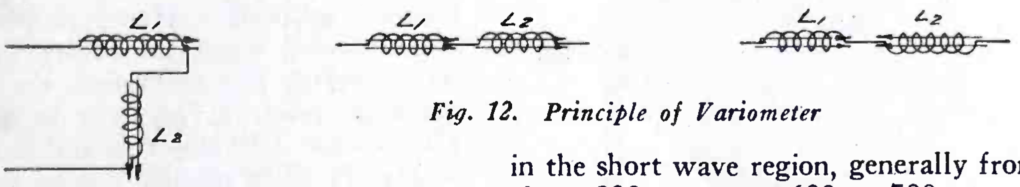


Fig. 12. Principle of Variometer

follows: If two coils having self-inductances, L_1 and L_2, are connected in series but are so disposed that there is no coupling between them, the total inductance is the sum of their individual inductances, $L = L_1 + L_2$, Fig. 12 (a). If they are connected so that their magnetic fields add and there is coupling, then the total inductance is given by $L = L_1 + L_2 + 2M$, where M is the mutual inductance between them, Fig. 12 (b). If they are connected so that their fields oppose and coupling exists then the total inductance is given by $L = L_1 + L_2 - 2M$, Fig. 12 (c). Thus by connecting two coils in series and arranging them so that their coupling is variable we can obtain a variation of inductance from a minimum of $L_1 + L_2 - 2M$ through a medium value of $L_1 + L_2$ to a maximum of $L_1 + L_2 + 2M$. Such a device is called a variometer. Unlike the tapped coil which gives a stepwise variation of inductance the variometer gives a continuous variation, the inductance passing through all values from minimum to maximum. Furthermore this variation is obtained without the necessity of tapping the coils.

The general construction is to wind two coils, one fitting inside the other as in Fig. 13. The inner coil may be rotated through an angle of 180°. At 0° the coupling is negative, that is, the magnetic fields of the two coils oppose each other, hence the inductance is a minimum. At 90° the two coils are at right angles to one another, the coupling is zero, and the total inductance is at its medium value. At 180° the coupling is positive, that is, the fields of the two coils add, hence the total inductance is a maximum. Between minimum and

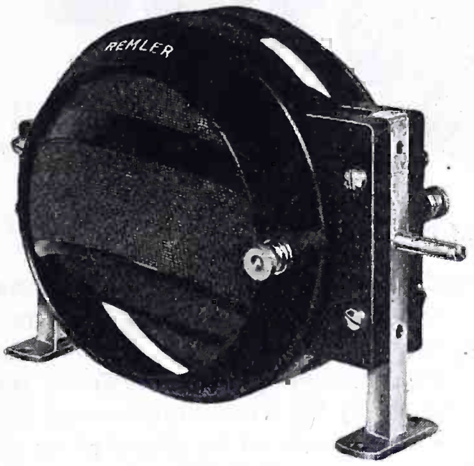


Fig. 13. Variometer

maximum values of inductance all intermediate values are obtained.

Variometers are designed to operate in the short wave region, generally from about 200 meters to 600 or 700 meters. The range of inductance is generally from about 0.1 millihenry to 1 millihenry, giving a 10 to 1 variation. Some variometers give a much greater variation. Thus that in Fig. 13 has a range from 0.05 to 1.25 millihenrys, giving a 25 to 1 ratio. This is exceptionally high. Fig. 13 (a) illustrates how the inductance of a variometer varies with the angular rotation of the inner coil. It is approximately a linear variation.

Due to the fact that variometers furnish continuous variation of inductance, they are used instead of condensers for tuning circuits. They find their greatest use in single-circuit receivers and in regenerative receivers of the twin-variometer type. Due to the low maximum inductance these coils are not suited to the higher wavelengths.

Wave-Wound Variometers

A very efficient type of variometer is the wave-wound type illustrated in Fig. 14. The winding is similar to that in the spiderweb coils, namely a wave winding. From the illustration it is seen that very little solid dielectric is used, most of it being air. Distributed capacity and dielectric losses are therefore much reduced. The range of inductance is from 0.1 mh. to 1.1 mh. Such a winding is bound to have less losses than one which is surrounded by solid dielectric.

Vernier Variometer

In sensitive sets extremely fine wavelength adjustments are necessary. Such adjustment may not be possible with the main variometer, such as those previously described. A "vernier" variometer is therefore used, sometimes, which is really a miniature variometer, in conjunction with the main variometer; four tiny coils connected in series, two of them being movable relative to the other two. The total variation in inductance which can be obtained with this is about 1% that obtained with an average variometer. Thus the change in inductance per degree rotation of the vernier is exceedingly low.

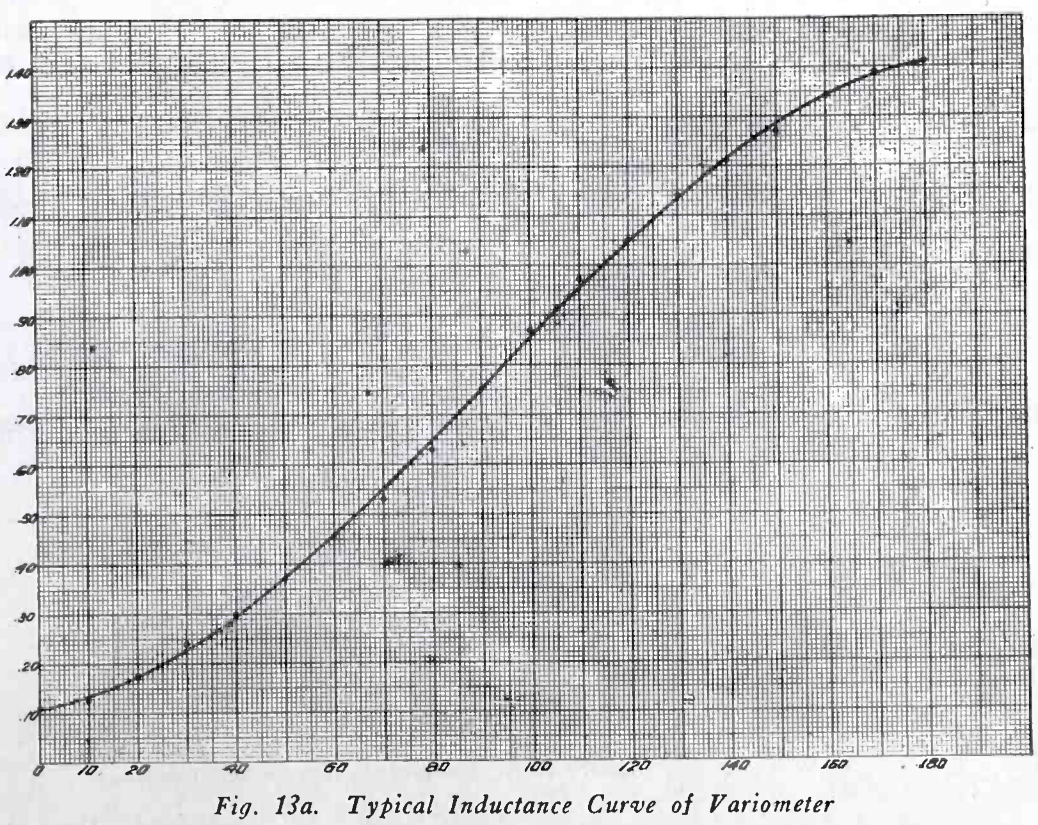


Fig. 13a. Typical Inductance Curve of Variometer

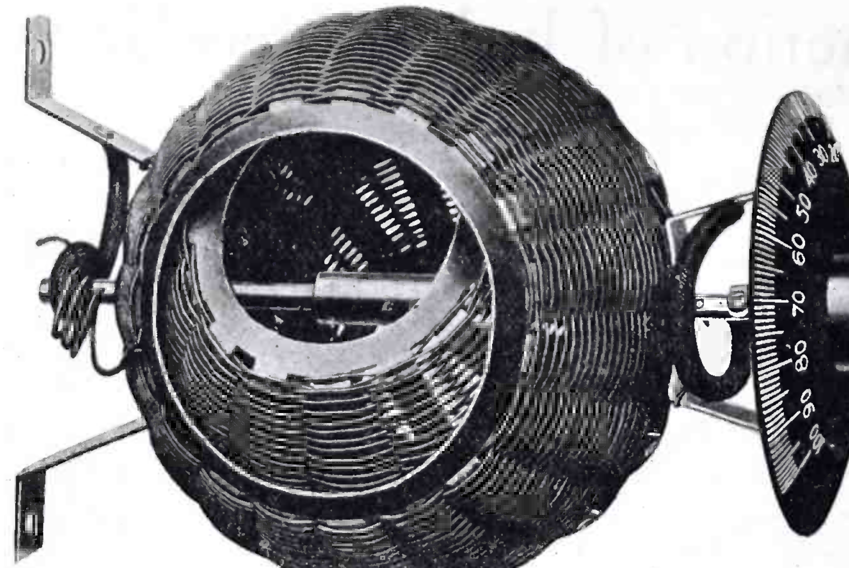


Fig. 14. Wave-Wound Variometer

Vario-Couplers

In order to transfer energy from one circuit to another, as from antenna to detector circuit, it is necessary to couple them together. Three methods are

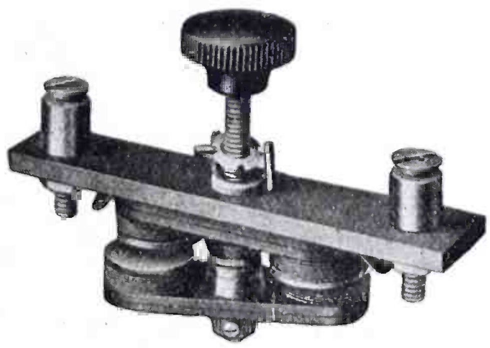


Fig. 15. Vernier Variometer

available: (1) electro-magnetic coupling, Fig. 16, (2) electro-static coupling, Fig. 17; and (3) conductive coupling, Fig. 18. All three ways are practicable, though the first is, by far, the most widely used, and is of interest to us now.

Electro-magnetic coupling is effected by the aid of two coils inductively related to one another. These coils constitute a vario-coupler, Fig. 19. The coils are not electrically connected. When the axis of the coils are parallel to one another the coupling is a maximum, hence maximum transfer of energy is obtained. If they are at right angles the coupling is zero, and minimum transfer of energy is obtained. Between these two limits any degree of coupling may be secured with corresponding variation in energy transfer.

Two circuits, Fig. 20, may be coupled to one another through their entire inductances L_1 and L_2. This is satisfactory in sets where only low wavelengths are used. Where it is necessary to use long waves it is more efficient to separate the functions of coupling and loading. Coupling is taken care of most efficiently by the vario-coupler and loading is taken care of by the loading coil.

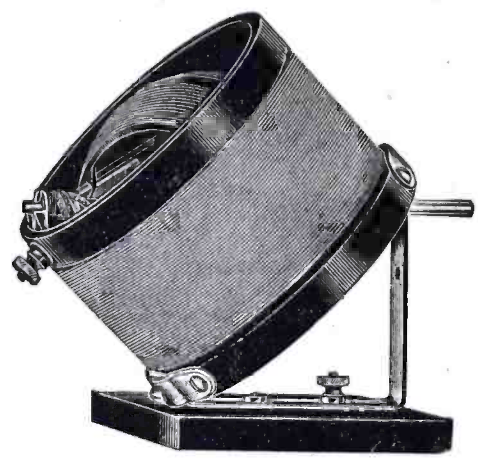


Fig. 19. Vario-Coupler

Figs. 5 and 21 illustrate how the loading coil and coupling coils are connected together, each performing its special function. In Fig. 21 the compact multilayer coil is used for loading, while in Fig. 5 the bank-wound multi-layer coil is used.

Zero coupling, meaning no transfer of energy, is seldom obtained with the

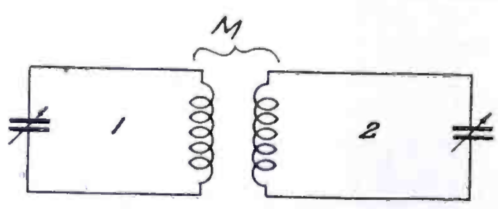


Fig. 20. Circuit Coupling

average vario-coupler. The reason for this is that there is always some electrostatic coupling present due to distributed capacity, coupling between leads, etc. This static coupling is sensibly constant in magnitude and direction, regardless of the position of the vario-coupler. At 0°, therefore, there is some coupling between the circuits. In order

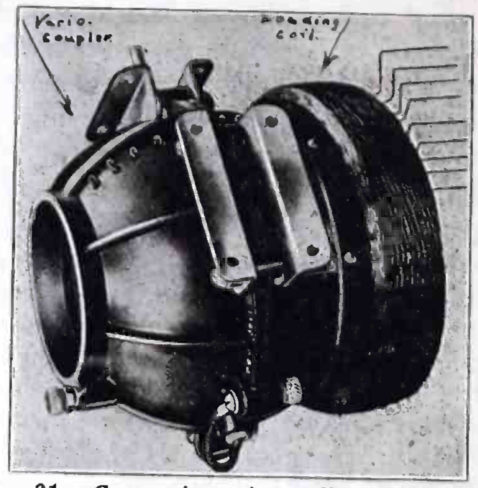


Fig. 21. Connection of Loading Coil With Vario-Coupler

to eliminate this it is necessary to neutralize this stray coupling. A method of accomplishing this is to design the coupler so that it rotates a few degrees to the other side of the zero point. This reverses the direction of the magnetic coupling, but not that of the electrostatic coupling. Hence a position will be found where the reversed magnetic coupling just neutralizes the stray coupling, resulting in zero coupling. This scheme is employed in the receiver of Fig. 7. The coupler is seen in the bottom center.

Vario-couplers may be made up of the efficient spiderweb and multi-layer coils. Thus Fig. 22 illustrates how a number of spiderweb coils may be mounted to form a vario-coupler. The coils are mounted so that their angular separation may be changed, thus producing changes in the coupling. The figure shows how a third coil may be added for use as the tickler coil in regenerative feed-back sets. By

Fig. 22. Spiderweb Vario-Coupler

using different size coils various combinations may be had for different wavelength ranges. To change the wavelength range of a set from low to high, the low inductance coils are simply taken out of the receptacle and the proper coils inserted. Such a system is very flexible and efficient, since it does not involve tapped coils and consequent dead-end losses. Vario-couplers of the basket weave type of Fig. 14 are also made. Their advantages are the same as for the variometer which has been discussed.

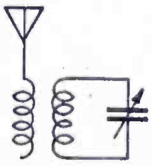


Fig. 16. Electro-Magnetic Coupling

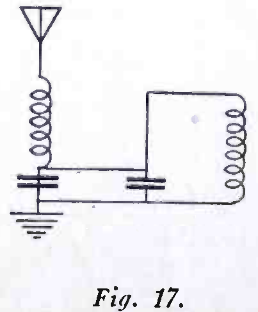


Fig. 17. Electro-Static Coupling

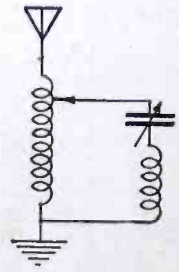


Fig. 18. Conductive Coupling

Elimination of Induction

At times it is desired to avoid any induction effects, as between circuits in the case of precision measurements. To confine the magnetic effects of a coil it is necessary to reduce its stray field. Even though two coils are at right angles there may be some magnetic induction due to stray fields. To avoid this it is necessary to use certain types of coil called "toroidal coils," Fig. 24. There is practically no external magnetic field from such a coil, the entire field being confined within its core.

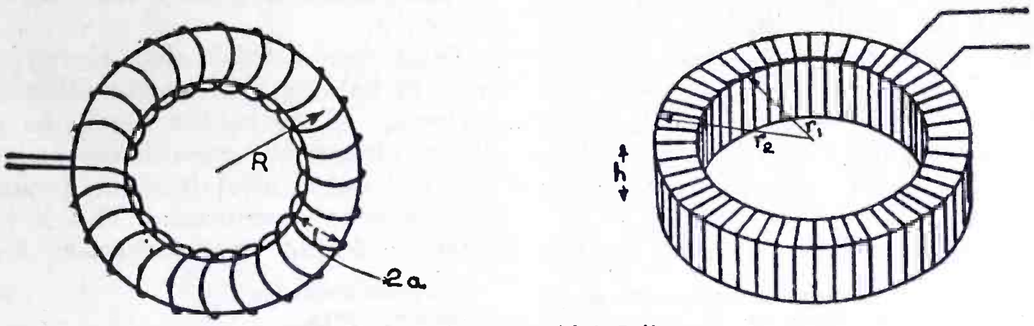


Fig. 24. Toroidal Coils

Choke Coils

In radio-frequency circuits it is frequently necessary to prevent the flow of radio currents from one circuit to another, as between oscillator and modulator circuits in the Heising system, Fig. 25. This is accomplished by the use of choke coils. The ideal choke coil is one which has only inductance and no capacity. By making its inductance large enough its inductive reactance may be made great enough to oppose the flow of any radio currents. However, the presence of distributed capacity results in these currents leaking throug the capacity paths. Merely high inductance is therefore not sufficient for radio-choking action.

A coil with distributed capacity has a natural wavelength. Analysis shows that such a coil has maximum impedance to currents of its own frequency when the voltage is applied between the ends of the coil. Thus a coil having distributed capacity would make an excellent choke coil for currents of its own frequency. Thus the compact multilayer coil, Fig. 10, having 100 turns and a natural wavelength of 217 meters as seen from Table II, would make an excellent choke coil at 217 meters. These coils are therefore very suitable for this purpose and convenient since choking action over a large wavelength range may be obtained by the use of the appropriate coil.

Transmitting Inductances

The general design considerations enumerated at the beginning of this article apply equally well to transmitter inductances. Actually the essential difference between a receiving inductance and transmitting inductance is that the transmitting inductance carries very heavy currents compared to those carried by receiving coils, hence the voltages acting between turns are very much higher. It therefore becomes more important here to guard against distributed capacity and leakage currents. Also the heavy currents must be accommodated with little heating of the coil wire.

Larger current-carrying capacity is obtained by the use of heavy litzendraht cable, heavy solid copper wire, and flat copper strip, all of which provide more surface area. The distributed capacity is reduced by using only single-layer coils and by spacing the turns. Spacing the turns also avoids any possibility of breakdown due to the larger voltages between turns.

During the past flat copper strip spirals were largely used in all spark equipment. However, with the continued development of bulbs and continuous wave transmission, the general circuits utilized have less need for this type of coil and for inductively-coupled spirals. Conductive coupling is largely used now. Where inductive coupling is used on C. W. transmitters litzendraht or solid wire single-layer coils are used in the fashion indicated in Fig. 5, or Fig. 19, coupling being secured by the rotation of one coil within the other.

However, as stated above, the trend is more and more towards conductively-coupled circuits, and in these circuits coils of the type shown in Figs. 26 and 27 are used. Fig. 26 illustrates an edgewise-wound helix of flat copper strip.

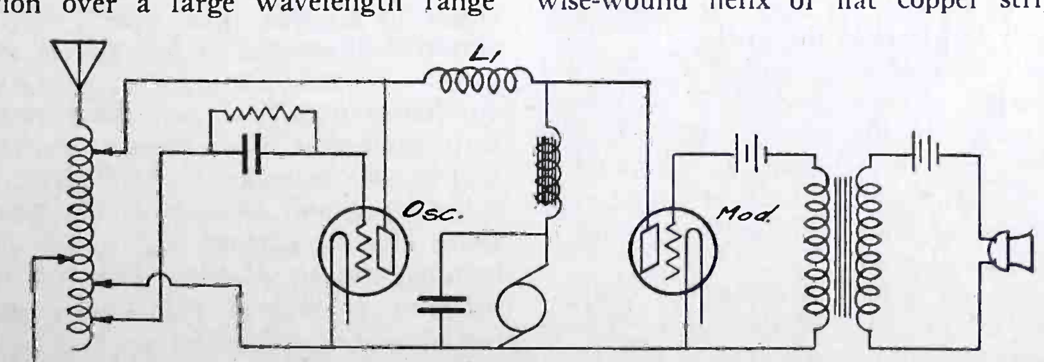


Fig. 25. Heising Modulation System With Choke Coil

It will be observed that there is plenty of wide spacing between turns and that the amount of solid dielectric in the field of the coil is very small. Flexible copper braid permits of connections to any part of the coil. Smaller coils may fit inside this and thus provide inductive coupling, or two such coils may be disposed so that they are inductively coupled to each other.

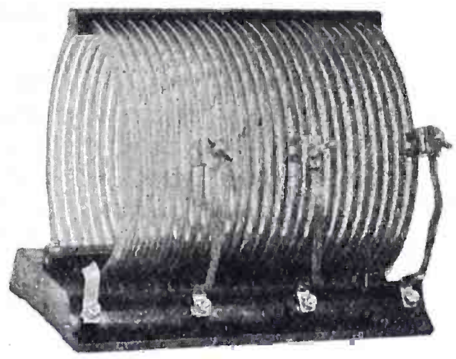


Fig. 26. Edgewise-Wound Helix

Fig. 27 illustrates another form of transmitting inductance. A bakelite tube is threaded and the wire wound in this thread. The wire used is No. 12 B&S solid copper. This coil being designed for use on low wavelengths, say from 150 to 400 meters, it is permissible to use solid wire instead of litzendraht or flat strip, because experiment shows that at these high frequencies there is no gain in conductivity by using litzendraht or flat strip. Skin effect is just as bad in one as in the other. As a matter of fact there is evidence to show that the losses in litzendraht at these high frequencies are greater than in the solid wire. For the amateur wavelengths at 200 meters to 300 solid wire is permissible. The slotting of the bakelite tube allows reasonable spacing between turns. Taps are brought out from every turn to slotted studs, to which connections may be made by insulated plugs.

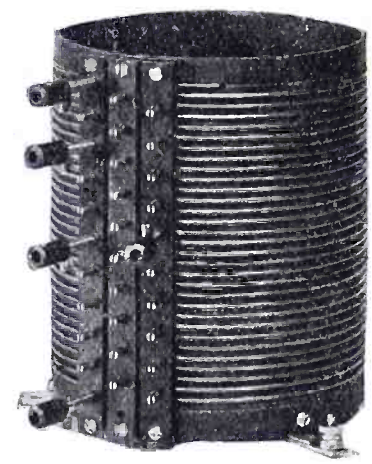


Fig. 27. Transmitting Inductance

These are typical of the chief types of transmitting coils, the other forms being largely the flat spirals. Single-layer coils are the only suitable type for transmission, multi-layer having too much distributed capacity, no matter how wound.

Rigging Up the Radio Shop

Part 2—How to Use the Equipment

By Raymond Francis Yates

This article is intended to help the amateur constructor who desires to improve the appearance and efficiency of his home-made parts. It is based upon practical experience and contains many worth-while hints.

ONE of the chief uses to which the lathe described in the first article of this series will be put is winding coils, since radio experimenters are everlastingly making coils. Fortunately this little equipment lends itself admirably for this service.

For the winding of single layer or bank-wound coils it will be necessary to make use of a special little jig which will accommodate a tube of any diameter. You will see this jig illustrated in Fig. 1, and the presence of the two cone-shaped wooden pieces will serve to warn us that we must learn to use our wood-turning tools. This we shall do later on. It will be noticed that the end of the bolt that carries the winding form should be drilled out a trifle to form a dimple that will engage with the dead center of the lathe when all coils are being wound. Otherwise the thing will fly off center, with danger of skinned knuckles.

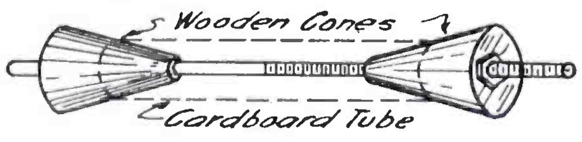


FIG 1

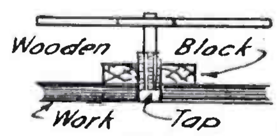


FIG 3

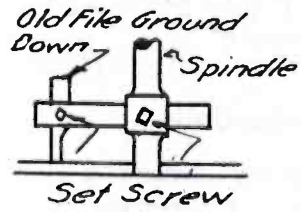


FIG. 6


FIG. 8

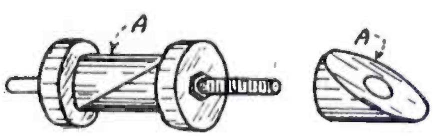


FIG. 2

FIG. 4

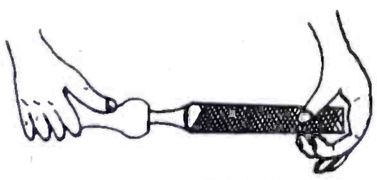


FIG. 5

Fig. 1. Jig for Winding Coils
Fig. 2. Form for Winding Solid Coils

Fig. 3. How to Tap a Straight Hole
Fig. 4. Trimmed Cutting Lip
Fig. 5. Proper Way to Hold a File

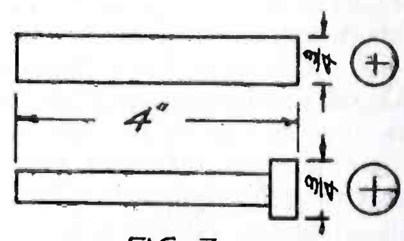


FIG. 7

FIG. 9

Fig. 6. Fly Cutter
Fig. 7. Simple Piece to be Turned
Fig. 8. Finding the Center
Fig. 9. Lathe Mounting

Another winding form for the solid type of inductance coil is illustrated in Fig. 2. Here we see that the center of this coil is split diagonally so that when the coil is completed the ends can be taken off and the core slipped out. Otherwise we would have great difficulty in removing the core and might have to spoil the whole coil to do so. It is evident that this second coil is not a universal proposition and separate cores will have to be made up for coils of different internal diameter and length. However, when using this device we can be assured of a neatly wound coil that is a pleasure to look upon.

It is surprising how few people know how to use taps and drills. In saying this the writer does not wish to indict all of the hams but a goodly portion of them, judging from those he has seen at work. Most of them pound keys like veterans, but positively manhandle a tap. The first essential in using a tap is getting a proper sized drill for it. It is not well to attempt to tap out a hole that is too small. Such a procedure usually ends with a broken tap and sometimes a spoiled piece of work. On the other hand, too large a drill means loose threads and a wobbly screw. Consequently, such threads are easily stripped.

One of the things responsible for bad tapping is an insane desire to rush the work. We can rush a key and push a transmitter to its limit and over, but we cannot rush a tap. In tapping out steel apply oil freely and if we wish to tap a hole real straight the little stunt shown in Fig. 3 will help.

Most of the things that hold in using taps are true also in using dies. The diameter of the rod or bolt to receive the thread is important. A die can be split very readily if forced on to a rod of too large a diameter.

Many amateur mechanics think that drilling is simply a matter of pushing the drill through the metal. That may hold true for certain metals providing the drill is properly ground. It should not be forgotten, however, that a lop-sided drill—by this is meant a drill ground more on one side than the other—will produce an eccentric hole appreciably larger than the drill itself. Anyone with half a mechanical eye can tell whether or not a drill is accurately ground. In the case of smaller drills, which are very difficult to grind on a revolving wheel, it will be found convenient to trim their ends up with a small hand stone.

If brass is being drilled it is well to trim off the ends of the cutting lip as illustrated in Fig. 4. Those who have drilled brass know that there is a tendency for the drill to catch just where it is breaking through. The little stunt just referred to will prevent this and it will assure a cleaner hole with a faster cut.

Who would think that there is a trick in holding a file when filing flat surfaces. If we hold a file in an ordinary manner we press down on it at each end and as a result of this pressure the file bows downward. This is just what we do not want to happen, since it will produce a piece of work that bellies out and the surfaces will be anything but flat. The proper way to hold a file for this sort of work is illustrated in Fig. 5. Here the file is bent upward and a good flat surface will result.

There is often occasion to use a fly cutter in a small radio shop. Such a cutter is illustrated in Fig. 6. It will not be necessary to buy this, since anyone handy with tools and aided by the little equipment that has been described will be able to make it. Ordinary cold rolled steel will be suitable for everything but the cutting tool which may be a piece of an old file. This will cut bakelite, wood and thin metal very nicely.

To assist those who wish to learn

Continued on page 6e

Home Radio Shop Practice

By D. B. McGown

This, the second article in the series, tells of the hand tools advisable for a home radio shop and how to lay out, drill and finish a panel. The directions are most explicit and will be followed by subsequent articles on the making of various radio parts.

Hand Tools

THE most important single tool, besides the machine tools already mentioned, is the vise, which serves for almost every operation. A good bench vise should be obtained and it should not be too small.

The other hand tools gradually blend from the "hand" to "machine" class. For example, taps and drills are generally considered as hand tools, yet they are of just as much importance in lathe work.

The following list of hand tools is suggested for the reader to start with:

*1 vise, preferably swivel, bench type.
*1 hacksaw, with adjustable frame.
1 set slotting saw blades (hand).
1 doz. hacksaw blades, soft back preferable.
*½ doz. hacksaw blades, "tubing" type, with small teeth.
*1 pair snips, medium size.
1 hand vise.
1 small screwdriver (telescopic type suggested).
*1 medium screwdriver.
1 large screwdriver.
1 spiral ratchet screwdriver.
*1 set twist drills, numbered sizes, from 1 to 60.
*1 set twist drills fractional sizes, from 1/4-in. to 1/2-in. by 16ths.
1 small hand drill, 0 to 1/4-in. chuck.
*1 large hand drill, 0 to 3/8-in. chuck.
*1 set machine screw taps and dies. 4/36 to 14/20, inclusive.
*1 scriber.
*1 combination square.
6 files: 1 6-in. round, 1 6-in. square, 1 6-in. three-corner, *1 8-in. mill, 1 10-in. bastard, and *1 14-in. bastard.
1 pair diagonal cutter pliers.
1 pair end cutter pliers, 5-in.
1 pair round nose pliers, 5-in.
1 pair long nose pliers, 6-in.
1 pair gas pliers, 6-in.
*1 pair side-cutting pliers, 7-in. or 8-in.
1 6-in. Crescent wrench.
1 10-in. pipe wrench.
1 6-in. pipe wrench.
*1 drill gage.
*1 soldering iron, preferably electric.
1 center-punch; automatic preferred.
*1 prick-punch.
1 4-oz. machinist's hammer.
1 12-oz. machinist's hammer.
*1 medium claw hammer.
1 nail-set.
*1 cross-cut hand-saw.
1 block plane.
1 cold chisel, 3/4-in.
1 cape chisel, medium.
1 diamond point graver.
1 round-point graver.
1 back-saw.
1 steel scraper.

The above list of tools is merely suggestive and not to be followed as any rule. Many can be omitted, and any additions desired can be made. Those starred would be considered as essential to perform the major operations.

The first thing to be done in making a set, after the work has been laid out and the designs settled, is to find what parts will be made up, and which will be purchased. Basically, the only things which cannot be made at home are vacuum tubes, head phones, measuring instruments, together with raw materials as sheet brass, copper, bakelite, rubber, mica, and the like, and small manufactured parts, such as screws, nuts, binding posts, etc.

Do not think, however, that all there is to be done at home is to buy the parts and throw them at the box, or panel and have them stick in good shape; far from it—as much care is needed to carefully mount various parts, and to coordinate their relationship to each other as there is in the making of the parts themselves.

Panel Layout

Probably the first process to be considered is the layout of the panel. One method is to buy the panel cut to size, and, with a pencil, lay off the holes, etc., and mount the parts right. But this makes a sadly hopeless job.

The primary operation is to square up the panel, and fit it to the cabinet. The panel should be ordered a trifle larger than the space into which it is to fit, as the sawing process usually leaves the edges rather rough and uneven. On the other hand, bakelite sheet is a most horribly tough and unyielding substance, and if very much material is to be removed the worker will spend a prodigious time in shaping it to fit. On panels of moderate size, cut with a common circular saw, it is best to allow from 1/32 to 1/16 in. oversize on all panels, but if a very rough sawing job is done it may be necessary to allow more than this. Some dealers can cut panels to much closer limits, and some even guarantee that they can turn out an absolutely even edge, true to size. If the latter can be obtained, it is much better than to waste labor in sawing it.

Besides careful sawing, it is also necessary that the panel be carefully squared up true. The first thing is to finish off one side by means of a straight-edge (from the combination square) and a medium bastard file. The first process is to "draw-file" the edge. In ordinary filing, we file across the surface, and the file cuts rapidly, as shown in Fig. 1, where the file is moved back and forth, as from *A* to *B*. In working bakelite this is a poor method, as the polished surface of the panel is liable to be chipped off by the file teeth. If the file is held in the same position, however, and worked back and forth, as indicated by *C-D*, the work will be done in a much better manner. True, it will be slower, but the surface resulting will be nearly perfect. The straightness of the edge can be tested with the eye by squinting along the edge, but it is much better

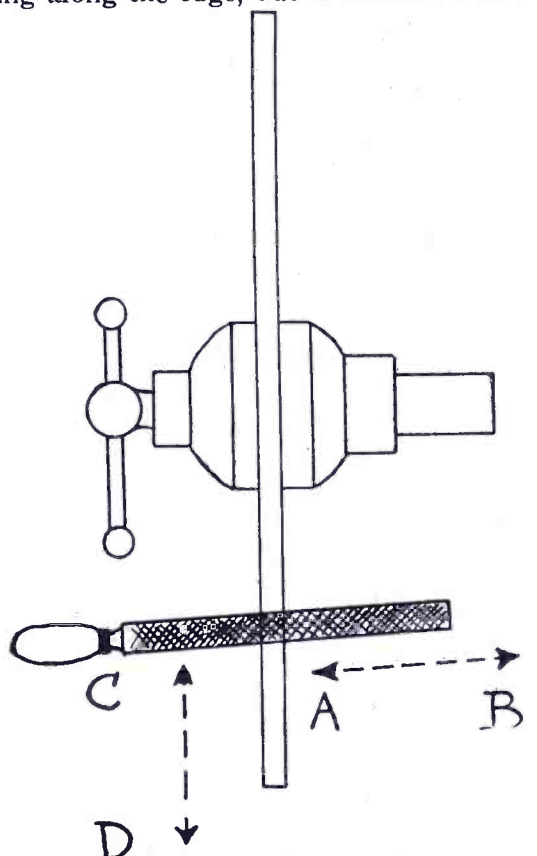


Fig. 1. Correct and Incorrect Manner for Filing the Edge of a Panel

to test it from time to time with a straight-edge. The squareness of the edge, in its relation to the surface, should be also tested by a square, and here again the advantage of drawfiling comes in. If the file is held squarely across the panel's edge it cannot result in anything but a square edge, and if the edge happens to be out of true it can be easily corrected by a slight tilt to the file.

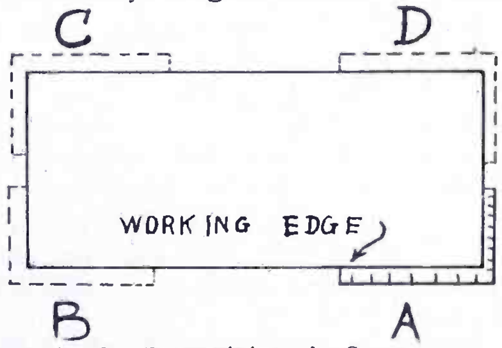


Fig. 2. Determining the Squareness of Corners

The other three edges are finished in the same manner. The squareness of the two ends is first determined, as is indicated by the various positions of the steel square shown in Fig. 2. The lower edge, called the working edge, is first trued up, and then the other ends are trued up and squared with the first edge; the right-hand edge being squared up as shown in position *A* of the square, and then after this is exactly true the opposite edge is trued up, as indicated by position *B*. When the two edges are found to be perfectly true, the upper edge, which is the only remaining edge, is then trued up. This can be squared to either end of the panel, as indicated by the two positions of the square, *C* and *D*. Usually, it is best to square to one edge, and then use the other simply as a check on the accuracy of the work. If the two do not check, it is positive evidence that either the so-called "square" is not true, or else that the squaring up of the edges has not been done properly, and both things should be checked at once, and corrected.

While the edges of the panel are being trued up, and smoothed down, the panel should, from time to time, be fitted into the cabinet in order to ascertain whether it is being finished to size. It is better, even, to allow a slight inaccuracy in the squareness of the panel rather than to cut down too much of the material and, as a result, have the panel too small to fit in the space provided for it. A properly-fitted panel should just fit snugly into the cabinet, without binding, and, at the same time, it should not be so loose as to "wobble about" inside of its mounting. It is quite as much of a problem to fit a panel perfectly as it is to make a good finished job of joining in a piece of wood—in fact, in some ways it is even harder, as the wood gives much more readily and can be much more easily worked and cut. Of course, if a large milling machine is available, this can be used, and a very fine perfect edge obtained.

Where the panel is to be mounted on a frame without a cabinet to cover the edges, the panel should simply be squared, and no attention need be paid to the closeness of fit. If the panel is 1/32 in. smaller than the mounting frame it generally will not be noticed.

After the draw-filing is completed, a wooden block about ½ in. thick, 1 in. wide and 3½ in. long should be covered with sandpaper or emery cloth and the edges smoothed down until all the file marks are removed. Now substitute a finer piece of emery cloth and smooth off the scratches left by the first piece. The edge then may be rubbed by hand, with oil and pumice, smeared on a soft rag, or still better carefully polished on a buffing wheel.

The panel is now ready for the location of the holes to be drilled through it. A simple and effective way is to lay off all distances, hole locations, etc., on the surface of the bakelite with a soft pencil and mark them with a prick-punch, center-punch them and drill. This method has the disadvantage that all the pencil marks, unless extremely light, will show up as scratches on the highly-polished panel surface, and which must be buffed off. Another method is to scratch the necessary markings on the back of the panel with a steel scriber, center-punch the holes, and drill them through the panel. This leaves all scratches inside of the cabinet, where they usually do not matter. The trouble with this latter method is that the worker is at all times working on the back of the panel and, therefore, all locations are reversed and serious trouble may result.

Probably the best, and still the simplest, way is to carefully lay off the exact size of the panel on a piece of drawing paper. Then lay out all various parts, from the actual front positions that they will occupy in use and, at the same time, lay off the positions of corresponding interior parts, such as variable condensers, which are to be supported from the panel. Lay off all holes with the greatest care. If an error is made on the paper it can be easily erased and corrected without any damage to the panel. When the whole thing is laid off to exact sizes and dimensions, cut the sheet out so it exactly fits the panel. Now lay it down on the top of the panel, and clamp it in place with small screw clamps. Then, with a prick-punch, punch through the paper sheet to the bakelite, punching every hole that is to be drilled. Then remove the paper and go over all the punch marks with a center-punch, and you are ready for drilling. It is a good plan to mark on the sheet the full data covering the holes, so no question can be raised while actually drilling. Then set up the panel in the drill press and, starting with the smallest size, drill all holes of that size. Discard that drill and drill all the holes of the next size, and so on, until the whole panel is drilled, countersunk, etc.

A specimen sheet is shown in Fig. 3, which gives all data needed for drilling in the shop, and at the same time will not be confusing. This sheet contains no dimensions, save drill sizes, or instructions to drill for certain purposes. For example, the smallest holes are those marked *tap 4-36*. For these holes a No. 43 twist drill is required, and when the panel is drilled all holes thus marked will be drilled with this size drill, and afterwards tapped out to fit this machine screw. Other sizes are drilled in like manner. The holes marked *Ctsk 6-32* mean that these holes will be drilled out to pass 6-32 machine screws, and then countersunk, so that flat-head screws of this size will fit with their heads flush with the surface of the panel. The larger hole, shown as *2-in. bore,* mean that these holes are not to be drilled, but are to be bored out to exactly a diameter of 2 in. When holes are indicated by instructions to *drill* to a certain size, this means that the holes are to be made the nominal size indicated by the drill size, and that no particular attention is to be given to the exact size, nor of the finish, or smoothness of the hole. If a fairly accurate hole is made, with scorings inside, on the walls of the hole, due to an unevenly-sharpened drill, the caption *drill* indicates this type of operation, but if the hole is to be *bored* out, this will indicate that the hole is to be made to exactly the size given, and that it must be finished true to size inside.

Panels usually are supplied with a highly polished surface, which is easily scratched. Light scratches can be polished off with a buffer, but it is indeed a task to polish them out with a rag and tripoli. Besides this, the smooth surface gathers dust easily. A "grained" finish can be easily applied to the surface, which will eliminate some of these troubles. To grain a piece of bakelite, it is first necessary to mount the panel on a table so that the whole front of the panel's surface is exposed. This can usually be done best by mounting some thin strips on the bench, strips thinner than the panel, and then tightening them up with wedges. Then take the same sandpaper block that was used to smooth the edges, and mount some rather coarse sandpaper on it—say about No. 1 grain. Then apply a medium body oil in generous quantities to the panel and rub the sandpaper back and forth over the panel's surface. Here the skill comes in.

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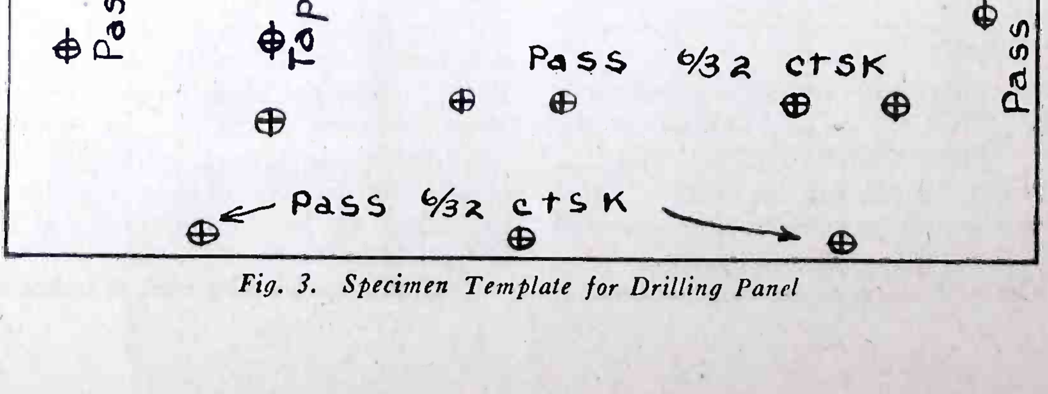

Fig. 3. Specimen Template for Drilling Panel

The Vacuum Tube Oscillator

By Florian J. Fox

This is the first of a series of three articles on the theory and construction of vacuum tube transmitters. These treat respectively of the oscillator, the plate voltage, and the filter and modulation. The instructions are equally applicable to C. W., I. C. W. and radiophone transmitters.

THE fundamentals of an oscillator for a transmitter are relatively simple. The circuit most used by amateurs is the Hartley with various modifications such as grid, plate or reverse feed-back. This circuit employs electromagnetic coupling.

The straight Hartley oscillator, Fig. 1, consists of an inductance L_1 of about 40 turns, a variable condenser C_2 of about .001 mfd., a grid condenser C_1 of .002 mfd., a 10,000 ohm grid leak, a 1 mfd. by-pass condenser C_3 and one or more vacuum tubes. Fig. 1 shows the most popular way of connecting this oscillator to the antenna system. The connections for the filament and plate voltage are also indicated.

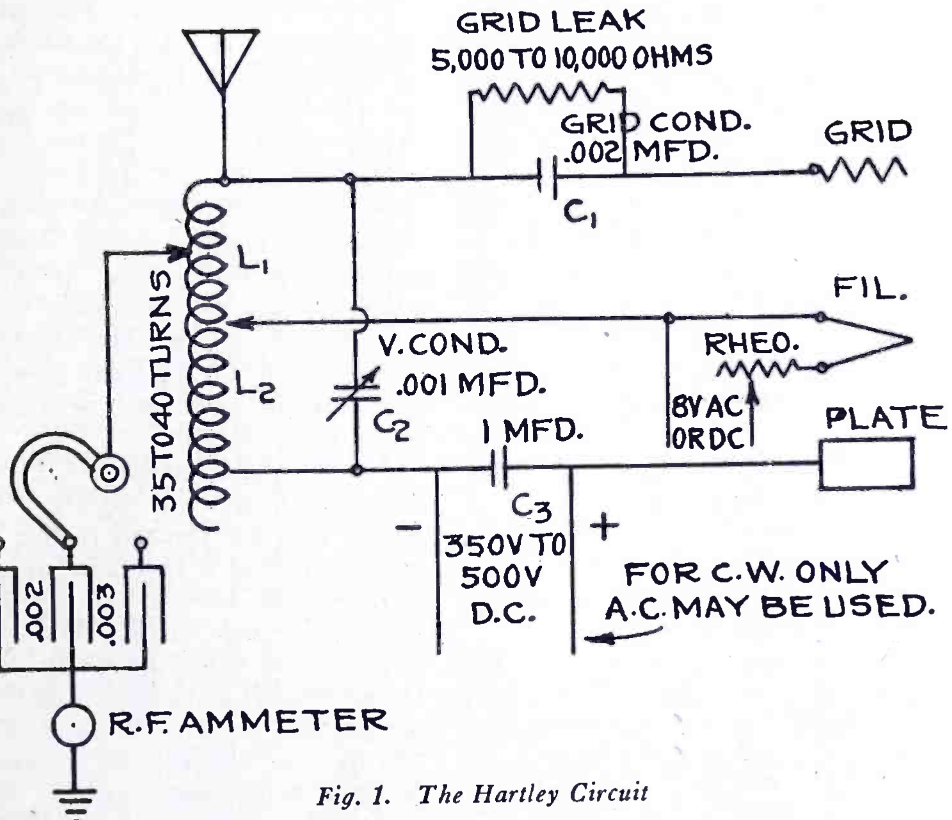

Fig. 1. The Hartley Circuit

Figs. 2 to 5 show some of the modifications mentioned. Although all of these circuits work well, the writer uses that shown in Fig. 3, but with the variable condenser connected between grid and plate. This connection is simple, efficient, and the results obtained are gratifying. Because of the system of modulation used, this particular modification had to be employed, since here the plate supply is connected between plate and filament.

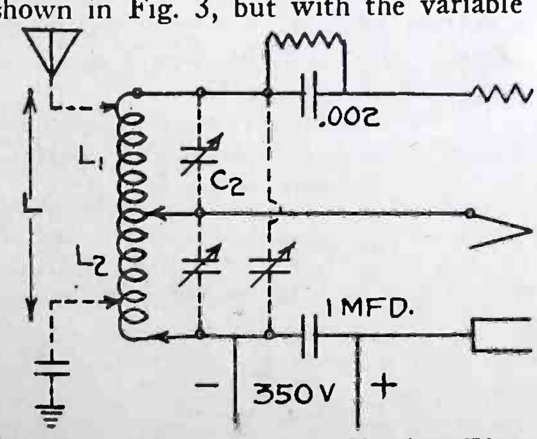

Fig. 2. Modified Hartley, Showing Three Possible Positions of Variable Condenser

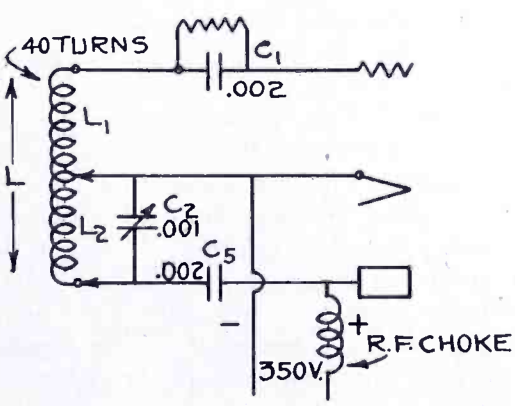

Fig. 3. Modified Hartley, with Different Method of Applying High Voltage

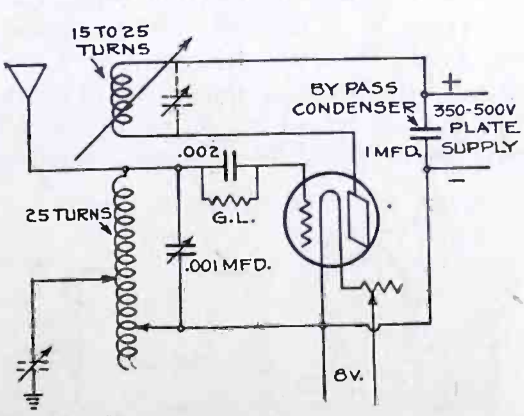

Fig. 4. Hartley with Plate Feedback

The connections of the feed-back circuits are essentially the same. The inductance L is made of two coils, L_1, a stationary coil of about 25 turns, and L_2, a movable or rotating coil of about 25 turns (best determined by tapping). L_2 is usually mounted inside the inductance L_1. It is similar to the tickler coil in the single-circuit tuner. These feed-back circuits have greater flexibility, but the writer does not consider them much superior to a well-constructed and well-tuned straight Hartley circuit.

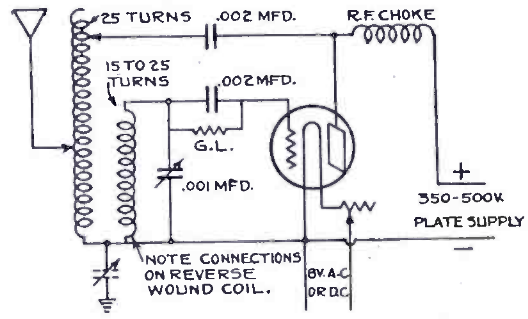

Fig. 5. Hartley with Reverse Feedback

The antenna may be inductively coupled to any of these oscillators, but straight conductive coupling as in Fig. 1 makes the set much simpler and works just as well in most cases.

In the Colpitts circuit the coupling between grid and plate is electrostatic.

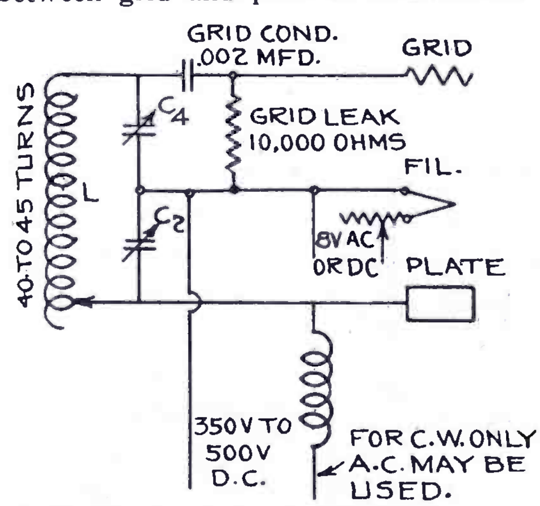

Fig. 6. Fundamental Colpitts Circuit

Condensers C_2 and C_4 of Fig. 6 perform this function. All other equipment is the same as that described for the Hartley circuit. Note particularly that in this circuit the filament does not connect directly with the inductance coil. Fig. 6 shows the fundamental oscillator. Fig. 7 shows how the oscillator is changed slightly in order to bring in the antenna system. The antenna system is considered a capacity or a condenser and is substituted for condenser C_2. C_4 now becomes a large variable condenser of .001 to .002 mfd. In order that the grid potential remain negative, the grid leak is connected as shown.

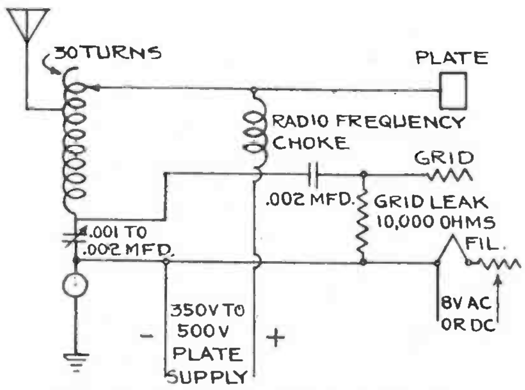

Fig. 7. Complete Colpitts Circuit

We must first understand the operation and characteristics of a vacuum tube as shown in curves, the most important one being that which shows plate current for different values of grid voltage, when plate voltage and filament

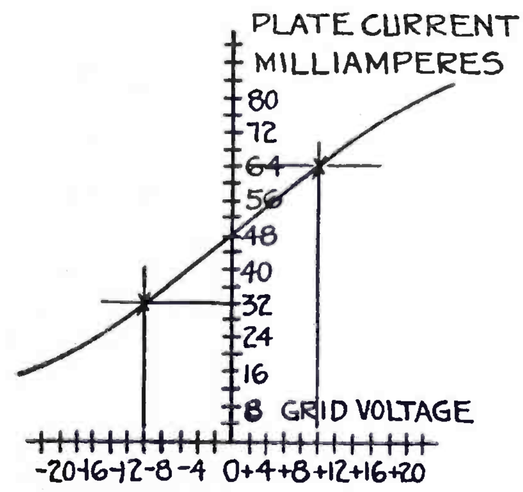

Fig. 8. Plate Current-Grid Voltage Characteristic of 5-Watt Tube

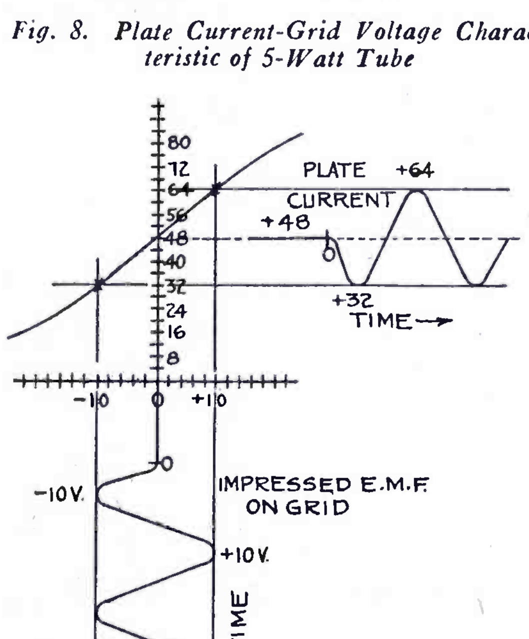

Fig. 8a. Effect on Plate Current When an Alternating E.M.F. is Impressed on Grid.

current are kept constant. See Fig. 8, which is obtained by applying a constant plate voltage and filament current to the tube, and reading the plate current in milliamperes, for various values of grid voltage, both positive and negative. If an alternating voltage is applied to the grid we see that the plate current must also rise and fall. Let us assume for simplicity that the grid potential is zero under normal conditions. Let an impressed alternating voltage vary between 10 volts positive and negative. As the grid becomes more negative the plate current decreases more and more, till at 10 volts negative on the grid, the plate current is 32 milliamperes. When the grid potential becomes less negative the plate current approaches normal. Some time later the grid becomes more and more positive and the plate current rises, and when the grid potential is 10 volts (positive) the plate current is 64 milliamperes, or 16 milliamperes above normal. Now, when the impressed voltage again becomes less positive, the plate current again returns to normal. It is seen that an alternating voltage on the grid can produce an alternating component of current in the direct plate current. This important fact is made use of in detectors, amplifiers, and oscillators. It should also be carefully noted that the normal grid potential can control the plate current. Thus if a tube has a fixed bias of 10 volts negative on the grid, the normal plate current will be 32 milliamperes. An impressed alternating voltage will fluctuate about this 10-volt position instead of about the zero voltage position as described above. Biasing is made use of to control the plate current in some cases, and in other cases to fix the operating point of the tube on some particular portion of the characteristic curve. Biasing is more important when tubes are to be used as modulators and amplifiers.

In a general way we can say that the action is about as follows: A direct voltage is applied to a circuit containing a condenser C_2 and an inductance L_2 in parallel (Fig. 1), and a variable resistance in series. This variable resistance is the path between the plate and filament of the tube. If the grid is more negative the apparent resistance increases, if it is more positive the apparent resistance decreases. In other words, the characteristic curve (Fig. 8) shows that, for a given plate voltage, the grid potential controls the plate current. This can be regarded as an apparent change of plate filament resistance brought about by a change in grid potential. The significance of this fact will be brought out later.

Consider now the equivalent circuit in Fig. 9. Suppose, for the time being, that resistance R is shorted out by closing switch A. Now let the condenser C_2 be charged by throwing the switch D to the left. Then let D be placed in contact with point C. The charged condenser now discharges through the inductance L_2. This will cause the circuit containing C_2 and L_2 to oscillate at its own natural period. $f = \frac{1}{2\pi\sqrt{LC}}$
The amplitude will decrease due to the resistance which is bound to be in the inductance L_2 and the leads to it and to C_2. So far this is similar to what takes

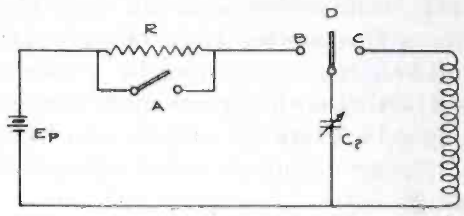

Fig. 9

place in a spark transmitter. Throwing of switch D to position C is analogous to the breakdown of the spark gap. Most readers are familiar with the theory of such oscillations; the converting of the electrostatic energy of the condenser into electromagnetic energy at the inductance; the collapse of the electromagnetic energy inducing a voltage which again charges the condenser, restoring to it the original energy minus that lost in resistance, etc., giving an attenuating current.

Next, suppose that switch D is thrown back and forth very rapidly. The condenser still has time to receive a charge each time, and it then discharges in the same way as described above every time contact is made at C. We now have exactly what would take place in a spark transmitter. The throwing of the switch corresponds to the vibrations of the interrupter or else the alternations of the 60-cycle transformer supply, depending on whether the set were made up of an induction coil or transformer.

Now imagine that the switch operates as fast as the frequency of the oscillations, i.e., at radio-frequency. The switch will then be in phase with the radio-frequency oscillations and undamped or continuous waves will result, as long as the switch remains in phase. If it were possible to make such a mechanical switch, we might do away with vacuum tubes. The direct current, or rather voltage, now supplies energy that was lost during each cycle. If such an oscillator were coupled to the antenna, a certain amount of energy would be radiated also, and this would again be supplied by the source E.

In the continuous wave transmitter energy is supplied practically continu-

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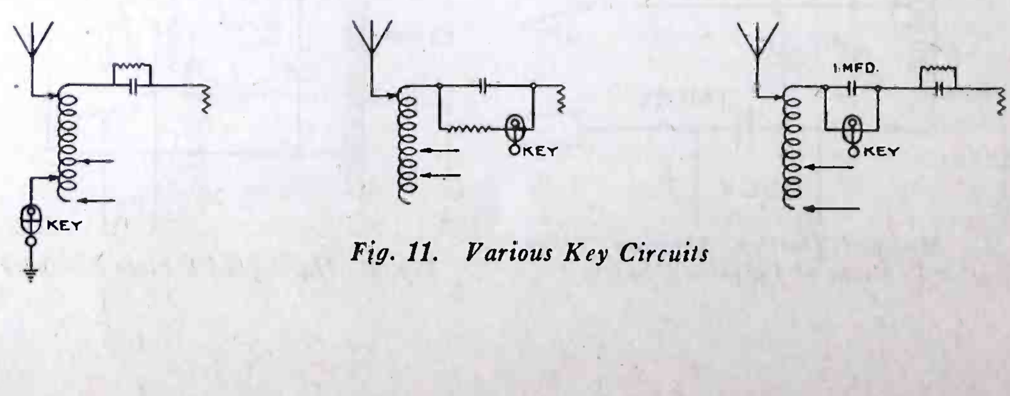


Fig. 11. Various Key Circuits

Design of Distortionless Amplifiers

By D. B. McGown

The author here discusses the factors that make for good amplification. These include the selection of proper transformers and tubes and their correct placement. This article, while complete in itself, is the third and final chapter in a series of three on the design of radio apparatus.

IN the design of an amplifier for the "speech input" circuit of a phone transmitter or for the operation of a loud-speaker in a receiving set, the first point to be considered is the ability of the amplifier to handle all the alternating current delivered to it. The frequency set up in a telephone system as a result of impressed speech, will range from about 250 to 2000 cycles per second. If music is to be transmitted, this range may be increased to anywhere from 100 cycles to 5000 cycles. This means that the amplifying system must handle all these frequencies with equal ease. If, through faulty design, an amplifier suppresses, or fails to pass any minute variations, it will cause the receiving apparatus to lack the sound qualities that are desired. The facility with which the "transmitter," or pick-up system, responds to slight variations is a matter of equal importance.

We can assume that the vacuum tube, if operated properly, will not produce any distortion. Therefore, as an amplifier system is nothing more than a transformer system operating from vacuum tubes, we must assume that here is where the distortion takes place. As vacuum tubes operate entirely on alternating current, we find that between the grid and filament, and plate and filament, we have a certain factor called the tube "impedance." Impedance is defined as "the apparent resistance in ohms of the circuit to an alternating current." This may, or may not, be the same as the d.c. resistance. Generally it is not, as almost any circuit will have some factors of inductance or capacity, which change the value of the d.c. resistance. The actual value of the grid-filament and plate-filament impedance of a vacuum tube depends entirely on its construction and especially on the spacing of the filament and grid, and the filament and plate electrodes. In standard types of vacuum tubes, we can assume that the various impedance values for both grid and plate circuits are equal for all tubes of the same type. That is, for a particular type of vacuum tube, we may have a nominal grid impedance, as it is commonly called, of 500,000 ohms, on the nominal frequency of 1000 cycles (which is the usual one on which speech circuit apparatus impedances and other values are determined) and the plate impedance may be about 20,000 ohms.

In alternating current circuits, we find that the maximum current will flow when two impedances of the same value are connected together. This is another way of saying they are in resonance in a transmitting system. Therefore, if we are to have transformers that match the input and output impedances of the vacuum tubes, we will get maximum current, and therefore the loudest signals. If the transformers are so designed that their impedance is equal to that of the tube, say at 100 cycles, and it is of either a higher or lower value on different frequencies, which is a very common condition, we will again have great distortion, as certain frequencies will pass through and be amplified with greater intensity, while others will not come through with anything like their normal volume.

Another important factor is the way in which the transformers are connected. If the plate supply current is permitted to flow through the primary of the coupling transformers, the core of the latter will be magnetized, the amount of the magnetic flux depending on the value of the various constants of the circuit. In any case, the effect will be to decrease the effective amount of iron in the core. If there was sufficient current passing to magnetize the core to the saturation point, the transformer would act as though it had only an air core, although generally this latter point is not reached, as most transformers will burn out before sufficient current can be passed through them to saturate the core. If the iron is worked just below the saturation point, enormous distortion will take place, as the alternating current from the vacuum tube will be alternately bringing the core up to the saturation point, and then reducing it by its own amplitude. The remedy for this is easy: If the direct current is kept out of the primary entirely, and only the alternating current from the input apparatus allowed to reach the transformer, we will have much better operation than it is possible to obtain with any other means. The direct current will so reduce the effective iron, even in a properly designed transformer, due to its magnetizing effect, that although on alternating current the impedances may match perfectly, with d.c. in the windings the relations will be entirely destroyed. The system of using a condenser in the transformer input circuit makes it necessary to supply the d.c. in some other way, which is taken care of by a plate choke coil, as indicated in Fig. 1, where the condenser C is placed in series with the primary of the coupling transformer (commonly and erroneously called "amplifying transformer"), while the d.c. supply to the plate is led through the choke coil CK, which is of large value (from 10 to 50 henries) and which prevents all the audio-frequency from the plate from going through it. The condenser C is of a large value, say 1 mfd., and is capable of passing the alternating current with little or no loss.

The operation of vacuum tubes on the proper point on their characteristic

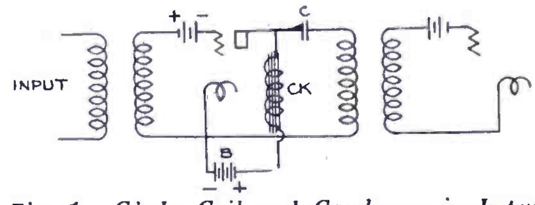


Fig. 1. Choke Coil and Condenser in Input of Amplifier Circuit with Bias Battery

curve, as determined by the proper value of the grid potential, is as important as anything else in the design of a distortionless amplifier. For low voltages up to 40 volts, if the filament rheostat is connected in the negative lead of the

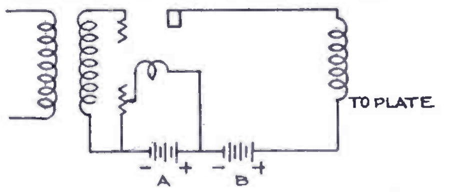


Fig. 2. Amplifier Circuit with Filament Rheostat in Negative Lead

A battery, as shown in Fig. 2, the potential drop across the rheostat will take the place of such a bias battery, but as this is variable, and is changed every time the filament rheostat is moved, the results will not be entirely satisfactory. The actual value of the bias battery, which consists of a few dry cells connected in series with the grid as shown in Fig. 1, the negative terminal connecting to the grid depends entirely on the tube used, and the plate potential applied. Tables already published in this magazine give these values, which are correct for standard tubes.

In the selection of transformers for use in any amplifier, the old "cut and try" method is to be avoided. It has been the custom for anyone buying a transformer for an amplifier to go to his various friends and ask what are the "best." The answers he obtains usually leave him in a worse state of mind than before. One friend says a certain brand are the best above all others, while another friend, who may be equally in earnest, says that that particular make is the worst he ever tried. The poor victim of such mis-information is then usually left in such a state that when he does buy the transformer he grabs blindly at anything offered. The fact that the first party was using the X brand of transformers on one type of tubes, and on say 60 volts plate supply, and that the second party was using the same transformers on an entirely different type of tubes, with say 120 volts plate supply, is never considered.

The builder of an amplifier is advised to steer clear of any and all types of transformers where the actual values of the input and output impedance are not stated by the maker. The so-called "ratios" between the windings of various transformers offered on the market are in themselves a confession on the part of the makers that they don't know what they are putting out. This "ratio" apparently is taken as the turns-ratio between primary and secondary only. To show how foolish this is, it is perfectly possible to wind 3 turns of wire on a core, of ½-in. cross section, and then wind 12 more turns over this first winding, so as to give a transformer with the so-called "four to one ratio." This is apparently correct, as 12 is 4×3. The impedance value of such a transformer would be in the neighborhood of a few ohms, however, and entirely unsuited for coupling two vacuum tubes, as is self-evident. How, then, can any of the so-called "ratio" transformers be any better? Suppose Blank & Co. makes a transformer with 1500 turns in the primary, and 6000 in the secondary. This is again the ratio of 4 to 1. Now, if Green & Co. makes a transformer on exactly the same size core, but puts 2000 turns on the primary and 8000 on the secondary, we will still have the same ratio between windings, but the electrical constants will be vastly different. Nevertheless, many makers list all their "amplifying" transformers by their turns-ratio, and let it go at that, either not knowing or not caring what the impedance values of the various coils are.

Such factors as the shape and material of the core have just as much effect on the design of transformers as the actual windings. For example, if a poor grade of iron were used, we would have to use a much larger core to carry the flux, than if we used the best grade of silicon steel. If the end joints of the core were not arranged to reduce the leakage to a minimum we would again have one single factor which would cause considerable change in the impedance values of the apparatus. The shape and distribution of the windings is another factor that deserves as much consideration. Still the practice of listing transformers by the supposed turn-ratio exists. If a maker lists his transformers as "so-many thousand ohms primary on so-many cycles, with secondary connected to so-and-so" we may assume that he has tried to design a transformer that will serve its purpose with at least reasonable efficiency, but beware of the "turns-ratio," or similar unknown types.

In mounting the various parts of an amplifier, as much care should be shown as in anything else. Certain irresponsible persons have made statements to the effect that it is impossible to work more than "three stages audio-frequency" without howling. These people show their ignorance or carelessness. It is perfectly true that the ordinary types of transformers and tubes, if mounted in any way that suits the maker's fancy, will not work very well, and if howling takes place, this is really all that can be expected. When we consider the enormous increase in volume of the signals from the input to the output in even a two-stage amplifier, even a very slight amount of the output current will cause trouble if permitted to get back into the input side. "Howling" is generally caused by interaction between circuits, due either to magnetic or electrostatic coupling, whereby sufficient energy gets back to the preceding tubes to make them oscillate at audio-frequency. This can be eliminated by proper shielding of tubes, transformers, and leads. The system of putting each stage in a separate metallic box is desirable, and will eliminate about 99% of the howling. Careful arrangement of the input and output leads will generally take care of the other feed-back. There is no reason, except the trouble from this feed-back effect, why, within the limits of the tubes, the amplification could not be increased to 6, 7 or 8 stages.

The actual limit of an audio-frequency amplifier, if properly designed, is the overload limit of the vacuum tubes used in the system. A simple receiving set will furnish sufficient energy to operate a pair of telephone receivers, and this small fraction of a watt is more than enough to operate a vacuum tube. If an amplifier is used, the amount of energy that operates the head telephone will be increased enormously, even if only a single stage of amplification is used. If a multi-stage amplifier is used, the energy output theoretically increases as the square of the number of stages. Actually, this does not hold, except for a very rough estimate. If an amplifier is to be designed to amplify very feeble currents, and to repeat them at moderate power, we can use tubes with higher amplification constant, and lower power input than if we wish to have a larger power output, and a corresponding reduction of the potential. Generally amplifiers are combinations of both of these actions.

If we wish to operate a loud-speaker of any type, we should first have an idea of the power input it requires, as well as its input impedance. If it takes 10 watts to operate it at normal volume, we will be foolish to attempt to operate it on receiving tubes. Again, if we wish to operate a small loud-speaker, as a Baldwin telephone attached to a horn, we only need a small amount of power, as too much will cause the phone to rattle.

If, again, we attempt to operate the small tubes at a value greater than they will carry safely, we find that up to a certain point they act properly. If the input is increased to more than this, the effect will be to put such a large charge on their grids that they will "block" the current flowing between filament and plate, and for an instant we will hear no signal at all, or a very weak one, but there will be a sharp clicking heard instead. At this point the tube is said to be overloaded and the only remedy is to use a larger tube, a higher plate voltage, or a lowered grid potential, none of which should be done unless the exact conditions of the circuit are known.

Some people express surprise that a "transmitting" tube will act as an amplifier, but actually it will operate as a more powerful amplifier than a receiving tube, simply because it will handle more current, which generally means a greater signal in the telephones, which depend on their wattage input for their loudness of signal.

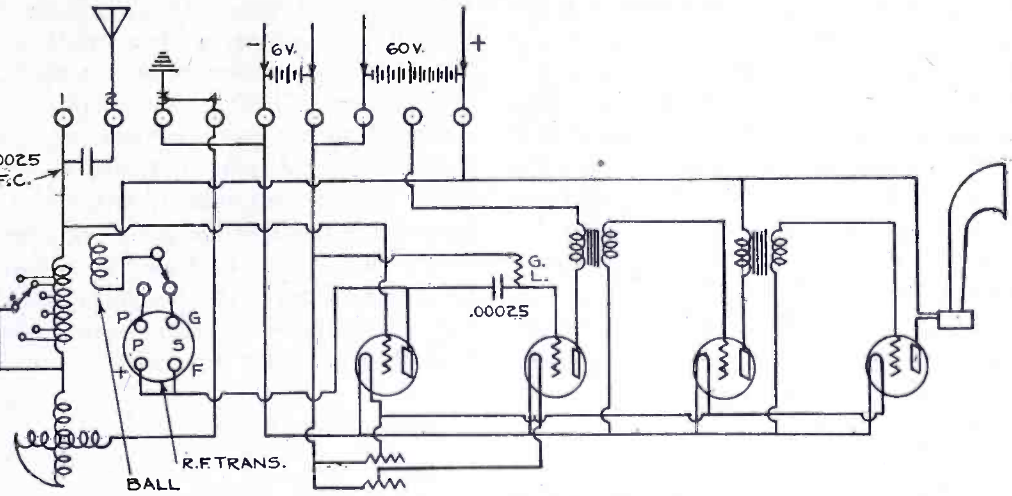
Taki Yonemura, Radio Engineer, sole link between Japan and other lands when all other communication systems were destroyed.

Through the courtesy of the New York Times we are privileged to reproduce this photo of Taki Yonemura, chief engineer of Japan's most powerful radio station, whose knowledge of English enabled him to flash the brief and poignant message acquainting this country with Japan's recent overwhelming disaster. Of all the means of communication linking Japan with the rest of the world, the 600-ft. towers of stations JAA were alone spared. It was from this station, located at Haranomachi, 178 miles from Tokio, that Chief Engineer Yonemura for three days and nights broadcasted the first authentic information of history's greatest natural catastrophe.

Why Bloop?

By J. O. Watkins

As this article is written for the benefit of the broadcast listener who may not be familiar with radio slang, let us say that to "bloop" means to radiate from a receiving set so as to cause undesired sounds in neighboring sets. The author tells how a single-circuit set may be made bloopless and thus conform to the Golden Rule of radio.



Circuit Diagram for Bloopless Set

I CAN forgive the broadcast fan who oscillates his detector for a few seconds in order to find the tune of a distant station, but not so, the bimbo who does all his receiving with it in that condition and attempts to set the beat note to zero. Upon how well he succeeds in keeping it at zero depends the quality of entertainment had by his neighbors. All in all, they receive about the same quality as he does. He does not need to do this and I propose to give him a circuit that makes it unnecessary, and at the same time which costs little more than the present single-circuit he has, or one to which he can easily convert it.

The solution is: one more tube on the old fliv, and if he follows the advice given here he need bloop no more. He will not let his tube oscillate continuously, because he cannot hear anything except carrier waves by so doing. He may discard his vernier and "slip up on 'em" rheostats, he will not require them. He will do his tuning with inductance or capacity as he should. Furthermore, he will cause his detector to detect, like a self-respecting soft tube will, leaving the job of regeneration to a tube built especially for that purpose. In so doing, he will be agreeably surprised at the way the "whiskers" have deserted that same aforesaid distant station, and in their place is a husky booming response like that of a local station. Furthermore, owing to the greater possible whiskerless regeneration, he will discover that, because he can neutralize the resistance losses in his antenna, the old fliv has become almost as selective as the coupled circuit usually is. There is more—he can, if he will, tune in that oft-mentioned distant station, then go away and leave his set alone, and that station will remain tuned in. The writer, in San Francisco, has listened to a program broadcast from a Chicago station for two and one-half hours without touching a knob. The listening was done with a loud-speaker.

There is a best filament temperature for an amplifier tube, likewise for a detector. Then why fiddle with them? Find that setting and leave it there. Turn the filament current on and off with a switch, and the rheostats may be left in one position for months, providing the battery is not permitted to exhaust itself. This will add greatly to the life of the filaments.

Referring to the circuit diagram, there are nine terminal connections, four of which are numbered. To use a loop, disconnect aerial and ground. Connect terminals *2, 3* and *4* together. Connect a large loop (it may be as many as 20 turns 3 ft. square) to terminals 1 and 2. It may be noted that with this connection the loop, condenser and internal inductance of the circuit are all in parallel. Such a combination has a smaller inductance than either the loop or the internal inductance, therefore the circuit may be brought to resonance even if the loop is too large to be tuned to that wavelength alone. Used in this manner, the loop is merely a collector with directional characteristics, but it is not strictly a part of the tuned circuit. It is therefore better to wind the loop with comparatively small wire, about No. 18, and space the turns at least ¼ in.

To use a coupled circuit, it is recommended that a separate vario-coupler and variable condenser be used to tune the antenna, and that they be kept as far away from the rest of the circuit as is practicable. Remove all except six turns from the rotor of this vario-coupler, and connect its terminals to *3* and *4* after removing the jumper. Place the jumper between *2* and *3*. For pickup work, it is best to make the change from coupled to single-circuit with a switch.

When using extremely small aerials, it may be necessary to resort to one of three alternatives in order to bring the circuit to resonance. One is to remove the jumper from *3* and *4*, and insert a loading coil; or, connect a small condenser across *1* and *2;* or, connect the aerial to *1* and short *2, 3* and *4* and ground them. This gives the parallel circuit.

At this point it should be said that when using this or any other single-circuit the antenna inductance should be kept as low as possible consistent with sufficient size for the necessary collecting features. The first tube in such a set is operated by the potential across the tuning inductance, whence, it follows that if practically all of the inductance of the antenna system is concentrated between the terminals of this tube, greatest efficiency will obtain. On account of this, a T antenna is to be preferred to an inverted L or other long form.

Single-circuit users are probably the worst sufferers from alternating current inductance picked up by the antenna. With this circuit, nothing other than radio-frequency impulses can pass the radio-frequency impedance. The detector tube is protected by a short circuit.

There are several reasons why one stage of impedance-coupled radio-frequency amplification gives a stronger response than does the transformer-coupled, not the least of which is the fact that if the primary of the transformer is tuned, it constitutes a parallel resonant circuit, which offers a maximum impedance to the frequency to which it is tuned, and because it contains a preponderance of inductance, the current through it will be a minimum and the potential across it maximum. If we utilize this potential directly to operate the detector tube, considerable gain in efficiency is the result. This applies whether the winding is in the form of a sharply-tuned circuit, or the more broadly-tuned transformer windings, found on the market. For the purpose of broadcast reception, one should not select either a transformer or impedance with too broad a wavelength band, such a rating proclaims them to be inefficient at any wavelength.

The conventional tickler ceases to be a tickler in this circuit and becomes a stabilizer. While it continues to con-

Continued on page 72

Construction of a Loud Speaker

By Stuart A. Hendrick, 2BJG.

Part of the charm of radio resides in the opportunity that it offers "to roll your own." From the simple directions here given any amateur can construct a satisfactory loud speaker at a minimum of expense.

THE loud-speaker to be described works on the electro-dynamic principle. It has a moving coil and the mica diaphragm gives the best tone possible and does not distort the music. The moving coil is suspended in a powerful electro-magnetic field. This coil is connected to the output circuit of the receiving set and any variation of the current in this coil will cause it to move up and down in the field. As the coil is attached to the mica diaphragm it will produce whatever sounds that are impressed upon it through the receiving outfit.

To build this loud-speaker is not as difficult a proposition as may be thought at first. Some of the parts will have to be turned out in a lathe, but they are very simple turnings and ought not to take a machinist long to make all of them.

The outside casing is made of a piece of iron or steel tubing 3 in. outside diameter and 5½ in. long with walls ⅛ in. thick. This tube, *A*, not only acts as the housing but also as part of the core to complete the magnetic field. A piece of wrought iron pipe could be used. The ends of this tube should be squared up in the lathe.

To make the electro-magnet, a piece of ⅝-in. soft iron rod is cut to a length of 4 in. as shown by *C*. Two fibre ends, *D, D,* are fitted tightly to the ends of this iron core. One fibre piece should be on the extreme end while the other is pushed down far enough to leave ¾ in. of the core projecting. Then wind the core with several layers of paper to insulate it from the wire. The winding consists of 2 lbs. of No. 20 D.C.C. wire wound on in even layers. At 6 volts this coil will draw approximately 0.9 ampere.

To make the moving coil, use a piece of soft copper or brass cut to the shape shown in Fig. 2. Wrap this piece around a wooden rod exactly ¾ in. in diameter and solder the ends together carefully. Bend the three ends together so that they will fit around a 2/56 hexagonal brass nut and solder them to the sides of it as shown in the drawings. Put a strip of thin paper around the lower part and stick it on with shellac or glue. Around this form wind 350 turns of No. 40 single silk-covered wire or enameled wire. The winding should be in layers as even as possible. A little very thin shellac is then put on the wire to hold it in place. The leads should be wound into a small spiral which will keep them from breaking after the speaker is in use.

The diaphragm is cut from clear white mica 4 mils (.004") thick and is 2¾ in. in diameter with a small hole, to fit a 2/56 machine screw, punched in the center. The moving coil is then fastened to the mica by putting a short 2/56 machine screw through a thin brass washer and then through the mica into the nut which holds the moving coil.

The resistance of this coil is too low to insert directly in the plate circuit of the receiver, so a transformer, which will be very easy to construct, will be necessary to use with it. Fig. 3 gives the details. If an old telephone induction coil is secured from the local telephone company it will save you the trouble of making the core and wooden ends.

If they must be made, use the following data to construct them: Obtain some soft iron wire and cut into 4-in. lengths until you have enough to make a bundle ⅜ in. in diameter. Then cut two blocks of wood about 1 in. square and ⅜ in. thick. Drill a ⅜-in. hole

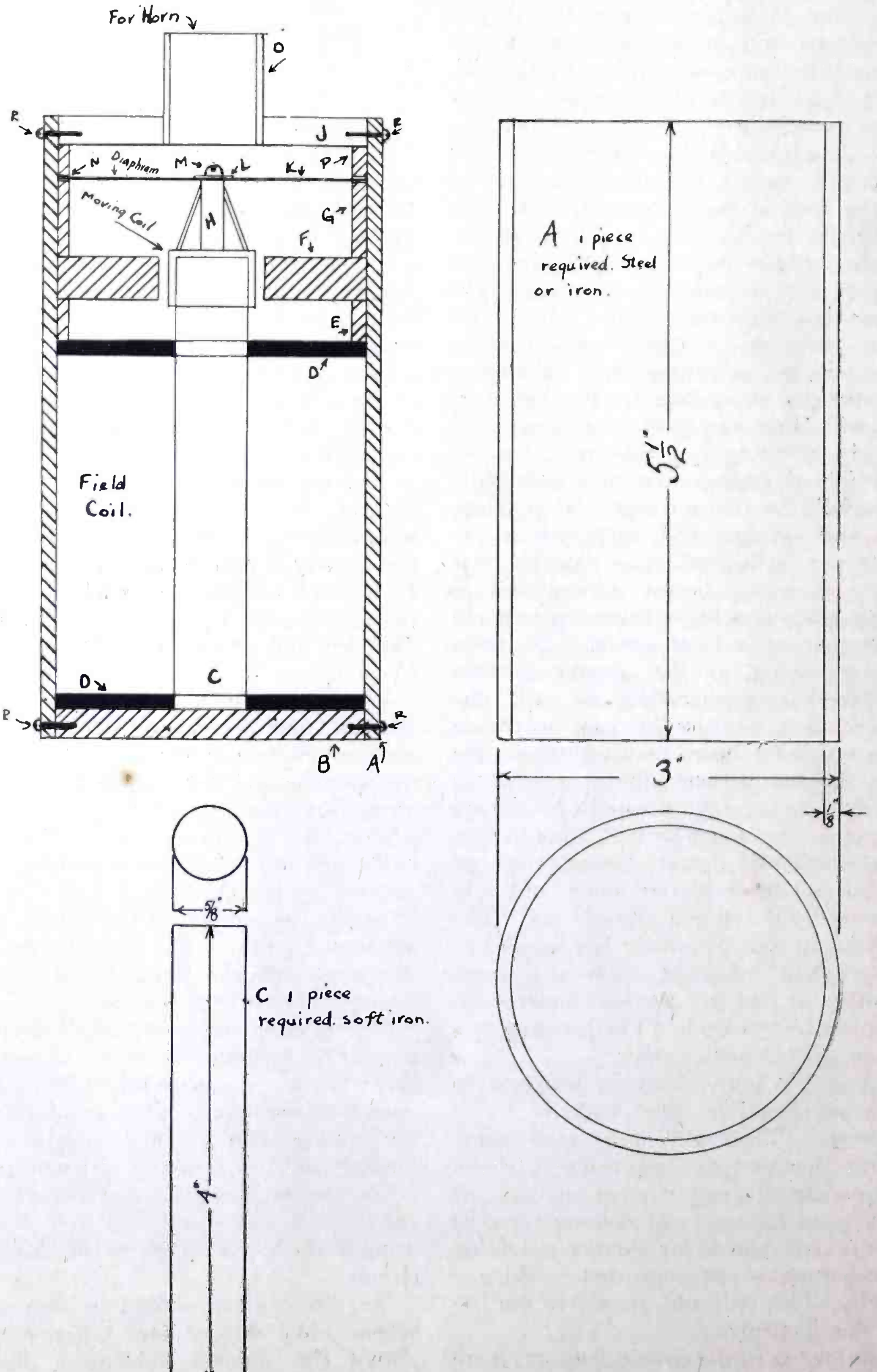


Fig. 1

through the center of these and fit them upon the ends of the bundle of iron wires. Put several layers of paper around the core and then wind on the secondary, which consists of 250 ft. of No. 38 D.C.C. wire. Put on 2 or 3 more layers of paper and then put on the primary, which is made of 1000 ft. of No. 40 D.C.C. wire. Wind this wire on as evenly as possible. This completes the transformer, which should be mounted upon the same baseboard as the speaker itself.

To assemble, the iron disc *B* is fastened into the bottom of the tube *A* with four machine screws *R*. Then the electro-magnet is slipped into place, and the leads are brought out through a hole in the side of the tube *A*. The spacer *E* is next put into place, followed by the pole piece *F*, and then by another spacer *G*. Around the edge of *G* glue a piece of rubber, felt or cord, to act as a washer to rest the mica diaphragm upon. After the diaphragm is put into place put another similar washer around the top edge of it and then put the spacer *P* into place. The cover *J*, which contains the piece of tubing *O* for fastening a horn to, is then put on and the four machine screws put into place to hold it tight. If the parts inside are loose, some cardboard washers should be put under the piece *J* until they do not rattle. This should be done carefully if you wish to have a loud-speaker which will produce good music and not noise from parts inside shifting around. The leads from the coil *H* should be wound into a spiral and then brought out through a hole in the case which should be bushed with a piece of rubber tubing.

It will be much better to purchase one of the numerous horns now on the market rather than to try to make one. It is suggested that a wooden one be bought instead of a metal horn.

The best procedure to follow in making this talker is to purchase all the necessary materials and take those that are to be machined to the shop with the drawings accompanying this article and have them made up. After they have been made the rest of the job is simplicity itself.

The man who spends the few hours necessary to build this instrument will find, when he has finished it, that he has a loud-speaker equal to the best of the commercial articles and he has that feeling of satisfaction which comes only to the man who is able to do things for himself.

Don't try to put the whole set in a box that is too small; remember that if placed too close together the various parts will have so much inductive coupling between them that they will howl horribly.

Don't break the tips of the vacuum tubes; if you do they make a fine hissing noise, but they make punk detectors!

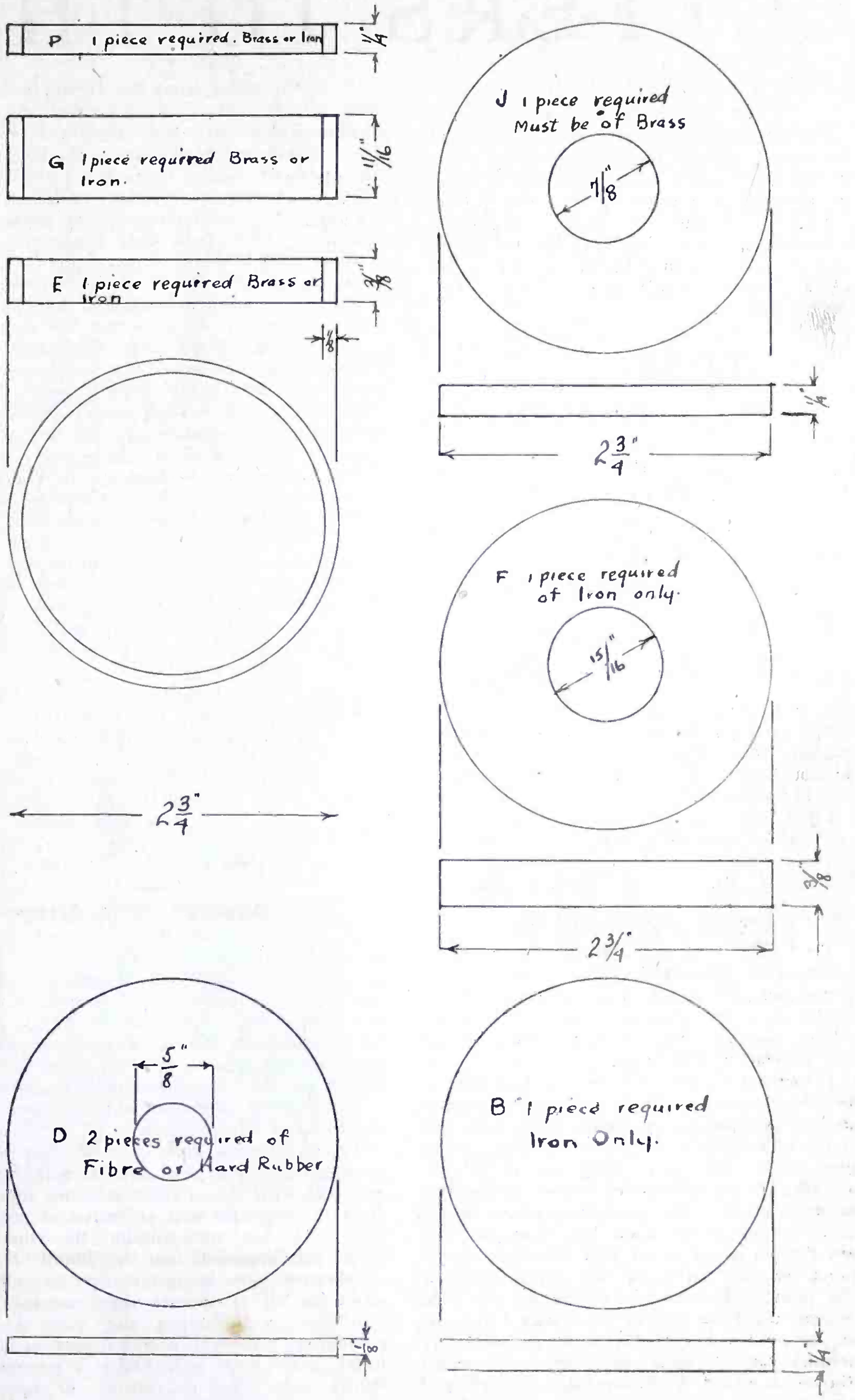


Fig. 2

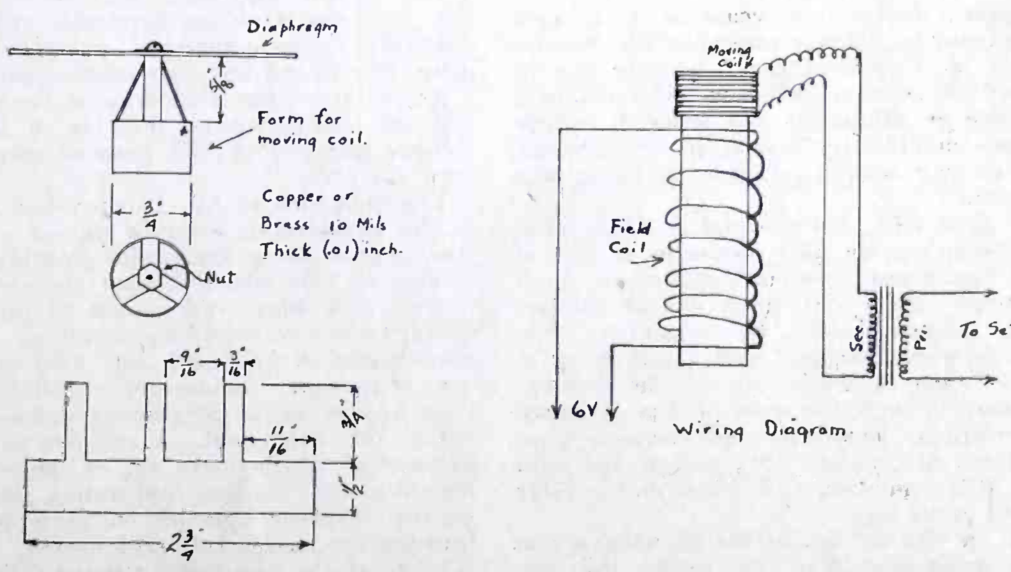
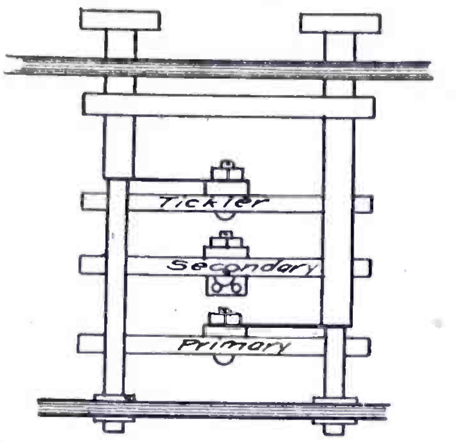


Fig. 3

LETTERS TO THE EDITOR

Improved Honeycomb Coil Mounting

Sir: I am writing to you in reference to the article which appeared on page 12 of your August issue, under heading of "Universal Motion For Secondary And Tickler Coils," by Arthur S. Gordon. While this mounting is very ingenious, I am of the opinion that a mounting as per the accompanying sketch would give a much greater ease of control.



A movement of the primary may be effected without the necessity of resetting the tickler. Also the tickler may be adjusted without changing the coupling between primary and secondary.

I think this to be a decided improvement, and would appreciate having you pass it on to the bunch.

Lynchbury, Va. NEIL E. HENRY.

The Time Limitation

Sir: Permit me to congratulate you on the editorial in August RADIO advocating the imposition of a time limit on broadcasting stations, in compensation for that recently placed on the amateur transmitters by the Department of Commerce.

Allow me to add that, with a cessation of broadcasting at a definite hour each night, it should be possible for amateurs to make use of the wavelengths given over to broadcasting previous to that hour, such use to be permitted until some hour the following morning, or even noon. The morning use of broadcast stations is so much less than the PM use that is seems to me that the stock quotations, weather forecasts, etc., which comprise the usually briefer broadcasts of the AM period could be shifted to waves from 600 on up to possibly 1500 meters without very serious conflict with other work, provided the exact waves were carefully selected and no unnecessary broadcasting indulged in for advertising purposes.

Such a development would be the greatest assistance to amateur expansion the Department of Commerce could possibly put in effect. It seems to me a time division is more flexible in adjustment and easier to enforce than an arbitrary fixing of wavelengths, which may involve complete rebuilding of a station.

I agree with your editorial that it is absolutely unjust for each successive attempt of the Department to adjust conditions to result only in further restrictions on the defenseless amateur, while the broadcaster goes merrily down the road with a pocket full of long green siphoned out of the listeners' pockets through his more or less disguised advertising, knocking over amateur, coast station, ship station, navy station, and even the SOS regulation, as he finds they possibly stand in his way.

I am heartily sick of the universal cry of the broadcaster that "the public, the dear public, DEMANDS broadcasting!" I can only see the thing from the viewpoint of the law, which holds the instigator of crime equally liable with the perpetrator thereof. I see the broadcaster putting up his station first, without asking the public whether his action is necessary; then the broadcaster baiting the public with programs he thinks sufficiently good to hold their interest in competition with other stations trying to fill the same place; and finally, having formed the broadcasting habit among his circle of listeners, he boldly declares that his station is in existence BY POPULAR DEMAND! The dope peddler has equal justification if mere popular demand is the point of attack.

However, it is perhaps merely visionary to expect that the amateur will be accorded so great a recognition of his service to the radio science as my supposed time division would presume, and a modification of the present regulations is all that we may hope for.

Whatever the change, it is to be hoped for the protection of both amateur and listener, that the practice of permitting broadcasting every hour in the 24 without equal freedom for the amateur, or restriction of the amateur increasingly, be stopped.

I believe I speak for every amateur in America when I say that I hope the amateur may see the day when he can tramp on the grave of the nighthawk broadcaster, and kick his tombstone into perdition beyond recall.

Very truly yours,
L. B. LAIZURE,
5544 Highland Ave., Div. Publicity Mgr.
Kansas City, Mo. A.R.R. L.

The Commissioner's Answer

Sir: As requested in your letter, there is returned herewith the letter of Mr. L. B. Laizure, of Kansas City, Missouri, commenting upon an editorial in August RADIO advocating the imposition of a time limit for broadcasting stations in compensation for that recently placed on the amateur transmitters by the Department of Commerce.

The Bureau does not entirely agree with the views of Mr. Laizure.

The opinion is quite general that broadcasting has merit and that it will increase in value with the advance of time, improvement in programs and perfection of apparatus. It is not monopolizing the ether and it is not intended that it should. While at present there is apparently not sufficient room for all to operate simultaneously, this condition is improving and there are encouraging prospects that efficient apparatus intelligently used will make it unnecessary before very long to restrict the operating hours of any first-class station.

The present day spark transmitters and arcs producing mush and harmonics will undoubtedly be much improved or replaced by more efficient and less interfering apparatus.

As you know, the elimination of the spark and arc transmitters on ships is an International question, as ships from all countries enter our ports.

The suggestion of Mr. Laizure that much of the broadcasting could be carried on wavelengths above 600 meters probably extending to 1500 meters without very serious conflict with other work is due to his not being familiar with existing conditions. The wavelengths between 600 and 1500 meters are at present considerably crowded. A large number of the government stations are within this band, and, in addition to this, commercial vessels make use of the wavelengths of 706, 800 and 1000 meters, and the marine telephone operates on three bands between 800 meters and 1200 meters.

Many of the broadcasting stations discontinue transmitting by 10:30 P.M. and those who are transmitting after that time should not seriously interfere with the amateurs, who are usually well qualified to adjust intelligently their selective receivers. In this respect, they have a big advantage over the inexperienced broadcast listeners, who in many cases are not familiar with their receivers, have not had the experience in selective tuning and do not possess the type of receivers which the amateur has found best suited for the elimination of interference.

Many of the regulations of the Department are not intended to be permanent, but subject to change as experience indicates such changes to be necessary, and for the benefit of the art.

Respectfully,
D. B. CARSON,
Washington, D. C. Commissioner.

Raising the Ante of Calls Heard

Sir: Having been an interested reader of Pacific Radio News, now RADIO, for the past five years, and having followed with interest its advancement as a radio magazine from year to year, I feel it is my privilege to make any suggestions which will in my mind tend to better the publication. Although I honestly believe RADIO ranks highest in efficiency as a real Book Of Knowledge for the amateur, there is one department which in my opinion wastes a good deal of valuable space and might be greatly improved. I refer to the Calls Heard List. As the efficiency of amateur transmitters has greatly improved with the adoption of the Continuous Wave method of transmission, I believe the distance which Calls Heard should be submitted to you for publication should be changed from 250 to 800 miles. This may seem unfair to some of the gang who may be in poor localities for radio work, but I think the majority will agree with me that any distance under 800 miles should not be considered exceptional unless it is made on an oscillating receiving tube. In order to stand back of this statement I decided to conduct a 30-day test to ascertain the greatest distance I could annihilate by the use of a standard receiver and I certainly surprised even myself.

I have been hearing Hams in the States for the past two years, but I have never considered the distance to the 6th and 7th districts as being great enough to excite me to send in a list. It was not until I noticed the list of calls heard rapidly increasing in number and the increasing difficulty of locating any station heard over 1000 miles distant that I thought it worth while to send in a list. I am sure you will agree with me that many amateurs suffer from eyestrain as a result of digging through groups of 50 or so call letters in order to find some station which has heard them working over 800 or 1000 miles.

I have tried every hook-up I could lay my eyes on and I decided to use the well-known Aeriola Sr. with one-step A.F.A. in the test. The antenna was more inefficient that those used by the BCL in the United States, being but a single wire 14 ft. above the ground stretched from a small tree to the house. The list includes stations from the four boundaries of the Good Old U.S.A., some using as low as five (5) watts power. The majority were heard from 10 to 12 P.M. local time, from the 10th of August to the 10th of September. I expect soon to be oscillating through 1500 miles of Alaskan atmosphere on 20 watts C. W.

Hoping you will publish this, so as to cause some discussion on the question of Calls Heard, I am, Yours Always For Better Radio,

LAYTON SCHELL,
Anchorage, Alaska Radio 7AHB

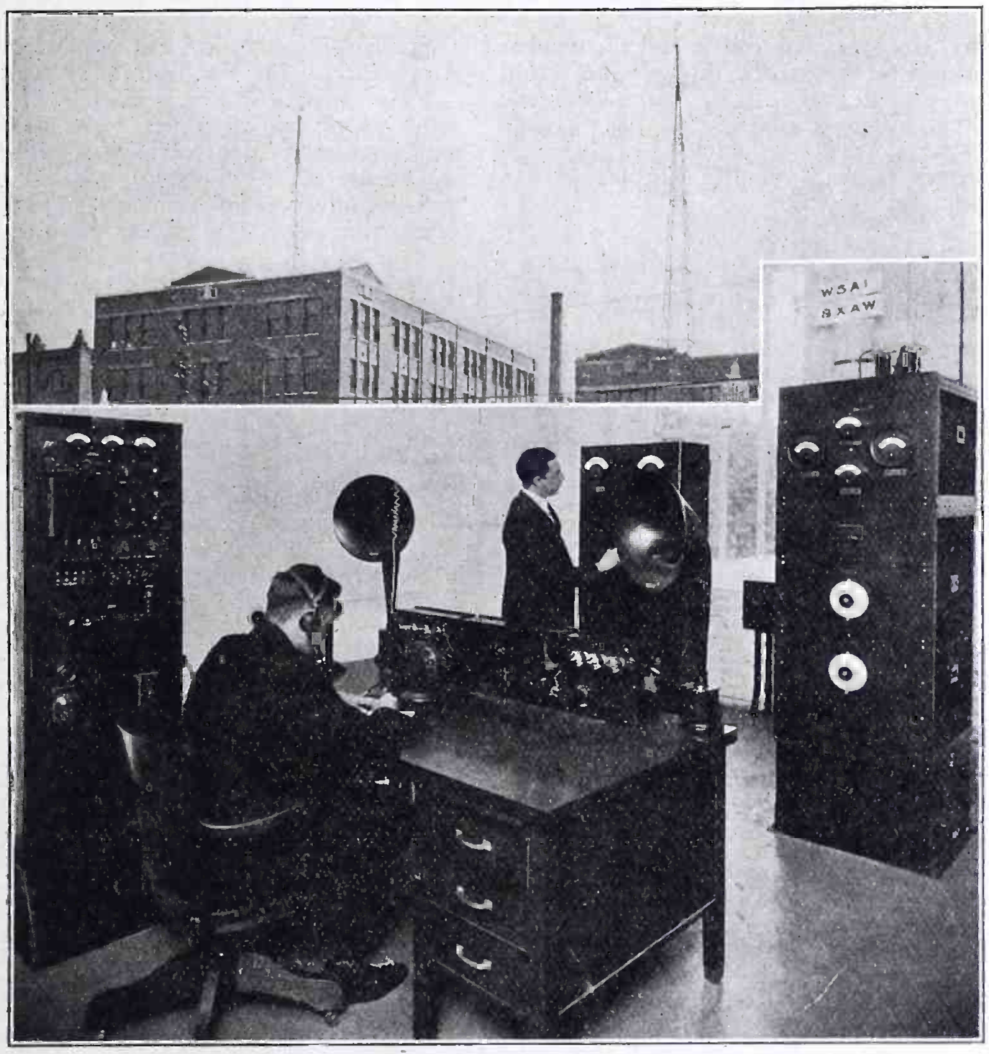
Continued on page 80

NEWS OF THE BROADCASTERS

RADIO STATION WSAI

Radio station WSAI is broadcasting on 309 meters from the plant of the U. S. Playing Card Co. at Cincinnati, Ohio. The transmitter is a standard Western Electric 500-watt set and was reported from every state except Utah, Nevada and Idaho during the first four tests.

The antenna system consists of a four-wire aerial with an active flat top of 65 ft., being supported by two steel towers on the roof so as to be $167\frac{1}{2}$ ft. above ground level. A regular feature of the program is instructions on how to play various games with cards.



WSAI.

THE RADIO BOOM IN SOUTH AFRICA

By C. A. REBERGER

As the result of a ruling by the Postmaster-General of the Union of South Africa, broadcasting and amateur transmitting stations will now be permitted. Though there are few broadcasting stations in this district at present, the passage of a year is bound to see the inauguration of many more. Broadcasting licenses are to be granted only to cities or towns, the people contributing towards the upkeep. The ruling says that every person who is desirous of "listening-in" to programs of any broadcast station must procure a "permit," which costs about $8 per year. Money realized from the issuance of "permits" will go toward defraying expenses of the station. It has been hinted that a committee is to be appointed by the governing body of each municipality, which will have full charge of the broadcasting station and will be paid a certain sum. It will be their duty to arrange programs, purchase necessities, pay all bills relating to the station and collect for "permits." This latter scheme, however, is only a rumor.

Cape Town, Johannesburg and Durban have already submitted their broadcasting schemes and all are equally anxious to have stations. Municipalities have been favored because of their semi-government status, their permanency and the fact that in such cases they would not look for large profits. It is reported that only one broadcast station may be set up within every 100 square miles.

Broadcast station licenses shall permit the station to broadcast for a period of five years. At the end of four years the broadcaster must intimate his intention to renew, and, if he fails to do this at that time, then the Post-master-General may refuse to renew it. The P.M.G. also has the authority to cancel a license if, in his opinion, the station is failing to transmit programs that he thinks are of the right type, regardless of how long said station may have been in operation. The regulations also contain a clause which says that a broadcast station must transmit any provincial news the P.M.G. may see fit to present to them for transmission.

It is provided that no person shall be allowed to experiment or operate a sending set within the distance specified in the license of a broadcaster, without complying with all regulations. If one is desirous of operating either type of station, he must apply to the P.M.G. for a license, which will be given him after paying the sum of $2. Upon issuance of the license the issuer will state what power and wavelength shall be used, but it is understood that no experimenting station shall make tests, etc., more than twice a week. Regulations governing the operation of amateur sending stations are very rigid and so set that they will not in any way "bust up" any portion of a broadcasting station's programs. Likewise, the hours of operation of the broadcast stations are so arranged that they will not interfere with amateur transmitting stations.

As a result of this letting down of the bars, many new radio factories have started and dealers are stocking up to meet the demand. Radio clubs are being started in all the cities and interest is running high.

NEW ZEALAND NOTES

By L. S. LANE

Now that broadcasting is an accomplished fact, radio is booming in New Zealand. There are several first class stations giving entertainment nightly, and there is ample evidence that their number and quality will be increased soon. A good feature is the co-operation between the B.C.L. and the amateur. Perhaps this is due to the fact that there is not an overwhelming number of broadcast listeners, most of them being roped in by the amateur clubs and initiated into the pleasures of telegraphy.

Several of the receiving sets installed by enthusiasts would make most American amateurs green with envy. The writer had the pleasure of listening on one single tube, single-circuit regenerative receiver in Auckland to a program broadcasted by KFI, Los Angeles, Calif. True, the music was weak, but it was good and clear, and when one considers that it had travelled 6000 miles to the listener and that he was only using one tube, it is some receiving. Several other American stations have been heard, but mostly with more than one tube. One ham claims receiving fragments of a concert from WDAF.

All the better class amateur C. W. stations on the Pacific Coast that work into the "wee sma' hours" are heard and copied in this country, 6XAD being quite a favorite. One of these days there will be trans-Pacific relay work, not tests.

At the present time there is under negotiation a system of tests to be carried out between New Zealand and Australia, across the Tasman Sea, roughly a distance of 1000 miles. This is nothing as regards distance to Americans, but we must take into consideration that the stations here are limited to 25 watts.

NEW AUSTRALIAN BROADCASTING REGULATIONS

By L. S. LANE

The government of the commonwealth of Australia has issued its regulations for radio broadcasting. These regulations have evoked much comment, both favorable and adverse, as they are stricter than those of any other English-speaking country. They call for an oath of secrecy from all licensees excepting those holding broadcasting receiving licenses. They state that the issuance of a license does not relieve the licensee of responsibility for any infringement of any patent or invention.

Licensed installations will not be permitted unless authorized to compete in commercial traffic with telegraph or telephone services. If government messages are handled the licensee must not charge more than half the rates charged to the general public.

Temporary permits may be granted for demonstrations of radio telegraphy or telephony in connection with lectures or entertainments of a specified character.

The following scale of fees is laid down for each year, or portion of a year, during which the license is in force:

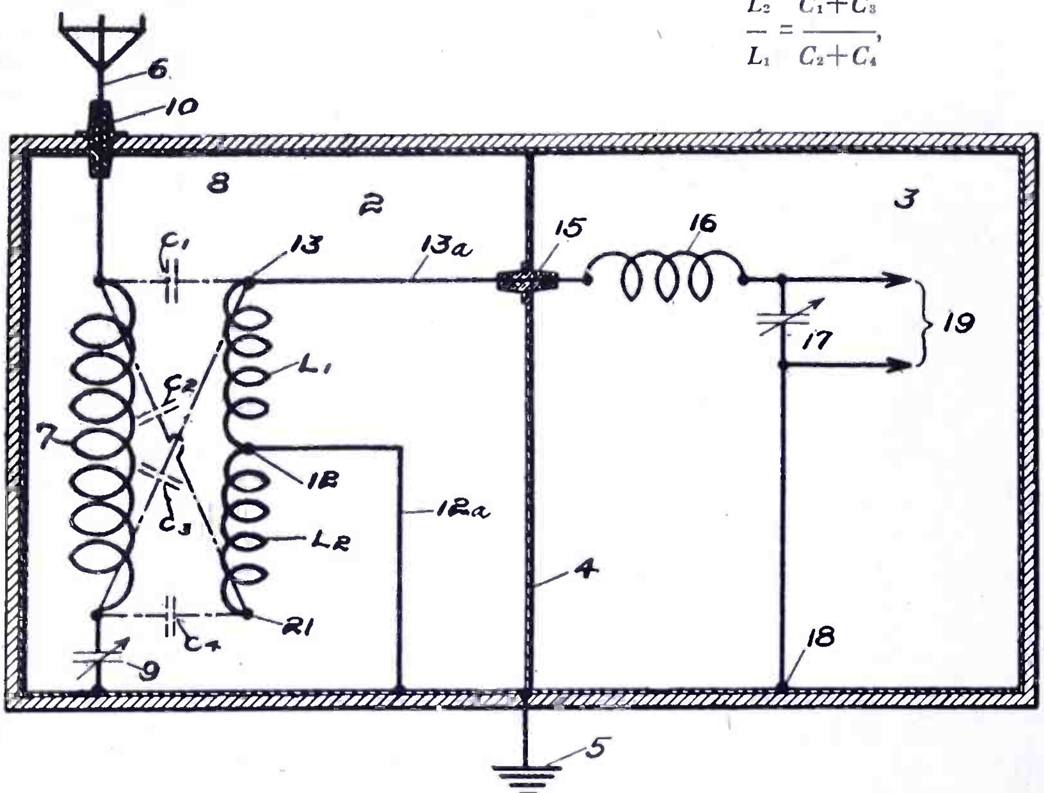
Continued on page 78

DIGEST OF RECENT RADIO PATENTS

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

L. A. Hazeltine, Pat. No. 1,450,080; March 27, 1923. Method and electric circuit arrangement for neutralizing capacity coupling.

This patent purports to disclose the famous Hazeltine neutrodyne circuit. As is well known, when two electric circuits are placed near each other (as for example when magnetically-coupled by a transformer, or when they form respectively the input and output circuits of an audion), a parasitic charging current is induced by one circuit in the other, due to the condenser action between them. The purpose of the patent is so to arrange the circuit that whatever capacitive coupling exists is substantially entirely neutralized. Although the patent discloses several types of circuits for which the scheme may be applied, we shall consider its application only for radio receiving circuits.



In the figure, the conventional antenna circuit *6-7-9-5* is shown, in which the ground connection is made through an electrostatic screen lining the box *1*. The box itself is divided by a screen *4* that shields the receiving elements of the detector circuit except the coupling coil L_1. In this way the parasitic currents are due solely to the electrostatic coupling between coils *7* and L_1, and are therefore more easily neutralized. The undesired capacity couplings are indicated in a somewhat diagrammatic manner by the condensers C_1 and C_3 located between the coils.

To neutralize these effects, another conducting element is added, such as a coil L_2, which is also electrostatically coupled to one of the two coils *7* or L_1. In this case it is shown diagrammatically as coupled in this manner to coil *7* and as connected conductively to the other coil L_1. The coil L_2 has a capacity current induced in it due to its capacity coupling with coil *7*, and the number of turns is so chosen that this current, acting inductively on coil L_1 by electromagnetic coupling, just neutralizes in L_1, the parasitic currents. The proper number of turns to effect this result is readily calculated from the formula:

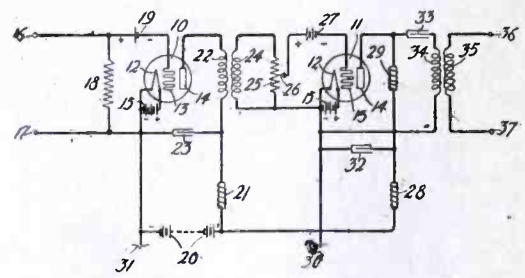
$$\frac{L_2}{L_1} = \frac{C_1+C_3}{C_2+C_4},$$

where now L_2 and L_1 represent the number of turns of coils L_2 and L_1, C_1+C_3 represents the total capacity between coils *7* and L_1, and C_2+C_4, the total capacity between coils *7* and L_2. It is stated in the patent that this scheme of connections has been used with great success in certain Navy type receivers; in these receivers the coils L_1 and L_2 were wound on a common bobbin, coil L_2 encompassing L_1, and the whole placed within a hollow bobbin supporting primary *7*, the degree of coupling between primary *7* and secondaries L_1 and L_2 being variable as in the ordinary loose coupler.

In the commercialized neutrodyne, a somewhat different arrangement of parts is utilized to eliminate the capacity coupling of the grid and plate in an audion, whether used as a radio-frequency amplifier or as a detector. The principle, however, is the same. An extra circuit is provided in that case also, which includes an inductor coil the equivalent of L_2, and which in fact may form a part of the usual secondary of the coupling transformer. Also a variable condenser is supplied, which is the equivalent of the capacity coupling between coils L_2 and *7*, and is placed in series with the inductor coil. This condenser unites the input and output circuits capacitively, while the coil is arranged to induce in one of them a neutralizing current. The effect of substantial neutralization is produced by proper adjustment of the condenser.

H. De F. Arnold, Pat. No. 1,465,332; August 21, 1923. Vacuum Tube Amplifier.

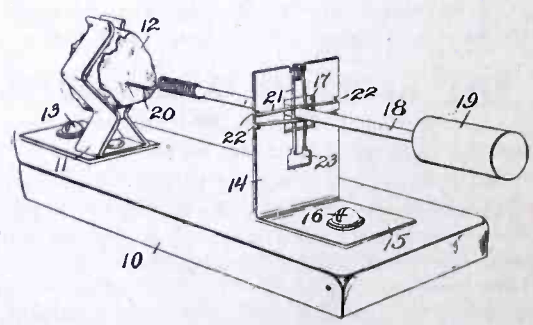
This patent discloses a scheme whereby a series of tandem amplifier tubes *10* and *11* may have their space currents supplied from a common plate battery *20*, without danger that potential variations in the output of one tube will affect the output circuit of the other.



The connections are standard except for the provision of inductances *21* and *28* in the output circuits of the tubes, and that capacities *23* and *32* bridge both the battery *21* and the respective inductances *21* and *28*. No clue is given in the patent as to the relative values of the capacities and inductances, and it is likely that a comparatively high value is best for the inductances, and a comparatively low one for the capacities, so that radio-frequency current will prefer the capacity path around the battery, while the inductances help in maintaining the direct current potential non-fluctuating.

A. N. Pierman, Pat. No. 1,463,554; July 31, 1923. Mounting for Stems of Crystal Detectors.

The device described in this patent relates to a novel form of mounting for the exploring electrode or catwhisker 20 for a crystal detector. Instead of a frictional ball and socket joint as is common, a very simple, easily constructed device is described. It includes a vertically supported plate having a large opening *17* through which the electrode supporting rod *18* passes. Tight wires such as *21* extend across this opening and define an opening that is slightly smaller than the cross section of rod *18*, so that when this rod passes through it is resiliently and frictionally gripped by these wires. The rod *18* may thus be rotated and also axially moved with relative ease.



E. F. W. Alexanderson, Pat. No. 1,466,263; August 28, 1923. High Frequency Signaling System.

This patent describes a vacuum tube transmitter set, in which instead of having modu-

Continued on page 68

QUERIES & REPLIES ON C.W. PRACTICE

BY

Gerald M. Best

TECHNICAL ADVISOR

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25c per question should be forwarded when personal answer by mail is wanted.

Kindly publish the diagram of connections, of the Grebe CR-12 Broadcast receiver.—L. T. S., San Antonio, Texas. —J. F. N., Durham, Calif.

The circuit of the Grebe CR-12 receiver is shown complete in Fig. 1. The coil marked *R. F. C.* consists of 25 turns of wire wound on the stator of the variometer. This coil should be wound on top of the stator, unless the variometer is of such construction as to make this impossible, in which case the winding will have to be placed inside the stator. If 120 volts is used on the plates of the audio-frequency amplifier tubes, a *C* battery of 9 volts, as is shown in the diagram, will greatly improve the quality of the amplified signals.

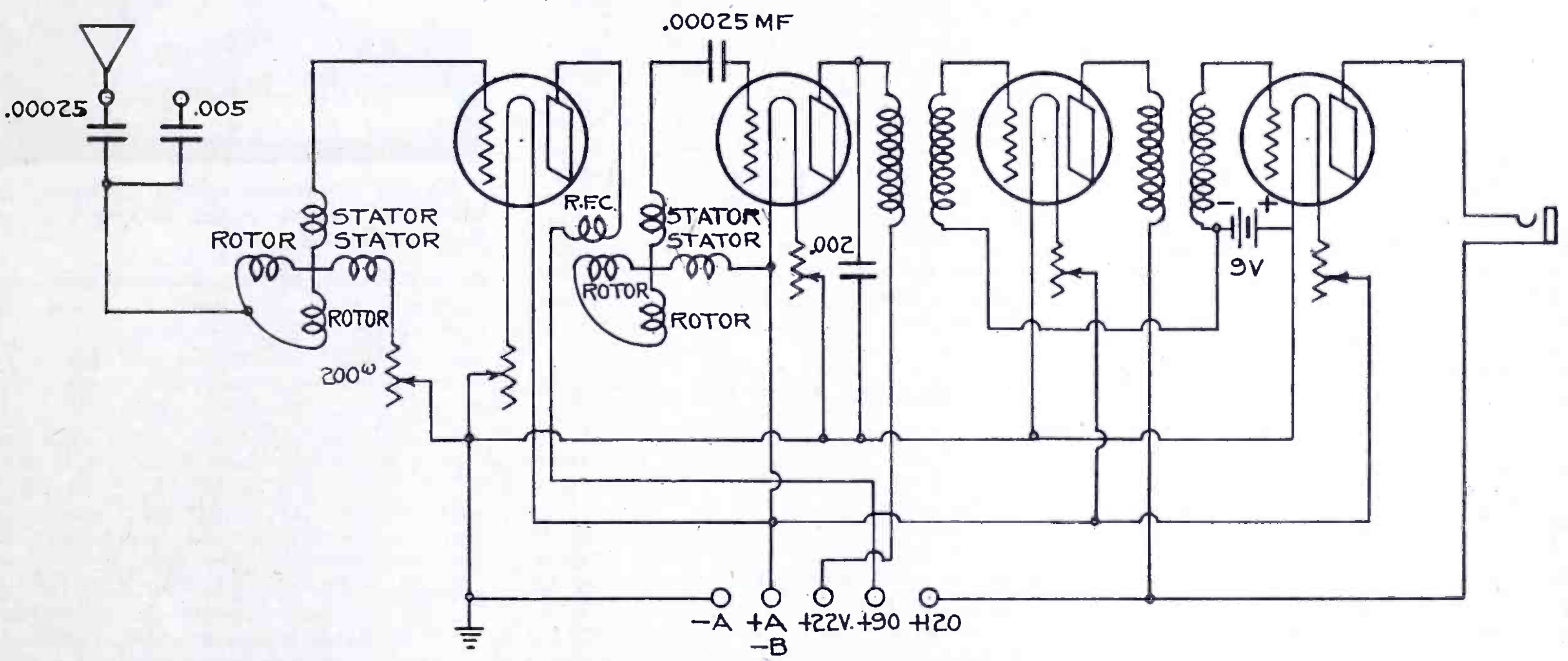


Fig. 1

The writer followed instructions in the article on Page 19 of April RADIO, for constructing a 1½ volt wet cell. The result was a voltage of .5 volts, which dropped to .2 volts if the voltmeter was held for a few seconds. An ammeter failed to show over 10 amperes. A more concentrated solution of sal-ammoniac was tried; also more zinc area, without appreciable effect. Does this indicate any method of correction? Can a borax solution rectifier such as is sold by the "Chi-Rad" Company in Chicago be used in charging the storage battery described in July RADIO? Kindly furnish a circuit for a one-step radio-frequency amplifier and detector, using tuned R. F. coupling, with a C-301-A and a C-12 tube.—R. W. F., Glendale, Calif.

The sal-ammoniac cell cannot be relied upon to supply more than one .25 ampere tube, and hence I am astonished that you were able to draw 10 amperes from it. The reason why you obtained such a low voltage reading was probably due to using a low resistance voltmeter, which drew so much current from the battery that the voltage dropped considerably. The fact that changing the area of the zinc plate and concentrating the solution did not increase the voltage indicates that the battery was all right, and your expectations too high. A borax solution rectifier may be used to charge storage *B* batteries provided that the battery to be charged is not too high in voltage. It might be a good idea to split the battery up into several sections, charging one section at a time, in order to obtain the correct charging rate. The circuit diagram you wish is shown in Fig. 2.

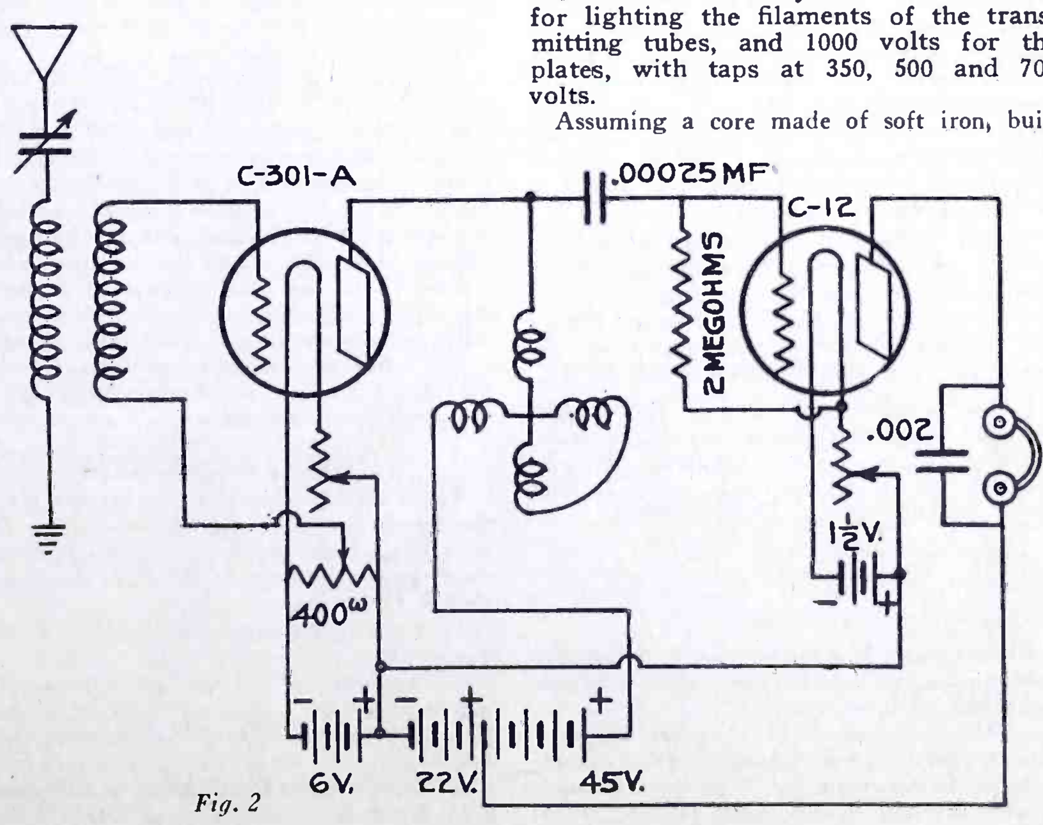


Fig. 2

Please publish the specifications for a rheostat to be used in reducing 100 volts to 8 volts, being variable in 10-volt steps. —E. E., Cheviot, Ohio.

It is very difficult to design such a rheostat without knowing the amount of current you wish to pass through the windings, and the purpose for which it is to be used. If you will send me the information, I will be glad to send you the dimensions of the rheostat.

Would like to obtain the constructional data for building a C. W. transformer to convert 110-volt 60-cycle A. C. to 8 volts, for lighting the filaments of the transmitting tubes, and 1000 volts for the plates, with taps at 350, 500 and 700 volts.

Assuming a core made of soft iron, built

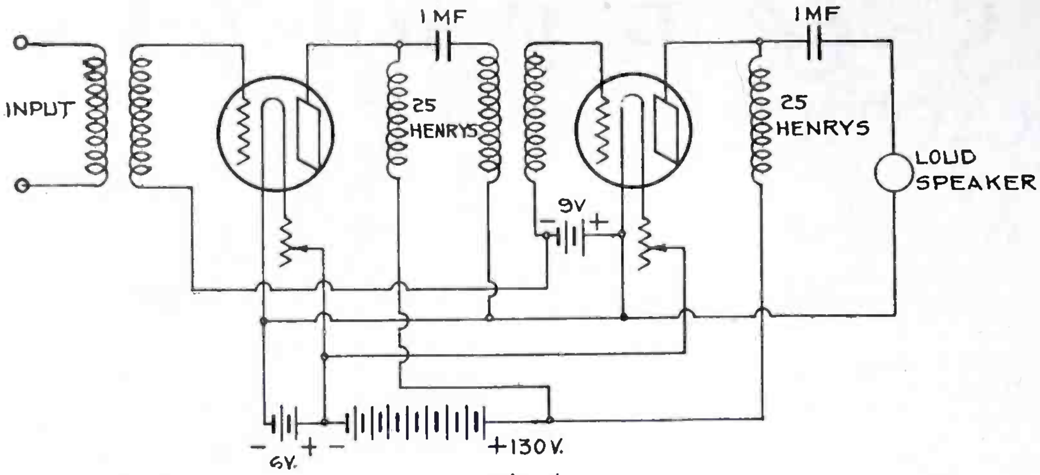


Fig. 4

up from strips 2 in. wide and 5 in. long, to a height of 2 in., a cross sectional area of 4 sq. in. will be obtained. If high grade silicon steel is available, reduce the core area to half. For the primary winding, 256 turns of No. 16 B.&S. cotton-covered wire will be correct. The filament secondary consists of 18½ turns of No. 12 B. & S. cotton-covered wire, with a tap at the 9¼ turn. The high voltage secondary is made up of 2320 turns of No. B. & S. cotton-covered or black enameled wire, with taps at the 812th, 1160th and 1624th turns.

Regarding the radio-telephone described in March RADIO, by G. M. Best, could I use 6 volts a.c. instead of d.c. on the filaments of the C-301-A tubes? Also would it be permissible to use more than 120 volts on the plates of a C-301-A tube?—J. D. W., Ontario, Calif.

6 volts a.c. may be used to light the filaments of both the oscillator and modulator tubes, although some noise will result. The C-301-A will function up to 150 volts plate, although the writer would not guarantee that the tube would last very long, in the oscillator position, at least.

In the diagram of an Efficient I. C. W. transmitter, published in June RADIO, a four-terminal spark coil was used. Kindly reprint this diagram using a three-terminal Ford coil. What size of condenser should be used to prevent sparking in the base of the tube? What type of antenna would work best with this set?—J. H. M., Hilo, Hawaii.

The diagram you refer to shows a power transformer, not a spark coil. Due to the new and rather strict amateur regulations, a spark coil supply for a C. W. set is not advisable if a better means is possible. I doubt if the spark coil would supply sufficient power to enable you to work over a very great distance. If, however, you do not care to build the transformer, I will be glad to send you a transmitting circuit, in which a Ford spark coil is used.

Please publish a circuit for a 10-watt C. W. set using the reversed feed-back system, and an electrolytic rectifier.
—H. S., Moberly, Mo.

A circuit such as you want was shown in Fig. 2 on Page 35 of September RADIO.

Kindly publish a circuit for two stages of radio-frequency amplification, detector and two stages of audio-frequency amplification, using honeycomb coils as the tuned circuit.—S. G., Detroit, Mich.

This circuit was published in August RADIO, Fig. 3, Page 35. If you have no copy of August RADIO available, I will be glad to send you the circuit.

Please publish a circuit for a two-stage power amplifier, to be used with a popular make of loud speaker.
—J. J. M., Lowell, Mass.

A two-stage power amplifier, using C-301-A tubes, is shown in Fig. 4. The choke coils shown are 25 henrys each, and may be adapted from Wayne bell-ringing transformers made by the General Electric Company. The primary winding of the Wayne transformer has an inductance of approximately 25 henrys, and the secondary winding can be abandoned for radio uses.

Why is it, when following the instructions of S. P. Wright to use water glass as a binder for coils, that my green silk wire is badly discolored?—W. R. M.

You probably heated the coils too hot. They should be dried out in a medium oven, and not baked as would be enamel. If this was not the case there may have been some impurity in the waterglass or the wire may have been laid on a rusty surface in the oven. This method is in regular commercial use with entire success.

NEWS OF THE AMATEUR OPERATORS

Call letters 8BHN have been re-assigned to Don Canady, 3439 W. 119th St., Cleveland, Ohio.

Call letters 6BCU, formerly assigned to H. Bidwell, San Marcos, Calif., have been re-assigned to George Pidcock, 227 First St., Richmond, Calif.

L. G. Snell, 6APV, 407 W. Ave. 52, Los Angeles, Calif., was recently injured by a fall from the top of a 72-ft. pole, which buckled and broke as he was erecting it. He expects to be around again in a few weeks and finish the job with a 6-wire T aerial with 20-ft. spreaders and cage lead-in to a 100-watt modified Hartley, both chemical and "sink" rectified.

7QC has been re-assigned to H. M. Buroker, Waitsburg, Wash., where he is operating a 20-watt C. W. and wants QSL's. All cards will be answered.

7RB has been assigned to John R. Todd, who, with 7WX, Geo. C. Miller, is at 3615 East F. St., Tacoma, Wash. 7WX will be on only during early morning hours. Reports of reception will be appreciated.

Call 9DCJ has been re-assigned to George A. Heintz, 2015 Clinton Ave., Minneapolis, Minn. He will QSL all who report his sigs.

Call 9BOL has been re-assigned to Robert A. Prehm, 86 So. 13th St., Minneapolis, Minn. 10 watts C. W. Will QSL all cards.

8CCI has been assigned to James C. Lisk, 902 So. Elizabeth St., Lima, Ohio. Please QSL; all cards answered.

RADIO 6XAD-6ZW

Radio 6XAD-6ZW will be on the air for the winter on and after October 25th. The operating nights will be Tuesdays, Thursdays, Sundays, from 10:30 P.M. to 4 A.M. Pacific Coast time.

Four transmitters form this winter's equipment:

1. 250-watt (WE) on 216 meters. Rad. 9.5 amps.
2. 250-watt (GE) on 220 meters. Rad. 8.8 amps.
3. 100-watt (GE and WE) on 212 meters. Rad. 6 amps.
4. 20-watt (WE) on 200 meters and below. Rad. 3.2 amps.

500-watt re-built-in-America British tubes will be used on various wavelengths for experimental efforts with other "X" stations. Major Mott will be very glad to hold especial tests on other than his regular nights, and at any hours that may be convenient to East-coast and other distant operators.

The address is: Avalon, Catalina Island, California.

Stations reporting 6XAD-6ZW, in addition to the Australian and New Zealand amateurs as previously reported, were 2BZD, 3AB, 4FN (Can.), 3BCQ, (3TR), 8HJ, 8CBB, 8BUM, 9AIO, 9AKE, 8ALF.

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station

By 6CHV, 1229 W. 24th St., Los Angeles, Calif.

(6aaj), 6aak, (6acm), 6abk, 6aiv, 6alx, (6alv), 6aly, 6ajs, 6anh, 6anb, 6arf, (6asj), (6aoi), (6aol), 6ao, 6aoc, (6aup), (6aos), (6aou), (6arb), (6atc), 6atv, 6aty, (6atz), 6aub, (6auu), 6avf, 6avu, 6avv, 6awa, (6awt), (6bcl), 6bcj, 6bak, 6bbh, 6beh, (6bfl), 6bfy, 6bgd, 6bg, (6bez), (6bgy), 6big, (6biq), (6bip), 6bix, 6bjs, 6bjy, 6blr, 6bly, (6bnt), 6bob, 6bop, 6bos, (6bql), (6bsj), 6buy, 6can, (6cai), (6cbd), 6cbu, (6ccu), 6ccy, (6cei), (6cej), (6cgd), 6cgg, (6chl), (6cim), 6cja, 6cjb, 6cje, 6cjj, 6ckf, (6ckp), (6ckr), 6ak, 6dd, (6et), (6fh), (6fy), (6gr), 6hp, 6hv, 6km, (6tu), (6tv), 6tw, 6zx, 7age, 7agv, 7ahc, 7ain, 7bj, 7ei, 7go, 7hum, 7io, 7iw, 7oh, 7tq, 7zn, 8bs, 9amb. Anyone hearing my 5 or 50-watt C. W. pse qsl.

By 7AEB, Walter Hemrich (7SC),
Kukak Bay, Alaska
(60 miles from Kodiak)

1er, 3blv, 3bva, 4gl, c5eb, c5go, 5fc, 5zak, 5gp, 5uo, 5in, 5lg, 5kg, 5ado, 5nn, 5gm, 5akn, 5mo, 5gi, 6adm, 6od, 6bfg, 6aup, 6bip, 6bcr, 6bvg, 6tv, 6hp, 6cfi, 6bcr, 6bpz, 6mh, 6bbu, 6bic, 6pl, 6cc, 6bvs, 6ceu, 6brf, 6arb, 6bmd, 6zi,, 6alv, 6aty, 6afv, 6gr, 6aio, 6et, 6awt, 6beg, 6bry, 6buy, 6bez, 6bqc, 6dro, 6ka, 6rm, 6big, 6chl, 6bjq, 6ajf, 6cba, 6aos, 6cbu, 6ea, 6fh, 6cas, 7nn, 7we, 7qj, 7ly, 7sz, 7qy, 7pf, 7lh, 7lr, 7eb, 7afo, 7ln, 7wm, 7adp, 7qt, 7je, 7age, 7ads, 7br, 7agi, 7ws, 7zv, 7akv, 7ahg, 7cf, 7to, 7go, 7km, 7bh, 7fd, 7zd, 7ei, 7sa, 8bux, 8xh, 8aio, 7atp, 8biz (or 9biz), 9cip, 9caa, 9amb, 9ape, 9lt, 9abu, 9bqq, 9auu, 9ccv, 9cga, 9ban, 9caf, 9dli, 9bkj, 9aic, 9zt.

By 3BVA, 40 S. Beaver St., York, Penna.

C. W.: (4ay), 4bq, (4bx), (4by), 4cs, (4dn), 4db, 4do, (4dx), 4eb, (4el), 4ep, 4eq, 4fa, (4 ft), 4fs, (4gl), (4gn), 4gx, (4gz), 4hr, 4hs, (4hz), 4kc, (4lj), 4me, (4mb), 4mi, (4na), 4nt, 4ot, (4pv), (4qf), (5ac), 5da, 5ek, 5fi, 5gm, (5ga), 5ge, (5gp), (5hl), 5in, 5jf, (5kc), 5lg, 5ll, 5lr, 5ma, 5mo, 5mn, 5nj, 5nn, 5ns, 5nv, 5pb, 5ph, 5ql, 5rb, (5rl), 5uk, 5uo, 5vy, 5wr, 5xv, 5aag, 5abt, 5aec, 5afq, (5agj), 5ajb, 5akn, 5acm, 5air, 5ama, 5amh, (5zas), (5zav), 6adm, 6afh, 6awt, 6bbh, 6bic, 6bvg, 6jd, 6cbu qra?, 6tv, 6ka, 9cr, 9ei, (9hk), (9lz), (9mf), (9mm), 9nu, (9po), (9pw), (9qr), (9uc), 9uz, 9vm, (9zt), 9zy, 9aac, (9aal), 9aau, 9aav, (9aaw), 9acl, 9adx, (9aic), 9aie, (9ahq), 9aim, (9ajh), 9alb, 9amb, 9aou, (9aps), 9apw, 9aqd, 9arc, 9arz, 9auu, (9aus), 9avc, 9awg, 9aws, 9ayx, 9axx, 9baf, (9ban), (9baz), 9bbg, (9bbr), 9bcb, 9bds, 9beh, (9bez), 9bjk, (9bkk), (9bkj), (9bko), 9blg, (9bmu), (9brk), 9brx, 9btt, (9bvz), 9bqh, 9byt, 9bxe, (9bwf), (9caj), (9caa), 9ccs, 9cdb, (9cee), (9cfk), 9chc, 9cho, 9cip, (9clz), (9ctr), 9cts, 9ctt, (9cxh), (9cwf), 9czs, (9cvs), 9daf, (9dcj), 9dcw, (9dek), 9ddn, 9dge, (9dgv), (9dhp), 9dis, 9dli, (9doe), 9dqa, 9dqe, 9drr, (9dts), 9dva, 9dve, 9dxn, (9dzy), 9alb, 9ebp, (9eev), (9efz), (9egh), 9ehn, 9eis, (9eky), (9elb), 9ekf.

I. C. W.: (1fb), (1acu), 1ckp, (8vq), (8awp), (8cdc), (9aaw), (9lz).

Can.—C. W.: (1ar), 2bn, (3bp), (3ds), 3ge, (3gk), (3he), 3kg, (3ni), 3oh, 3ty, (3xn), 3adn, 3zt, 3xx. Will answer all mail communications.

Continued on page 44

Canadian 9BP Reports Calls Heard at WNP, July 28th, September 20th

By Jack Barnsley

CANADIAN station 9BP operated by me at Prince Rupert, B. C., was the first amateur station to work WNP, *Bowdoin,* in winter quarters at Refuge Harbor, 10 miles north of Etah, North Greenland, latitude 78.30 north, longitude 72.30 west. On September 7th I first got into communication with Donald H. Mix, the operator who was chosen to accompany the McMillan expedition to the Arctic, and since then I have maintained regular communication with him and relayed his messages to America.

Mix advises that Can. 9BP is the only station to date (Sept. 20th) that has successfully communicated with him, although he has heard 500 American stations (and was heard by 1ANA at Chatham, Mass., on August 27th, after three weeks' silence). He has advised the Chicago Radio Laboratory, through me, that I am the winner of Zenith set, a duplicate of the receiving equipment on the *Bowdoin,* which was offered as a prize to the first amateur successfully communicating with Mix.

My transmitter employs two 50-watt tubes in a self-rectifying circuit. My receiver is a three-circuit regenerative with audio-frequency amplification. The *Bowdoin's* signals have been loud at times and I have found no difficulty in taking many messagess for relay and also in copying about 600 words of press for the New York *World,* together with the list of amateur stations heard by Mix from July 20th to September 20th. I have also been giving the expedition the news of the day, including their first news of the Japanese earthquake and Jack Dempsey's victory over Firpo. Mix has been unable to get any of the press transmitted by the high power station at Annapolis because it is drowned by the high power European stations on his single-circuit long wave tuner.

Both stations have been bothered by static and interference from VAJ, the 7 kw. Navy spark station on Digby Island, two miles from me, has made it necessary to do most of our work after midnight, which is three in the morning for Mix.

Mix tells me that the station is still located aboard the *Bowdoin* and that, although some of the food and supplies have been taken ashore, the members of the expedition are living aboard and will continue to do so. There is danger that the ship may be crushed by the ice, and, in that case, it will be necessary to move their headquarters to shore. A new aerial and counterpoise for the transmitter is being rigged up. He states that early in September there was a foot of snow on the ground and ice was beginning to form in the harbor. The temperature was 22 degrees F. They are in the midst of the country where members of former expeditions perished, including seventeen members of the Greely expedition who died of starvation in 1884. Conditions are good for the scientific observations they wish to make and the various points they are to visit can easily be reached by dog sledge after the harbor freezes. The party is planning to set up a tablet entrusted to them by the National Geographic Society, and they say they can reach Cape Sabine with their dogs in six hours for that purpose.

Walrus hunting is one of the occupations of the party and they are depending on a supply of walrus meat for their subsistence during the winter months. Up to the beginning of September they already had the meat of five walrus packed away under rocks on shore as a base of supplies and this was being increased from time to time as opportunity arose.

The object of the expedition is to study the flora and fauna of the northland and to gather data on magnetic phenomena. A magnetic observatory was set up on shore for this purpose soon after the arrival of the ship and regular observations are being taken which will prove of great value from a scientific viewpoint.

A cairn was discovered on the west side of Refuge Bay by the explorers. This cairn was erected seventy years ago by the first American Arctic explorer, Dr. Elisha Kent Kane.

Wood is very precious in the far north. The wood used by the expedition in the building of a large and comfortable house at Etah in 1914 they found had been completely demolished and all that was left to indicate a former habitation was some rusty cans and scrap iron. All wood had disappeared.

Before the *Bowdoin* left Wiscassett, Maine, on June 23rd last for her fourteen months' trip to the top of the world, it was announced that she would endeavor to keep in touch with the outside world by amateur radio and this she has been enabled to do through my station. Other polar expeditions have carried radio apparatus and failed to keep in communication. But where commercial radio has failed the amateurs have succeeded.

During the summer months there was continuous light fading into twilight, but never getting dark. This made radio work difficult, but, with the coming of winter with continuous darkness, the radio conditions should improve materially and no doubt communications will be established by the *Bowdoin* with other stations. Probably before this is published. Mix expressed a wish to be able to work other stations so as to take part of the load off this one and thanked me heartily for listening for him nightly and relaying the messages which he sends me to be forwarded. At the time of writing he was just beginning to hear broadcasting stations loud enough for a loud speaker. The stations that he was able to get best were KFH?, KFI, WJAZ, WDAP and WOAW. The call letters of amateur stations heard by Mix up to September 20th were as follows:

Calls Heard by Operator Donald H. Mix Aboard Schooner "Bowdoin"

Heard at Godthaab, Greenland, July 28th to 31st (ck6)—1ccz, 8apn, 8bjz, 8dcz, 8oe, 9aly.

Heard July 31st and August 1st, 65 North lat. 53 west long. (ck11)—1cre, 2bqh, 3apr, 3zs, 8bdu, 8bxx, 8ced, 8dla, 8px, 8nb, Can. 1dd.

Heard August 1st, 66 north lat. 55 west long. (ck4)—3zs, 8nb, 8px, 9aps,

Heard August 2nd and 3rd, 69 north lat. 55 west long. (ck5)—1cmp, 1ee, 2axk, 3zm, 8ame.

Heard August 3rd, 71 north lat. 56 west long. (ck 8)—1aqm, 1bac, 1uh, 2awf, 2cqz, 8cgu, Can. 3dj, Can. 3gk.

Heard August 6th and 7th, 77 north lat. 71 west long. (ck11)—1ajp, 1ayz, 1brq, 1ts, 2bum, 2cur, 2cxd, 3bdo, 3bnu, 8csj, 9dce.

Heard at Refuge Harbor, Greenland, lat. 78.30 north long. 72.30 west, August 8th to September 20th, first district (ck18)—1abs, 1acu, 1ali, 1ana, 1arf, 1aw, 1bbo, 1bcg, 1bes, 1bvr, 1cdm, 1ckp, 1cpo, 1er, 1fb, 1fm, 1uj, 1ze.

Second District (ck21)—2acd, 2afp, 2agb, 2ajw, 2alm, 2awh, 2brb, 2brc, 2bsc, 2byc, 2bzv, 2cbc, 2cbg, 2cji, 2cla, 2coa, 2om, 2rb, 2rs, 2wr, 2fp.

Third District (ck10)—3ab, 3apt, 3bfu, 3bg, 3bva, 3bvl, 3iw, 3me, 3vo, 3zo.

Fourth District (ck9)—4by, 4ch, 4ft, 4gl, 4gx, 4hs, 4ku, 4qu, 4rh.

Fifth District (ck46)—5acr, 5adb, 5ado, 5aec, 5aeu, 5agj, 5aic, 5aij, 5aiu, 5ajj, 5akn, 5aky, 5alr, 5ama, 5bm, 5dw, 5ek, 5fc, 5ga, 5ge, 5gm, 5gp, 5hl, 5in, 5jf, 5ky, 5lg, 5ll, 5lr, 5mm, 5mn, 5nn, 5ns, 5nu, 5pb, 5qe, 5qq, 5qr, 5rm, 5uk, 5uo, 5va, 5wg, 5xv, 5za, 5zav.

Sixth District (ck83) — 6aak, 6abk, 6ac, 6acg, 6age, 6aiv, 6ajd, 6anb, 6aol, 6aos, 6aou, 6aph, 6arb, 6atc, 6avv, 6awt, 6bbc, 6bbh, 6bbw, 6bcl, 6bgv, 6bgy, 6bic, 6bih, 6bjq, 6bkh, 6blv, 6bly, 6bou, 6bpz, 6bqb, 6bqc, 6bql, 6brf, 6bou, 6bve, 6bvg, 6bvs, 6bwz, 6cai, 6cat, 6cbu, 6ccd, 6ccy, 6cet, 6cfi, 6cfz, 6cgd, 6cgw, 6che, 6chl, 6chv, 6cid 6ckf, 6ckh, 6ckp, 6cmi, 6cmr, 6cmu, 6cnl, 6dd, 6et, 6fh, 6fy, 6hp, 6hv, 6jx, 6ka, 6km, 6nb, 6pl, 6rm, 6tu, 6tv, 6ua, 6uo, 6ux, 6vk, 6zah, 6zar, 6zk, 6zp, 6zx.

Seventh District (ck48)—7abf, 7aic, 7acm, 7adp, 7adr, 7ael, 7agi, 7agv, 7ahv, 7ak, 7bg, 7bj, 7br, 7cf, 7dc, 7ei, 7fd, 7ge, 7gi, 7go, 7gp, 7hg, 7io, 7iy, 7je, 7ks, 7kv, 7lh, 7ln, 7lr, 7ly, 7qy, 7sf, 7sz, 7tk, 7to, 7tq, 7ud, 7we, 7wm, 7ws, 7ya, 7yl, 7zd, 7zf, 7zl, 7zn, 7zu.

Eighth District (ck69)—8aab, 8aaj, 8ab, 8ada, 8aeg, 8afp, 8aio, 8amf, 8amm, 8amp, 8anp, 8apt, 8apy, 8aq, 8aqo, 8asv, 8avd, 8avn, 8awp, 8bbi, 8bci, 8bda, 8bdu, 8bdv, 8bfh, 8bjv, 8blx, 8bvt, 8bxh, 8ccr, 8cdd, 8cdz, 8cei, 8cko, 8cpp, 8cqh, 8crb, 8ctp, 8cur, 8cwu, 8cxm, 8cyz, 8dat, 8dig, 8djd, 8djf, 8dkm, 8es, 8ft, 8gz, 8hn, 8hv, 8ig, 8ij, 8kg, 8kj, 8rj, 8ry, 8ue, 8uk, 8vn, 8vq, 8vt, 8vw, 8vy, 8xh, 8yv, 8zc, 8zz.

Ninth District (ck180)—9aal, 9aaq, 9aau, 9aav, 9aaw, 9ack, 9aec, 9ahj, 9ahz, 9aic, 9aim, 9aja, 9ajh, 9alb, 9alx, 9amf, 9ami, 9aml, 9ams, 9aog, 9ape, 9apf, 9apv, 9apw, 9aqg, 9aqk, 9arc, 9arz, 9aua, 9auu, 9avc, 9avi, 9avn, 9avp, 9avz, 9awg, 9awk, 9axx, 9ayi, 9ayl, 9azx, 9baf, 9ban, 9bav, 9bbw, 9bch, 9bdb, 9bdh, 9bds, 9be, 9bez, 9bfi, 9bhc, 9bhd, 9bhq, 9bjk, 9bk, 9bkk, 9bkr, 9bmu, 9bmx, 9bpv, 9bqj, 9bqq, 9bqy, 9brk, 9brs, 9brx, 9bsg, 9bsz, 9btl, 9btt, 9bun, 9bvo, 9bwf, 9bxc, 9byc, 9byt, 9bze, 9bzi, 9caa, 9cah, 9caj, 9ccs, 9ccz, 9cdr, 9cdv, 9ce, 9cfk, 9cfy, 9cga, 9ch, 9chc, 9cil, 9cip, 9cjs, 9cka, 9cks, 9cln, 9cte, 9ctn, 9ctv, 9cvc, 9cvi, 9cvo, 9cvs, 9cxh, 9cxo, 9czw, 9dat, 9daw, 9dbh, 9dcr, 9dct, 9dcw, 9ddj, 9dek, 9dge, 9dgv, 9dgw, 9dhg, 9dhn, 9dhp, 9dhs, 9djb, 9dkj, 9dkq, 9dky, 9dli, 9doc, 9doe, 9dof, 9dpf, 9dqe, 9dqh, 9dqm, 9dqu, 9drk, 9dro, 9drr, 9dsw, 9dte, 9dwm, 9dxr, 9dyz, 9dzy, 9eae, 9ebp, 9ebt, 9eea, 9eev, 9ehn, 9eiv, 9ekf, 9ekt, 9eky, 9elb, 9eld, 9es, 9gd, 9gk, 9hk, 9hm, 9hw, 9ig, 9ih, 9jf, 9lz, 9mc, 9mf, 9nu, 9pn, 9qi, 9uc, 9uh, 9xn, 9zg, 9zt, 9zy, —9bdh spark.

Canadian Stations (ck14)—2bn, 2cg, 3bp, 3ni, 3xn, 4cl, 4dq, 4er, 5cn, 5ct, 5go, 5hb, 5hg, 9bp.

Alaska Station—7it.

Hawaii Station—6ceu.

Mexico Station—JH.

Bulletin 916 from General Radio Co. of Cambridge, Mass., illustrates and describes a number of new or standard high-grade parts, including a four-step inductor and a variable air condenser especially designed for experimental use, vacuum tube sockets, amplifying and modulation transformers, rheostats and potentiometers, hotwire ammeters, and a complete amplifier unit.

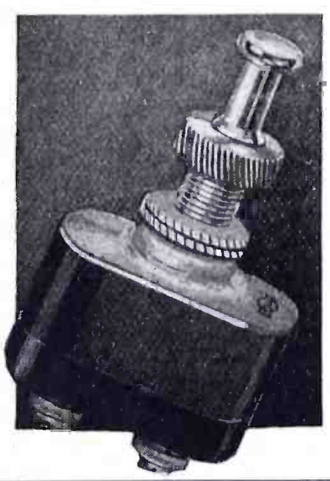
FROM THE RADIO MANUFACTURERS

Bradleyleak, a grid leak adjustable between ¼ and 10 megohms without noises, steps or jumps, by turning the adjusting knob; makes possible the accurate adjustment of grid leak resistance for any tube used in a detector circuit; base is recessed to receive .00025 mfd. fixed condenser as an extra attachment.

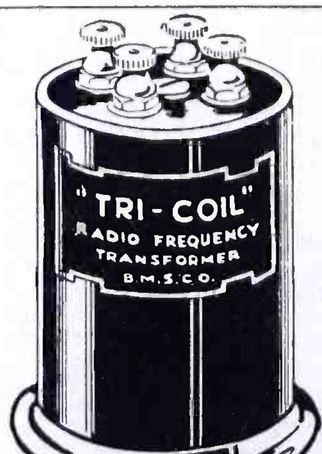
Atherton Super Audio-Frequency Transformer for powerful amplification and clear reproduction over all wavelengths without distortion or resonant peak; made in three ratios: 5 to 1 for first stage, 3.75 to 1 for second stage and 1.45 to 1 for third stage.

Alsop Vacua-Pump and Gauge for exhausting vacuum tubes or for other vacuum experiments in radio.

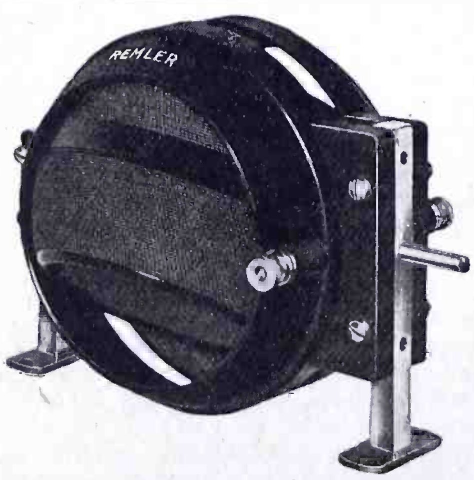
"Metalectric" soldering iron with 8 ft. of cord wire, series current tap and attachment plug for operation on any electric circuit in series with a lamp, constructed entirely of nickeled metal with German silver point and interchangeable tip; point connected to handle by a spring coil so as to "get around corners" in intricate soldering; heating element of nickel chromium.



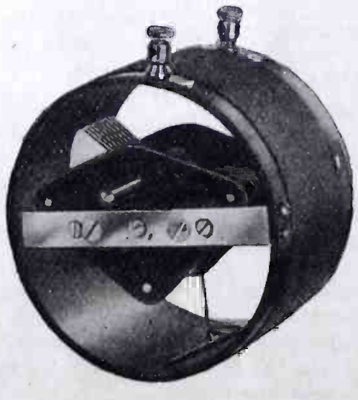
C-H Radio Switch, a convenient and dependable means for connecting and disconnecting the *A* battery; has positive wiping contact and is fitted for panel mounting; set is connected by pulling switch knob out and disconnected by pushing it in.



"Tri-Coil" radio-frequency transformer with compensating coil method of coupling so as to give high amplification over entire range of broadcast wavelengths. "The compensating coil shifts the phase of any energy passing from the plate to the grid circuit of any amplifier, thus tending to eliminate regenerative howling and to neutralize the effect of changes in load or capacity in the primary part of the circuit on the secondary part of the circuit."



Remler New Model Type 500 Variometer, range 180-570 meters; new design of internal pigtail connections insure permanent and quiet contacts; black rotor and stator; polished nickeled standards and trimmings; green silk windings.



Horne "Verni-Tuner," a combination in one mounting of primary and secondary windings and variable condensers with binding posts for aerial, ground and output circuits ready for panel mounting; tunes up to 550 meters; intended for use as a complete tuned radio-frequency unit, for use in regenerative circuits or as a Reinartz or Flewelling tuner.

Comparison proves FIL-KO-STAT Supremacy

Price **$2**

Recommended and sold by Dealers in High Class Radio Supplies

In Canada 2.75

AT FIRST it was just our own word. We claimed Filkostat was best. We proved it by laboratory comparisons.

Now radio fans everywhere are joining in the chorus: *"Filkostat is the best filament control."* Their own working comparisons prove it and the testimony keeps pouring in. Here is some of it.

"I have tried four different rheostats and must say the Fil-Ko-Stat beats them all." W. R. Hagedorn, Hay Springs, Nebraska.

"The Fil-Ko-Stat is the most satisfactory instrument of its kind I have ever used." Arland M. Kenny, D. M. D., Boston, Mass.

"Since using your Fil-Ko-Stat, I have picked up five stations I never heard before." A. S. Allsup, Kansas City, Mo.

"In my estimation the Fil-Ko-Stat is the finest adjusting rheostat on the market." C. J. Eastman, Radio Engineer, Omaha, Nebraska.

"It is only since using the Fil-Ko-Stat that I realize how wonderful a radio set can be made." S. George Kerngood, New York.

"I have tried all rheostats on the market, and the Fil-Ko-Stat is so far superior for fine tuning, that you are certainly deserving of every radio fan's good wishes." R. C. Stewart, Williamsport, Pa.

"Fil-Ko-Stat results are simply wonderful. Reception of broadcast was a revelation to me, absolutely no noise or distortion of any kind. I have been using a wire rheostat and tube noises, etc., which were impossible to eliminate are entirely done away with." George A. Farley, Baltimore, Md.

"I am of the opinion that the Fil-Ko-Stat is the best filament control on the market. . . . I have recommended the instrument highly and it is a fact that I picked up two Los Angeles stations with a single regenerative detector shortly after installing it." Paul H. Woodruff, Chicago, Ill.

"Comparisons were made with every reliable filament control on the market and we are pleased to note that your Fil-Ko-Stat gives the closest possible adjustment of any type of vacuum tube, and was the only instrument which could be used for all tubes, giving equal critical adjustment at the high resistance as at the low resistance." Radio Guild, Inc., New York.

FIL-KO-STAT, distinctly designed to permit infinite adjustment of the minute electric currents used in heating the vacuum tube filament, gives absolute control of electronic flow and the finest tuning possible, conquering distance and eliminating noise.

FIL-KO-STAT has no screws to tamper with, no adjustments to puzzle you. Only two terminals and you use them for *ALL* tubes—including 5 watt transmitting tubes. It is triple tested and adjusted at the factory to the ideal "off" position for any of them.

FIL-KO-STAT resistance element is the result of considerable experimentation. It is 70% metallic substance.

While the inability of the wire rheostat to properly control the electronic flow is generally admitted, it is also wise to avoid the use of inferior powdered carbon rheostats. Our experiments have proven them unreliable. Our experiments likewise proved the weakness of the easily broken disk type.

Filkostat reliability and durability are unconditionally guaranteed by the manufacturer.

The D. X. Instrument Co.,
Harrisburg, Pa.

RADIO STORES CORPORATION

SOLE INTERNATIONAL DISTRIBUTORS

DEPT. R 11—218-222 W. 34th ST., NEW YORK

We have a limited edition of W. G. Merritt Garvey's Radio Hand Book. It contains hook ups, general statistics and advice to the set builder. Discovering that Mr. Garvey recommended the Filkostat for fine filament control, we have taken over an edition and will send a copy of this booklet anywhere at the handling cost of 10c.

Full Resistance ***30 ohms***

CALLS HEARD

Continued from page 40

By 9BWF, 2515 S. Harrison St., Ft. Wayne, Ind.

1aw, (1er), 1fb, (1on), (1rr), (1acu), 1acz, 1ajp, (1arf), 1awj, (1bbo), 1bcg, 1ccz, 1cdm, (1cmp), (1cpo), 1brq, (2by), (2fp), 2rm, (2acd), 2ana, 2awf, (2axf), 2bbv, 2bcr, 2bog, (2brb), 2brf, (2bsc), 2bum, (2cbr), (2cee), 2cjr, (2cui), 2cur, (2cuz), (2cto), (2cxd), (3ab), 3bg, 3de, 3hs, (3hh), 3il, (3iw), (3jj), 3nz, 3sg, 3tj, 3uk, 3vo, 3wf, 3zo, 3ajg, (3auv), (3awh), 3adb, (3bbv), (3bgg), (3bfu), (3bdo), 3bml, 3bnu, 3bol, (3brf), 3bva, (3bvl), (3bwt), 4by, 4cs, 4db, 4do, 4dt, 4eb, 4ef, 4ga, 4gl, 4gn, 4hl, (4hs), 4hz, 4iw, (4kc), (4ku), 4nw, 4me, 5aj, 5ek, 5fz, 5gi, 5gm, 5gp, 5hl, 5kc, 5ly, 5mm, 5nj, 5nz, 5re, 5rq, (5rl), (5sl), 5un, 5xw, 5abj, (5aam), (5akw), 5aec, 5amf, 5arr, 5xab, 5zav, 6zz, 6awt, 7zo, (8aq), (8es), (8fm), (8hn), (8hv), (8kj), (8nd), (8sf), (8wg), (8zc), (8and), (8atp), (8awp), (8azo), (8bci), (8bfh), (8bfi), (8bdh), (8bjv), (8cei), (8cdc), (8cqh), (8ctn), (8cxm), (8dgs), (8dki), (8eak) qra?, (9ta), (9aaw), (9acl), (9aic), (9aus), (9awa), (9bfi), (9beh), (9bis), (9bqq), (9bsg), (9brk), (9cpp), (9dcr), (9dhp), (9dpc), (9eev), (9efz), (9ekf), (9elb).

Can. (2bn), 3ds, (3ia), (3in), wwv.

Anyone in Ore., Mont., Idaho, Nev., N. M., Ariz. or Utah hearing my 10watt during Aug. and Sept. pse qsl. All answered with printed card.

By 7BJ, Vancouver, Wash.

1aw, 1bbo, 5ado, (5aij), 5gp, 5in, 5ns, 5uo, 6bbh, 6ccr, 6zh, 8apt, 8abci, (8es), 8zj, 9aal, 9ahz, 9aic, 9ape, 9amb, (9avc), 9awg, 9axx, 9baf, 9ban, 9bjk, 9bun, 9bsg, 9bqq, 9cp, 9caa, 9ccs, 9cip, 9cga, 9cvc, 9dqe, 9dqu, 9dli, 9dro, 9eky, 9elb, 9ig, 9qf, 9uh, (9zt).

By 6CBE, Alameda, California

1bu, 4ar, 5za, 5lg, (vy qsa), (6's too numerous), 7aci, 7acv, 7afe, 7afo, 7akv, 7ali, 7auz, 7adl, 7bj, 7br, 7bj, 7hg, 7hf, 7hk (vy vy qsa), 7sf (all over room), 7nr, 7ly, 7qy, 7qi, 7yl, 7wt, etc., 8biy, 8dig, 9aaw, 9au (read all over room), 9axx, 9bun, 9der, 9dt, 9je, 9zt, (Anybody hearing 6CBE 5-watt C. W. pse. qsl.)

By Gerald Newmarch, Canadian 5CD, 1439 Comox St., Vancouver, Can.

All C. W.: Can.—3bp, 4bv, 4br, 4hh, 4dk, 9bx, 9bp. Amer.—5qy, 5uj, 5zag, 5xd, 5za, 5ge, 5aby, 5zak, 5kc, 5xaj, 5qt, 5xb, 5zav, 5acf, 5ado, 6zo qsa, 6bjq, 6zw, 6bin, 6bow, 6if, 6bx, 6bqb, 6cc (qsa all over room), 6rm, 6zz, 6fh, 6xk, 6zb, 6re, 6bkz, 6bic, 6avf, 6arr, 6aiy, 6zn, 6anh, 6ao, 6bcl, 6bjr, 6bko, 6bcl, 6lu, 6zh, 6bao, 6aqw, 7bj, 7pf, 7sy, 7ny, 7om, 7zo, 7nf, 7adg, 7ey, 7tt, 7ba, 7aff 7wt, 7zn, 7mf, 7zu, 7lr, 7ri, 7we, 7iy, 7gn, 7ua, 7gk, 7zv, 7dh, 7abb (qsa), 7io, 7lo, 8axc, 8ue, 8bk, 8asv, 8beo, 9bik, 9bj, 9zm, 9bji, 9qa, 9asr, 9bjv, 9bx, 9aza, 9gs, 9bcs, 9yw, 9uh, 9cwr, 9abu, 9eea, 9cvg, 9lw.

Phones: kpo, kuo, kdyl, kdyf, kfbk, kfdb, kfz, kgw, kgzb, kzr, kfi, kfae, cfcn, cfcc. 5-watt C. W. coming up at 5CD.

At 8AGO, Biddle Arthurs, Jr., 3046 Centre Ave., Pittsburgh, Pa.

1gv, 1iv, 1my, 1uj, 1uu, 1abs, (1acu), 1aip, (1ajx), 1alj, 1ana, 1apm, (1aqm), (1ask), 1bbo, 1bcu, 1bes, 1bez, 1bfq, 1bgc, 1biy, 1bkq, 1bri, 1cdm, 1cmp, 1cmx, (1cpd), 1xp, 2al, 2ax, 2by, 2fz, (2kk), 2mu, 2rb, 2wf, 2acd, 2aja, 2aly, 2apy, 2awh, (2awl), (2axf), 2ayz, (2baw), (2bbx), 2bgi, 2boi, (2brb), 2brc, (2bsc), 2bum, 2bvh, 2byc, (2byg), 2caf, (2cee), (2cei), 2cfb, (2cim), 2clu, (2cqz), (2cui), 2cur, 2cvu, (2cxz), 2czr, (3ab), 3bg, (3ds), 3dq, 3fs, (3hh), 3iw, 3oe, (3sg), 3tr, 3vo, 3aak, (3adb), (3apt), 3auu, 3auv, (3awh), (3bbv), 3bei, 3bek, (3bgg), 3bgt, 3blu, (3bnu), 3bqa, 3brf, (3bva), (3bvl), (3ccu), 3cfv, (3cia), 3cve, 3zo, 3zs, 4ab, 4ai, 4by, 4ft, (4gl), (4gw), 4gx, 4hs, (4kc), 4ku, 4lj, 4mb, 4mi, 5gm, 5gp, 5hl, 5nj, 5ns, 5aag, 5abt, 5ack, 5amh, 5zas, 5zav, 7zn, 8's too numerous, 9dk, 9ei, 9nu, 9pn, 9qb, 9vm, 9aas, 9aaw, (9aem), 9ajh, 9aps, (9apv), 9apw, 9awa, 9awg, 9beh, (9bgy), 9bqq, 9brx, 9btt, 9bzi, 9ccz, 9cfk, (9cln), 9dek, 9dhg, 9dlw, 9dns, 9egh, 9ekf, 9zt.

Can.—2bn, (3aa), 3bp, 3co, 3ds, 3ni, 3oh, 3xn, (3xx).

Daylight: 1iv, 1biy, 1bri, 1cmx, 2awh, (2bbx), 2brb, 2bte, 2byg, (2cxd), (3ab), 3bg, 3hh, 3ia, 3iw, 3tr, 3aak, 3auv, 3awh, (3bgg), 3bnu, (3bva), (3bvl), (3ccu), (3cia), 4ft, 4gx, (8bbf), (8blq), (8bvx), (8ctn), (8ddx), (8dkm), others too numerous, 9ajh. Can.—(3aa), 3xn.

By 6GZ, 1430 Wright St., Los Angeles, Calif.

5ako, 5aky, 5ns, 6aa, 6abk, 6acm, 6acz, 6agw, 6alq, 6alx, 6aly, 6ams, 6aos, 6aot, 6aqp, 6arb, 6atv, 6aty, 6avn, 6bcl, 6bez, 6bfl, 6bfy, 6bih, 6bin, 6bip, 6bli, 6bly, 6bmd, 6bnc, 6bql, 6buy, 6cbd, 6cbu, 6ccu, 6cei, 6chl, 6chz, 6gr, 6ik, 6in, 6rm, 7acy, 7adg, 7adp, 7afn, 7age, 7agv, 7agw, 7agy, 7ahc, 7aiy, 7bj, 7br, 7cf, 7cr, 7fd, 7go, 7gp, 7ih, 7io, 7iy, 7ji, 7jw, 7ks, 7la, 7ln, 7lr, 7nn, 7oh, 7pj, 7qj, 7qn, 7qt, 7sc, 7vf, 7wg, 7wm, 7wo, 7ya, 7zf, 9amb, 9ayu, 9bxq, 9caa, 9dli, 9dva, 9eea. Can.—5cn, 5go.

Continued on page 46

Continued from page 44

By 9DAW, 3832 Elliot Ave., Minneapolis, Minn.
2agb, 2om, 3bfu, 3bnu, 3buc, 3cfv, 3chg, 4cs, 4dt, 4jk, 5aab, 5aef, 5acm, 5abt, 5adv, 5aec, 5agj, 5agn, 5ahd, 5ajj, (5ajb), 5ama, 5amh, 5asc, 5ga, 5gi, 5gj, 5hz, 5kc, 5ko, 5kw, 5gf, 5ll, 5mb, 5md, 5mm, 5mn, 5mo, 5nj, (5ns), (5ql), 5qq, 5rb, 5rl, 5sk, 5uk, 5uo, 5va, 5zav, 5zm, 6awt, 6cbu, 7bj, 7ih?, (7iy), 7mb?, 7zf, (7zv), 8ada, 8aeg, 8apy, 8arq, 8avd, 8axb, 8bci, 8bcu, 8bda, 8bdu, 8bfh, 8bgl, 8bhe, 8bjv, 8bog, 8bvr, 8aio, 8caz, 8cdc, 8cei, 8cko, 8cnr, 8coz, 8cur, 8cyx, 8dcz, 8dgx, 8dlo, 8fm, 8hv, 8ix, 8jj, 8lt, 8vq, 8vs, 8yae, 8zz.

Can.—3adn, 3ds, 3gk?, (3he), 3kg, 3xn, (3zs), (4cn). Would appreciate reports on my sigs. All cards answered.

By 9BJT—Squirt, Streator, Ill.
C. W.: 1aw, 1kv, 1acu, 1arf, 1bbo, 1bcg, 1cdm, 1ckp, 1ze, 2fp, 2afp, 2agb, 3he, 3hv, 3su, 3zo, 3ajg, 3bfu, 3bva, 3bvl, 4ai, 4bq, 4cs, 4dn, 4dx, 4gx, 4gz, 5ek, 5gp, 5hl, 5in, 5nn, 5ns, 5re, 5va, 5ado, 5aec, 5agj, 5ahd, 5akw, 5ama, 5zas, 5zav, 6cu, 6ea, 6eb, 6en, 6jd, 6ka, 6tv, 6zw, 6zz, 6alv, 6arb, 6aru, 6avv, 6awt, 6bjq, 6bvg, 6cbu, 6xad, 6xbc, 7bx, 7bj, 7lu, 7sc, 7zd, 7zu, 7zv.

Spark: 2om, 5bw, 8bda, 9cen.

Can. C. W.: 3an, 3bp, 3ds, 3ni, 3xn.

By 8RY, Arthur C. Bates, Sullivan, Ohio
5fc, 5kr, 5lr, 5nj qra pse?, 5nt, 5zav, 6awt. Have moved from Burton to Sullivan, 20 miles south of 8YAE. Pse qsl my sigs on a W-E 50-Watter ChemRec, es change qra in call books.

By 3BGG, Russell Lichty, York, Penn.
(1aw), 1er, 1fm, 1fb, (1gv), (kv), 1oj, (1my), 1rr, 1uj, 1vv, (1abs), (1acu), 1ajx, 1akr, 1alo, 1apm, (1ayz), (1bbo), 1bcg, 1bkq, 1ccz, 1cou, 1cpo, (1cre), 2by, 2ax, 2ea, 2ei, 2fp, 2gk, 2jk, 2ki, (2kr), 2mu, (2rb), (2wr), 2afp, 2abx, (2brb), (2cee), 2cei, (2cim), (2clu), (2cor), 2cpk, 2cpa, (2cur), 2cuz, (3ab), (3bg), (3jj), (3acy), (3adb), 3ajg, (3aly), (3atb), (3apt), 3bbv, 3bfw, (3bij), 3bmm, (3brl), (3brf), 3bsb, (3bvl), (3ccu), 4af, 4bx, (4by), 4eb, 4ft, (4gl), 4gn, 4gx, 4hr, 4hs, 4it, 4jk, 4kc, 4th, 5fv, (5gp), 5mo, 5vk, 5agj, 5xab, 7zu, 8ab, 8aq, 8es, 8gz, 8hj, (8hv), 8ij, 8lw, 8pd, 8un, 8ve, 8vq, 8zd, 8zz, 8abm, (8afd), (8ago), (8apt), 8ann, 8arq, (8bbf), 8bfh, 8bhy, 8bis, 8bjv, (8blx), (8bno), (8boa), 8bsy, (8bvt), 8bzc, 8ccr, (8cgu), 8cko, 8cpp, 8cpy, 8czz, 8dac, 8dke, (8dkm), 9ei, 9es, 9ig, 9lz, 9ta, 9pw, (9uc), 9ul, 9aau, 9aav, 9aaw, 9aem, 9ajs, (9ajh), 9alx, (9aps), (9amu), 9aoy, (9aus), (9awk), 9baz, 9bhd, 9bhg, (9brk), (9bwf), 9bye, 9ctx, 9dcy, 9efz, 9ekf, 9elb. Can.—(2bn), (3oh), 3bp, 3he. Detector only was used for these signals. The transmitter is one 5-watt tube using 1100 volts on the plate radiating 2.5 amps. Would appreciate reports on my signals. All correspondence answered.

By 6BOR, Portable 6AOF at Idylwild, Calf.
1bbo, 2tt, 5adb, 5aky, 7go, 7lh, 7akv, 7akz, 8dig (osa), 9gd, 9aau, 9bjk, 9bun, 9bvo, 9caj, 9cvc, 9eae. All heard Aug. 28 with one C-299 tube.

By Raymond Johnson, while near Independence, Ore., Sept. 1 to 10; CR-5 type receiver and 1-step Audio
1bcg, 4gl, 5ek, 5hl, 5nj, 5pb, 5qq, 5aml, 5zav fone, 6fh, 6fy, 6hv, 6mh, 6nb, 6ua, 6acr, 6ajf, 6atz, 6awt, 6bff, 6bgc, 6blg, 6bos, 6brf, 6bve, 6cbu, 6cbw, 6cfi, 6che, 6chz, 6cid, 6efz, spark 6gt, 6acr, many sevens of course, 8gz, 8hv, 8ij, 8ig, 8yn, 8zz, 8adk, 8afd, 8apy, 8bci, 8bcu, 8bdu, 8djf, 8dkm, 9cr, 9dt, 9hk, 9mf, 9aau, 9aaw, 9acw, 9aim, 9aim, 9amb, 9ara, 9asj, 9axx, 9bcz, 9bmu, 9bsz, 9btt, 9bun, 9bzi, 9ccs, 9cbj, 9caa, 9cdw, 9cvc, 9dce, 9dgv, 9drk, 9dqu, 9dwn, 9dyz, 9ehv, 9eky.

Can.—3ni, 5cn, 5ah.

Broadcasters—cfcn, chbc, ckck, kfi, khj, kfad, kpo, wgy, woaw, Edge-water Beach Hotel, Chicago.

Commercial—kfs, kpe, kph, kse, kok, vae, vab, vag, vaj, vak.

I hope to be on the air again shortly. Station will be in Los Angeles, EX—6CFP.

By 9FI, New QRA, 4511 Colfax Ave. So., Minneapolis, Minn.
1acu, 1arf, 1bbo, 1bcg, 1ccg, 1cdm, 1cmp, 1er, 1afp, 2ajr, 2ani, 2awl, 2boi, 2bqc, 2bxn, 2bxw, 2cjr?, 2crk, 2cxl, 2bn, 2bj, 2rp, (2wr), 3abw, 3awl, 3bdo, 3bvw, 3bva, 3chg, 3co, 3el, 3oh?, 3os, 3vo, 3zs?, 4ama, 4bq, 4gl, 4gw, 4gx, 4hz, 4kc, 4kg, 4kf, 4ku, 4mi, 4us, 5abt, 5acq, 5afq, 5akn, 5awu, 5zav, 5ek, 5ga, 5gm, 5gn, 5gp, 5ku, 5kw, 5ll, 5mn, 5mo, 5ns, (5rl), 5vc, 6atz, 6awt, 6bvg, 6cbu, 6ces, 6cgd, 6ka, (7en), (7em), 7zv, 8aaj, 8aio, (8ahr), 8aju, 8ajn, (8akr), 8aeb, 8aag, 8aju, 8amf, 8amm, 8amp, 8aon, (8apt), 8apy, 8arq, 8aws, 8akn, (8azo), 8aye, 8bah, 8bci, 8bda, (8bfh), 8bge, 8bhy, 8bjv, 8blc, 8blx, 8bno, 8bog, 8buv, 8bux, (8buz), 8bxx, 8bzc, 8ccr, 8ced, 8cej, 8cnr, 8cnw, (8cpd), 8cqn, 8csj, 8cur, 8cxm, 8dal, 8dat, 8dge, (8dgc), 8dgx, 8dkm, 8bva, 8zae, 8ab, 8au, (8es), 8fm, 8df, 8gz, 8hv, 8hw, 8ij, 8kr, 8sb, 8se, 8vt, (8vy), 8wg, 8zz.

Continued on page 81

The thrill of great distance

For 12 years, Tuska-built radio receivers have been famous for long range reception, and have made records that are unsurpassed.

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Some of the most experienced radio inventors and engineers in this country designed and built the Tuska. It is right, forever, and needs no tinkering. Have no fear that it will soon become obsolete. A Tuska set bought today will be serviceable for years to come.

THE C. D. TUSKA CO., Hartford, Conn.

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RADIO

TUSKA RADIO

RADIO—THE CONJUROR

Continued from page 20

your rapid dots, your curtailed dashes and the briskness of good business in all your sending . . . .

Listen again with me; there are a multitude of others out there. Hark—another familiar note. KEZF, just a wandering tramp. Let me see—Ah yes, I remember. It was on a long drag up from Buenos Aires, a trip marked by wonderful weather from the day we left the muddy waters of the Rio de la Plata till we sighted the highlands of the Jersey coast. A chap named Leitch was at the key on KEZF, then. There is a new hand there now, but I am sure that Leitch cannot have forgotten that trip, wherever he may be. We touched in at Rio, that Queen City of the South. Oh, if only I could describe the picture that panoramically spread before our eager eyes, as we entered that circlet of indescribable beauty. Standing on our good ship's deck as we slowly glide in through the murk, a sliver of light, merrily skipping from wave to wave, comes beckoning out from each tiny globe. Messages they seem—messages of welcome and promises of delight to sea-weary sailors.

No Leitch, I don't believe you will forget that trip up from the south. Don't you remember, it was Christmas morning that we passed the point on which nestles Pernambuco. Far off shore we were, and how tempting looked that green shore line. Longingly, almost wistfully, we gazed at blurry distant homes of men; for it was Christmas and the most nomadic spirit among us could feel the pull of home ties on that day of days.

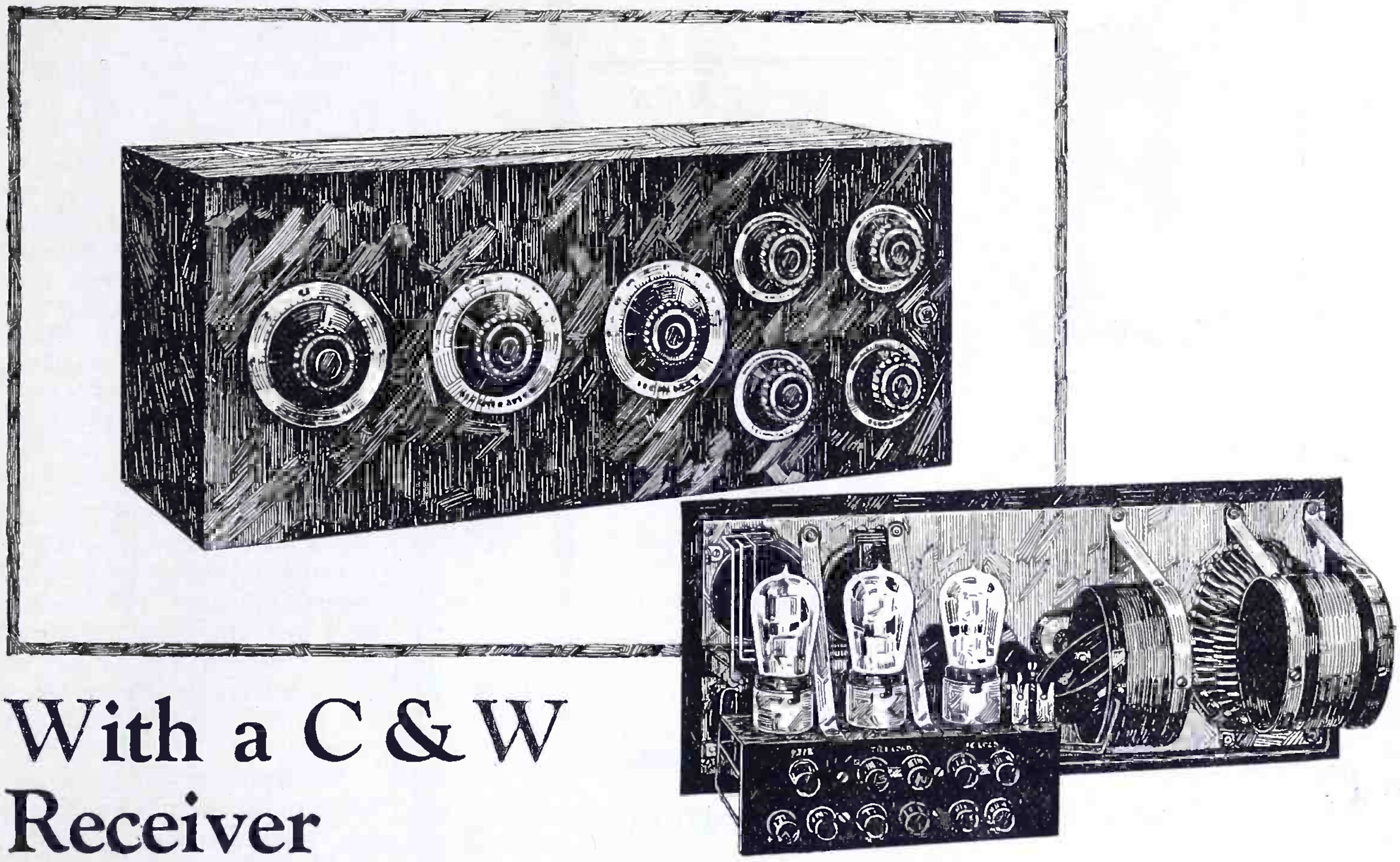
My mind wanders, and fain would linger, lovingly, on memories of those days, but let us back to our radio. Listen to the sharp, brisk handling of the ship to shore, the ship to ship traffic. A friend here—a new man there; all intent on the rapid and accurate handling of important ship-owner business, or the "Love and Kisses" messages from eager passengers on an ocean greyhound making in for port.

When I hear the word RADIO, the vision I see is of these old friends of mine, these Knights of the Dot and Dash, rovers, nomads, carefree wanderers exploring into the farthest-flung corners of the wide world. Dear indeed is that word to me. I love the craft because of the joy of poking into out-of-the-way places of the earth it has given me. I love it for the shipmates, pals and comrades it has led me to.

Strange indeed are the tales of hardships and dangers faced by some of these "brass pounders" of the sea. Strange, also, are some of the meetings between brother operators. I have in mind a rather odd acquaintance made with a young fellow whose story, if

Continued on page 50

Get Your Station



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Continued from page 48

written, would make reading as exciting as that in any of our adventure magazines. The berth I had at the time was on an oil tanker in South American trade. For over two years we had been estranged from our native shores, and were tired of foreign ways. We had just pulled into the Canal Zone after a run around the southern continent.

With a few of the officers, I was sitting in the half-open court café of the Hotel Metropole, in Panama City. Eagerly we were drinking in the songs and chatter of a troupe of entertainers just down from little old New York. A bit of heaven, it seemed to us; a bright touch of "home sweet home," come down to cheer us up.

My gaze wandered to a neighboring table, occupied by a small group similar to our own, fastening upon a chap of twenty or so. Why I noticed him particularly, I do not know. He was not exactly striking, a smooth blond head of hair, face browned by salty winds, and a merry twinkle in his eyes, for he too was enjoying the bit of Broadway entertainment. His head snapped back in a laugh at some witty sally, and then I noticed the fingers of his right hand, resting lightly on the table, beat out in code the "Hi" of an operator's laugh.

My heart warmed, as one's heart is wont to do upon the spying of a friend not seen for long. With a grin I could not keep off my face I went over with the greeting: "Hello Sparks, what are you off of?" The amusement on the chap's face was quickly replaced by surprise. His eyes took me in with a flash, but nothing daunted:

"Hello yourself. I was on the *Olockson*. What are you on?"

"I'm on the *Harkness*. She is laying alongside the shops for repairs. Just came through the "big ditch" today. We heard something about the big fire on the *Olockson*. Guess you had it pretty warm for a while, didn't you?"

Drawing up a chair, I expected to "listen in" on a good yarn, adding, by way of an opener: "Where does she lay now?" Sadly disappointed I was, for Blondy (the only name I remember my friend by) seemed reluctant to talk about the adventure he had gone through.

"They have towed the hulk of the *Olockson* into Panama Roads now," he said, his eyes again on the couples dancing. "It was warm, for a while, but the port captain sent us out help and we were only in the boats a few hours. Lucky for us the fire broke out while we were close to land. We were not quite out to Cape Mala; only a few hours out of Balboa. Had it not been for the heavy static, it would have been easy to get a message in for help. Say," nodding at the jolly crowd,

Continued on page 52

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The Supremacy of the AMPLION is the Supremacy of Actual Performance

Continued from page 50

"doesn't this make you think of the Winter Garden?"

Through the whole evening we sat, laughed at the fun makers, talked shop, and compared notes on the pleasures each had derived from Mediterranean runs; North Atlantic runs; South American runs or on the good old Pacific. Only an occasional word was dropped regarding the fate of the *Olockson.*

Next morning, I got the real story from one of her mates who wandered aboard the *Harkness* for a chat, as we lay at the dock.

The *Olockson* had passed through the Canal, bound for Australia, with a cargo of gasoline in drums. Leaving Balboa, heading out for the many thousand mile run to the island continent, she caught fire in her cargo when only a few hours from port. The fire spread with enormous rapidity, the drums of gasoline exploding and burning with great heat, shooting high pillars of flame from her blown-open hatches.

Blondy, the operator, had but a few minutes in which to get his message for help delivered to the shore station. He was dragged away from his seat, into the boats, before he was sure that the message had been received and thoroughly understood through the terrible static that makes operating a nightmare in that locality.

The boats stood off and watched the fire, expecting at any moment to see the final explosion that would open up her sides and let "old briny" in, to quench the flames and hide the havoc in its depths. Breathlessly they watched for the final plunge but as the minutes grew into hours, the fire seemed to abate. The heaven-pointing flames died down to little spurts; clouds of smoke poured out and drifted down the gentle breeze.

The boats closed in to a better view. The captain, with the love of a master for his vessel, eagerly watched the apparent dying out of the fire. Finally, with the hope that is strong up till the last bulkhead gives way, he decided to board her again.

Blondy, fearing for the non-delivery of his message, begged to be allowed to go aboard also. The chief engineer was the next to volunteer. In a few minutes, they three were aboard the burning vessel again.

The skipper and chief hurried to the smoke-belching hatches and Blondy to his radio room. As he feared, there was trouble over his message. With a prayer that his emergency batteries would not give out, he started to work, giving as many details of the ship's whereabouts and condition as he could. So intent on his work was he that what was going on in the holds of the vessel was not noticed.

Continued on page 54

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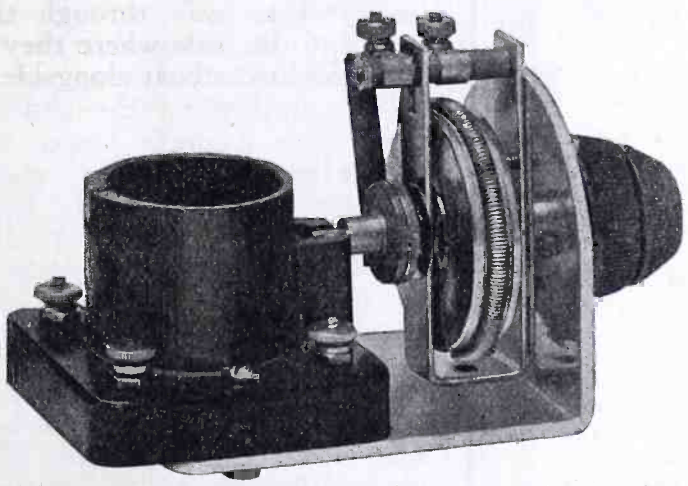

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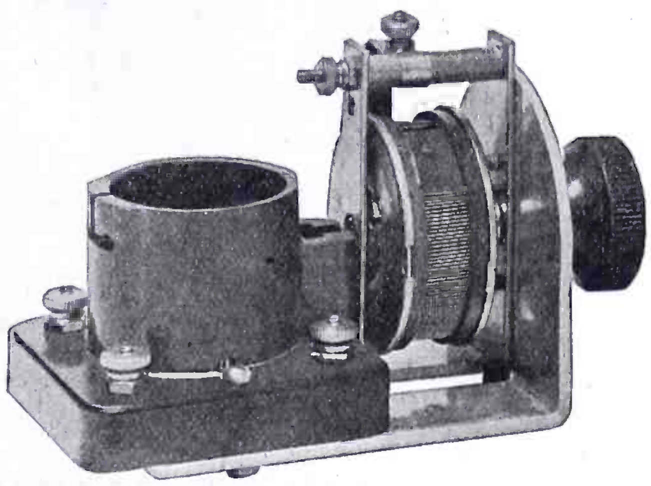

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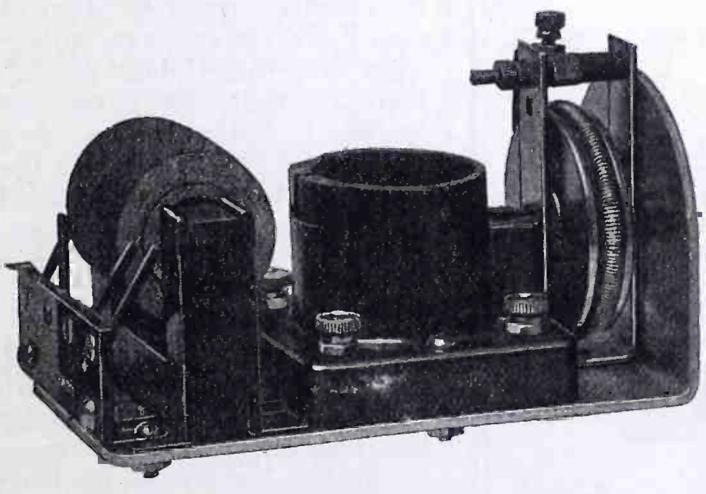

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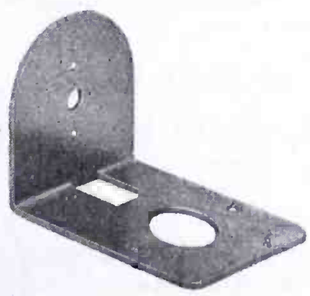

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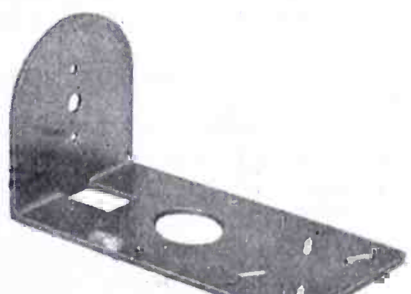

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Continued from page 52

The roaring, devouring flames below spread and found fresh food. With an explosion that rocked the boat the fire broke into another hold. Again the livid, seething tongues shot high. Right under the midship house she was burning now and the heat and smoke enveloping the radio shack on the boat deck above must have brought the wonder to Blondy, whether or not he was alone on board. The anxious watchers, who stood by at a little distance in the boats, told me that not once did Blondy show up on deck.

Hammering away with his messages for assistance, bucking the tropical static, he had no time to think of what was going on around, until finally the captain, who had given up all hope for the *Olockson*, came in and called for him to come away. The heat in the quarters had grown terrible. They fought their way through the black smoke to the side where they signaled and soon had a boat alongside.

Over and away, they had not put more than a ship's length between themselves and the now derelict *Olockson* when her midship house was shaken by an explosion, the deck just aft of the house was torn open and the officers' quarters and radio room were engulfed in a roaring, consuming sheet of flame.

Blondy my boy, you may not be demonstrative, you may not be of the kind that delights in telling and bragging of hazards undergone; you may not be of an excitable and loquacious nature, but I am sure there must have been a shiver run down your spine and your lips could well have quivered with a prayer of thankfulness for delivery, as you saw that last curtain of flame enshroud, forever, your much-loved radio room. It was only a few nights later, in that crowded cafe, that you quietly told me, "Yes it was rather warm, for a while," and I agree with you. It must have been!

Ah, dreams; dreams of you—Radio, most wonderful of crafts. 'Tis true that for years you took me into many far places, over many hundreds of thousands of miles of sometimes storm-swept, sometimes calm and lazy waters; but how little I know about you. The deepness of your mysteries causes men of great talent to shut themselves away from the world, to delve and probe into the intricacies of your workings. The great scope of your power has caused the linking together of nations as never has been done before. The love of being the guiding human hand that directs your wonderful work has been the joy of a countless army, the Knights of the Dot and Dash.

Just now as I sit writing, I am in a new country for radio. On the summit of a High Sierra mountain pass. The state is California, land of sunshine and

Continued on page 56

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Continued from page 54

flowers it may be down below, but my cabin walls are shaking with the force of a blizzard that is roaring and freezing and piling the hard snow pellets many feet deep against the little building. In the storm's lull the wail of a coyote comes down the air, a lonely cry from a lonely soul. The walls of my radio shack are hung with guns, with traps, snowshoes and skiis.

We are isolated on a mountain top, over 9000 feet in the air. Isolated as far as personal touch with the outside world goes, but far from lonely as long as the radio works. In the country behind us hundreds of men are tunneling through a mountain's stony heart, liberating the power that lies latent in high mountain lakes and snowfields. Hundreds of men that are shut off from the world, were it not for the binding link of radio.

Tomorrow, perhaps, if the storm abates, a dog team will be in with the mail. Intimate personal letters that we long to get and patiently wait for, but the sour-dough dog musher always drops into the radio shack to get the last minute news from the world he has just left behind.

Radio the Conjuror—indeed 'tis that you are. Mystic juggler of distances, swimmer of oceans, climber of mountains, and in your service what queer places do you shunt your devotees into!

THE SIMPLEST SUPER

Continued from page 18

top of the knob and turn it with a long-handled screwdriver. Successful operation depends largely on the grid leak adjustment, which controls the variation frequency. The correct setting can be left as it is after it has once been found.

The 25-turn spiderweb is the tuning inductance and the 35-turn the tickler. They should be separated by a sheet of waxed paper. Honeycomb coils of 50 and 75 turns respectively may be used instead, or the plate circuit may be tuned with a variometer.

There is very little to say regarding the operation of the set. If the tickler coil is poled properly the set should oscillate as soon as the tube is turned on. If it doesn't, either reverse the connections to the plate coil or turn it over. With the set oscillating, a high-pitched whistle should be heard in the phones. Adjusting the grid leak will change the pitch of the whistle. Vary the leak until the whistle is almost inaudible. Then turn the condenser dial and, if there is anything on, it will come in. It is really simpler to hook up and operate than an ordinary regenerator.

Remember that a storage battery as used in a radio set requires a drink of distilled water quite often, as well as any other type of storage battery.

McGUFFEY'S ARC TRANSMITTER

Continued from page 22

Glad of the respite—for he had about exhausted his list of calls, including the C Q and a miscellaneous collection which he had made up for the occasion—McGuffey left the house. When he returned, Mrs. McGuffey told him to call up one of the wireless boys, who had been trying to get him by telephone. He called the number that she gave him.

"Say, have you heard the Poulsen fellow calling on the wireless telephone?" asked his friend. "He has been yelling for some one in town to lay off on his arc—says he can't do anything through the interference. He has been C-Qing for the last fifteen minutes. Better listen-in—it's good. I can't hear anything, but the Poulsen man is sure having a fit. Thought I'd tell you."

McGuffey hurried back to his instrument. The Poulsen man was calling, asking whoever had an arc to get in touch with him. "You're wrecking my ticker" was the final closing words of the Poulsen man.

Now, as I have already said, McGuffey lived within three blocks of the Poulsen station. It was possible that, in spite of untuned circuits, and with oscillations hashed up with alternating current, that he would carry that far. Anyway, the fact remained that McGuffey's arc transmitter had established communication. With a great glow of pride McGuffey threw his switches and made ready to announce his identity to his friend at the Poulsen station. It was one thing to build an arc transmitter, and then to have a high-powered wireless telephone call you—well, I ask you if in those days an amateur's cup of happiness could be nearer to overflowing? Especially in those days. Ask any old-timer.

Now, in the construction of his arc chamber, McGuffey had overlooked one constructional item. That was the installation of a poppet or release valve. A certain amount of gas collects from the ether, and, mixed with air, forms a highly explosive mixture, which, when the arc is struck, ofttime explodes violently. The poppet valve allows this to escape harmlessly. McGuffey had no valve on his arc chamber. And his joints, where the sliding carbon electrode passed into the arc chamber, were far from air-tight.

Now we begin to get down to the action of this tale. In the next room, McGuffey senior, returned from a dusty trip to his ranch out of town, was preparing to revel in the luxury of a bath. Outside the window of McGuffey's wireless room, the McGuffey cat, as fine a specimen of cathood as could be found in the city, was snoozing peacefully in the late afternoon sun.

Continued on page 60

Continued from page 58

McGuffey "struck" his arc. Coincident with the striking of the arc, a vagrant gust of wind blew in through the open window, and the bathroom door, not securely fastened, swung open.

There was immediate action. The copper electrode, fastened to the end of the can, and, as I have said, removable, separated hurriedly. Weighing about five pounds in all, it sailed through the open bathroom door, which McGuffey senior, balancing precariously on one foot in the bath tub, was just leaning forward to close. The metal electrode caught him halfway between the hurricane deck and the flying bridge, with a sound somewhat similar to that made when a wet fish is thrown against a pile of sand. The remaining part of the arc chamber went in the opposite direction, through the open window, pinking the McGuffey cat squarely on his aristocratic nose.

The McGuffey bathroom, like many others of its kind, was large enough for one to change his mind in, but not much larger. The door in the opposite wall opened out into the parlor of the McGuffey home, where Mrs. McGuffey was entertaining three lady callers who had just arrived and were being ushered into the parlor. McGuffey senior, losing his balance, toppled, struck out frantically, caught the doorknob in his hand, twisted it violently as he strove frantically to recover himself, and tumbled into the parlor in the much the same state as he had entered the world some forty-five years before. I draw the curtain over this harrowing scene, which is more than McGuffey could do, much as he would have liked to, and turn to the McGuffey cat.

The McGuffey cat went straight up into the air in one bound of surprised bewilderment, landed three feet away, and made off spitting and yowling, unheeding of direction. His second leap carried him squarely into a dishpan full of home-made tomato catsup that Mrs. McGuffey had set out to cool. The cat and the catsup mixed in an entangling embrace.

I can not conceive of anything quite as startling as a cat surrounded with a halo of tomato catsup. Nor is there anything, I imagine, more utterly annoying to a cat than a bath in catsup. Cats do not like baths of any sort, and I know of no reason that a cat should have a partiality to catsup baths over any kind of a bath. When the McGuffey cat emerged from the catsup, which he did with haste, he resembled very much a futurist stampede. Bewildered beyond sense of direction, he dashed frantically around the house and up onto the front porch. Here the three ladies were taking agitated leave of Mrs. McGuffey, who was equally agitated as they. All three ladies were dressed in becoming white, and the McGuffey cat in his mad rush across the scene added touches of color to their attire that, attained under different circumstances and through different means, might have been quite charming to the feminine viewpoint.

Of course my tale ends here. McGuffey had to dismantle the arc transmitter, or as much of it as there was left to dismantle. But in his cup of bitterness there was some consolation. He, rank amateur, had builded and successfully operated the first amateur arc transmitter on the coast, mayhap in the whole country, and he occupied a position of envy among his fellow experimenters. For, had not the Poulsen operator used seven kilowatts of power in calling him on the wireless telephone signalling his station out from the many! That, in those days, was going some.

BOZO LEARNS ABOUT WOMEN — AND BATTERIES

Continued from page 12

"Yeah!" derided Bozo. "Think I didn't try that? I put boxes under her, and two dozen newspapers, to absorb the acid as it ran off, and even a tin dish, but they were no good—not none of them!" Bozo's vehemence was too much for his grammar.

"My, my!" chided Sparks placidly. "How you do go off at half cock! Just glance under the table there, and you'll see how I keep my ancient juice box from doing its stuff all over the rugs, and making red spots on them——"

"And burning holes—nice round holes—in'em!" supplemented Bozo as he leaned forward. "What's that—a glass tray?"

"Exactly!" said Sparks proudly. "One of these more-or-less newfangled baking dishes. It's made of glass, and it can't be eaten through or otherwise messed up by battery leakage. And it doesn't ground your battery and add to the natural noises of a set; as a matter of fact, it very beautifully insulates it."

"Now I wonder," remarked Bozo thoughtfully, "just why I didn't think of that myself? I tried almost everything else in the house——"

"Good idea, all right," admitted Wildcat. "But those dishes cost something. Why wouldn't one of these paraffin-impregnated fibre trays that photographers use do just as well? It would be quite a lot cheaper, and do the work just as well, so far as I can see."

"Guess it would," said Sparks, "although for an expensive cabinet or for use where there are really valuable rugs, I think this annealed glass just about the thing."

"I wonder if the folks will let me bring my set back into my room if I'd keep my battery in a tray like that?" puzzled Bozo. "I don't see why not——"

"The Missus let me bring my battery back into this room after I thought of the idea," said Sparks with a broad smile. "So perhaps your folks——"

"WHAT?" shouted Bozo and Wildcat together.

"I had about the same experience Bozo had, I guess," said Sparks. "It would seem that *no* woman, whether it's a wife or a mother, likes to have battery acid make little red stains on her good carpets——"

"Or to make nice little round holes in 'em!" ammended Bozo feelingly.

RADIO SHOP

Continued from page 26

how to use hand turning tools, the writer will describe the turning of the simple piece shown in Fig. 7. First it will be necessary to get a piece of stock ¾ in. in diameter and about 4 in. long. The approximate center is found by using the dividers as illustrated in Fig. 8. The center holes are then drilled with a centering drill and the pieces mounted in the lathe with the aid of a lathe dog as illustrated in Fig. 9. The tail stock should be moved forward just far enough so that its center will engage the work not too tightly. A little oil on this center will help. In hand turning, the tools are supported upon the "T" rest with the cutting edge of the tool in contact with the work which is revolving in the lathe. The work if first roughed off with the heel tool until it is down to within 1/32nd of its ultimate diameter. If the work being turned is brass, it is well to give the heel tool a slight negative rake to prevent it from cutting too deeply into the work. This, and the correct position of the tool and the cutting center

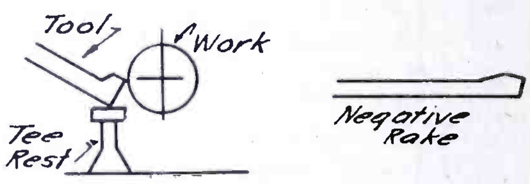
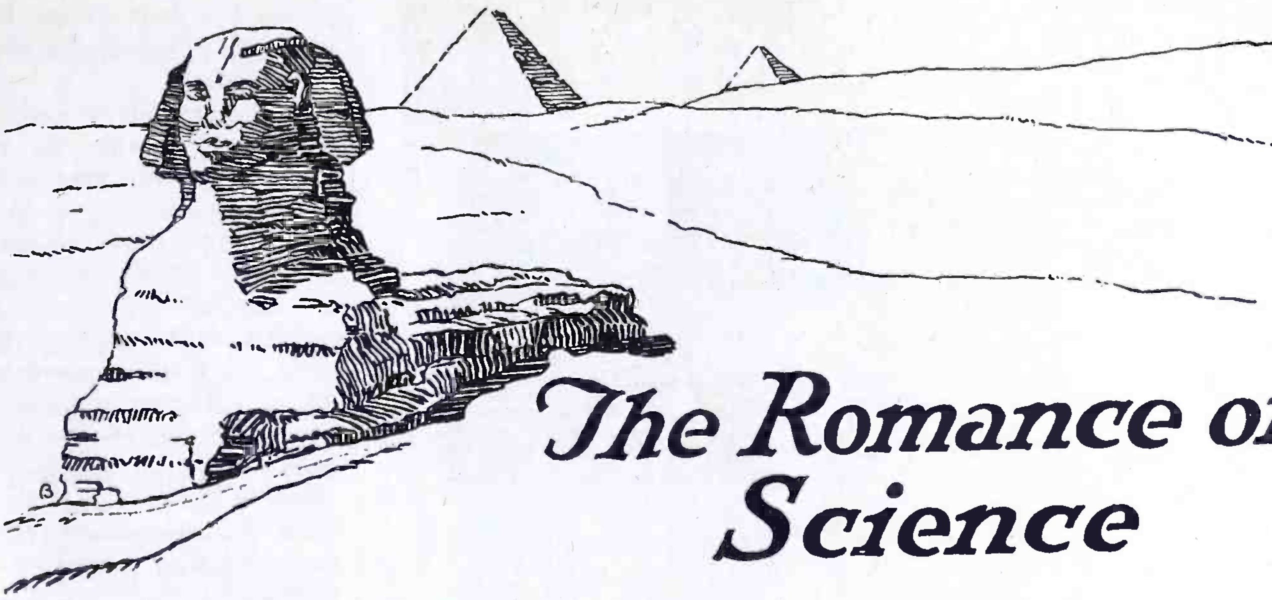


Fig. 10. Correct Position of Tool

will be understood by reference to Fig. 10. The operator should take light cuts until he becomes more familiar with the manipulation of hand tools—something that comes only through a certain amount of experience.

Wood turning will be greatly facilitated if we purchase for our lathe a small spur center which the manufacturer can supply for a dollar or two. This is simply a little disk with a tapered shank and a screw mounted in the center. It takes the place of a chuck in holding the work and is a convenient thing to have about. In general, wood turning tools are held in the same manner as metal turning tools, save that the feel is different and it is necessary to take care that the tool does not dig in too deeply. One hand of the operator is kept near the cutting end of the tool and the other hand at the opposite end. This gives plenty of leverage and prevents accidents. In this connection the writer wishes to warn the reader that the skew chisel is the one most difficult tool to use in wood turning, since it is apt to dig into the work and pull itself from the operator's hands. It should be laid on the "T" rest at an angle of about 60 degrees in relation to the surface. The chisel is drawn back slightly and at the same time the handle is raised until the chisel starts to cut.

Continued on page 64



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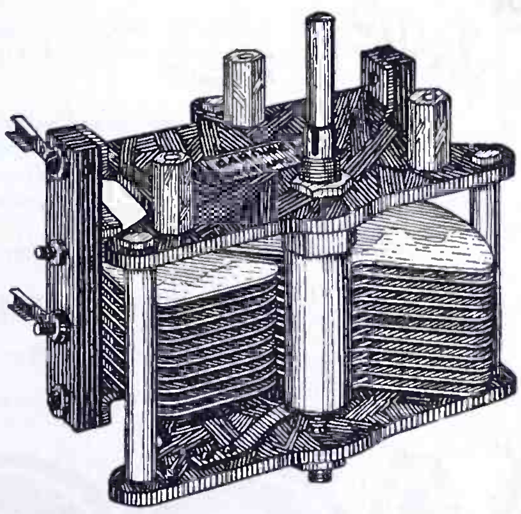

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Continued from page 62

In using the skew the operator should never start at the end, since there is danger that the chisel will catch and split the wood. In roughing down a piece it is best to use the gouge, since this has a terrific capacity for ripping off wood.

Close-grained wood should be used wherever possible in turning. Such woods not only take a finer finish, but can be turned much more easily and with much less danger of splitting. Maple is a very satisfactory wood to turn and a beautiful finish can be produced.

The writer believes that he has covered practically everything that would be of value to the radio experimenter in connection with shop work. As pointed out in the previous article, a little ingenuity and horse sense used with this equipment will enable the experimenter to surmount practically any difficulty.

SHOP PRACTICE

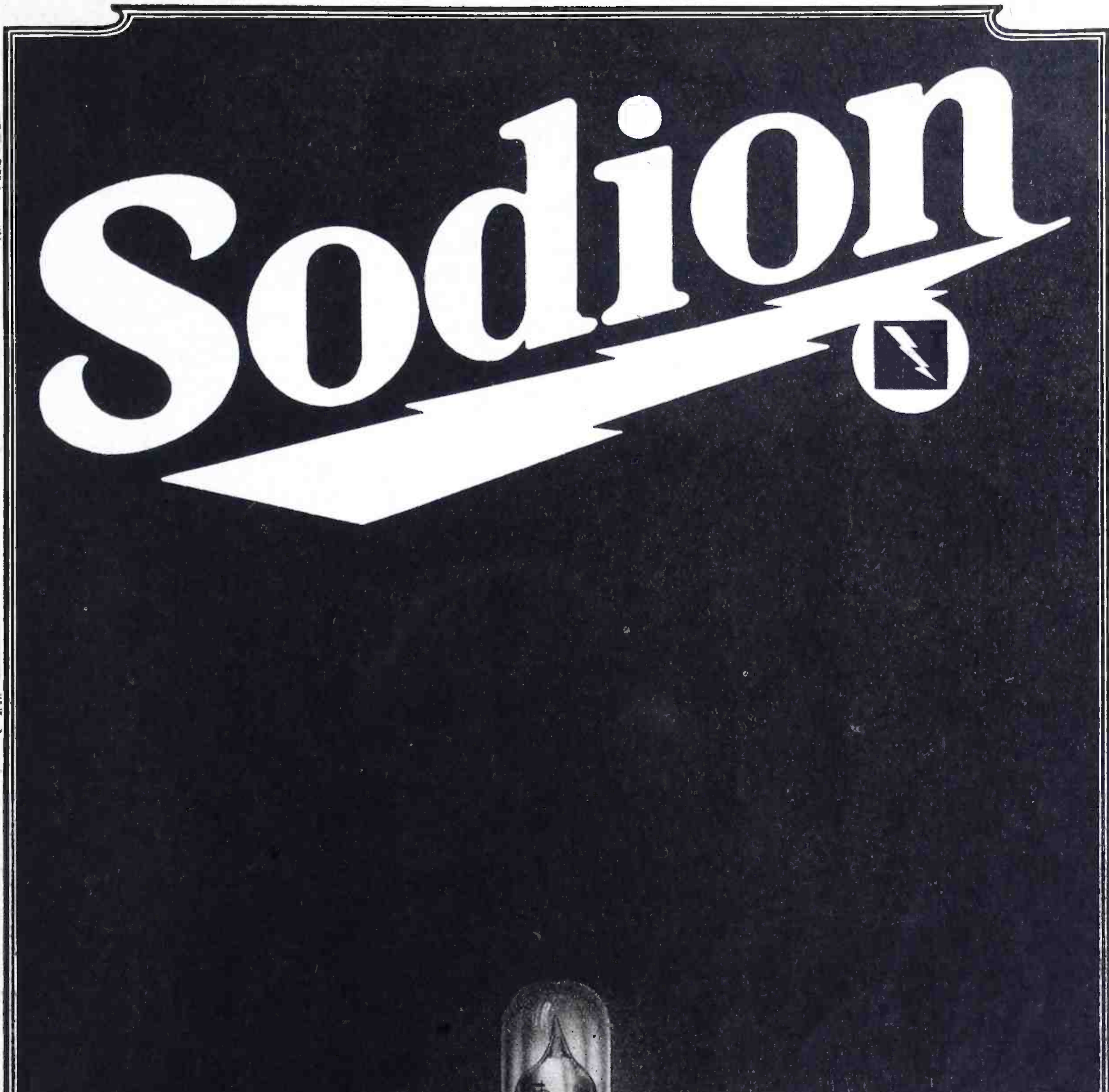
Continued from page 28

Start at one edge of the panel and sweep the sandpaper along the whole length of the panel with a single stroke in the direction of greatest length of the panel. Then sweep back in the same direction, and gradually work across the whole panel's face. At first the job will appear as a series of scratches, but gradually, as the rubbing continues, these scratches will blend in, and become a satiny smooth-finished effect with a decided grain in the direction of the rubbing. It may be necessary to use several different pieces of sandpaper and, after the whole surface has been smoothed down with coarse paper, a finer grade should be substituted, more oil being applied as needed. Once the rubbing has been started in one direction never try to change the direction of the graining, or rub the grain crosswise, as this will put scratches on the surface that are almost impossible to remove, and will give a very poor looking job. When the final rubbing is completed and the whole surface of the panel is smoothed off properly, add more oil to the surface and wipe off the whole surface with a clean rag, taking care to continue the wiping in the same direction as the panel was rubbed, until every trace of grit and free oil is removed.

The oil adds just enough finish to the panel to give it a rich smooth black appearance, which can be easily restored at any time by wiping the surface with another rag, moistened with a trifle of oil. Wire scratch-brushing will give an equally good effect, but this is more difficult to use than the sandpaper and oil, and it also takes more equipment. Sand-blasting will give a very pretty appearance to bakelite, provided it is rubbed with an oily rag after the blasting process, and in some ways this is superior to the rubbing process, as it gives a satiny finish, without any grain effect. It likewise is difficult of performance unless attempted by one equipped for such work.

The final procedure in the preparation of the panel for use will be the engraving. This is practically impossible to do at home. Many concerns have engraving machines, and, for so much per letter, will do the job in a much better way than could be done at home. Makers of apparatus are strongly advised to patronize these firms rather than to spoil the panel by attempting to scratch markings on by hand. Steel letters and figures may be used if no engraving work can be done, but even then indifferent results are obtained, as the steel figures simply dig into the panel and do not remove material, such as is necessary in an engraving process, and, furthermore, as such figures are all separate and are used singly, the lettering

Continued on page 68


Sodion
The Plant Behind It

Continued from page 66

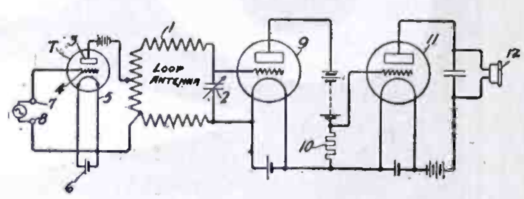
can never be lined up so it looks well. Small metal markers or tags, with various letterings, can be obtained, and often make a fair substitute, but the machine engraving is to be preferred by all means.

The panel is now complete and is ready for assembly into a set, wavemeter, or whatever it was designed for.

RECENT RADIO PATENTS

Continued from page 38

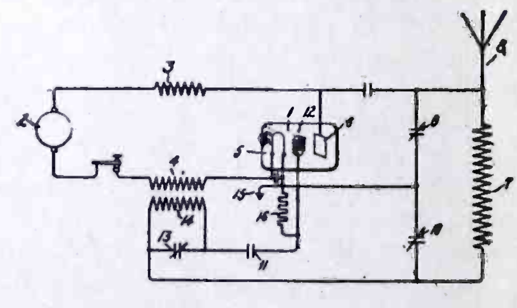
lated groups of radio-frequency waves, the groups transmitted have substantially constant amplitude with very little damping; and between groups there is no radiation.



This is accomplished by the addition of certain elements to a conventional oscillating tube circuit, comprising inductance *7*, and capacities *8* and *10* forming a closed high-frequency tuned circuit. As is common, this tuned circuit is connected to the plate *6*, filament *5*, and grid *12*, the latter connection being effected through capacity coupling *11*. The new part of the circuit is the inductive coupling *4-14* between the grid and plate circuits, and the tuning of circuit *13-14* by the aid of variable condenser *13*, to an audio-frequency. The energy transferred to the grid circuit by this coupling acts to interrupt the oscillations at an audio-frequency rate.

S. Loewe, Pat. No. 1,464,083; August 7, 1923. Receiving Apparatus for High Frequency Signaling.

This patent describes a receiving system using a local source of energy for heterodyning, in connection with a loop antenna *1*.



The advantage of the system is that variation in antenna tuning by the aid of condenser *2* results approximately in equal variations in the frequency of the local source, so that the beat or difference frequency remains the same. This result is accomplished by bridging only a portion of loop *1* with the local source *13* which is in the form of an oscillating audion. To render this tube oscillatory, the inductive coupling *14-15* is used between the output and input circuits, the part *14* being also a part of the loop inductance. The detector circuit may be bridged across the tuning condenser *2*, and as many stages of amplification may be used as desired.

"Theory and ' ration of Reflex Circuits" is the subject of excellent 16-page pamphlet published l The Wireless Shop, Los Angeles, Calif. (Price 25 cents). This describes the co uction of six different sets, including reflex ›erflex, inverse duplex and neutrodyne.

HOW "CAN" THE HUMMING BEE

Continued from page 19

paper placed over L_2. The latter has about 42 turns of No. 24 bare wire. The turns of L_1 may have a 1/32-in. twine spacer wound on and removed, to reduce self capacitance and to permit fractional turns to be tapped if desired. The wire should be coated with collodion after the proper tapping point *5* for the neutralizing condenser C_2 is found as described below, and C_2 itself should be a fixed condenser in its final form, once its value is determined.

The problem now takes the following shape: Use a Gen. Radio or Cardwell variable air condenser, which have relatively low losses in place of the condenser C_2. Tap off point *5* at about 1/6 of the total turns, i.e. at 2 turns. This is the start. We will now find the best value of C_2 on the variable for this particular tap in order to see if we can completely neutralize the capacity C_1. Probably we can not do this at first, but we will try for the best result with different values of C_2 and then do it all over again with the tap *5* taken on either side of its present location.

We know that C_1 is most nearly neutralized when CL_2 has the greatest tuning range. This follows from equation (*1*), and our source of oscillations is the receiver across which L_1 is shunted. This receiver must be calibrated to go lower and higher in frequency than CL_2, as we must tune the latter both at its zero and full scale positions for every value of C_2 tested.

We know the receiver is in tune with L_2C when a phone in its plate circuit gives a click as the tuning element in it passes just through the tuning point. A tuned plate circuit is best for this purpose.

Many may object to such lengthy tests to determine a simple thing—but they may be assured that no more fascinating or instructive set of experiments can be made by an amateur. They're bound to learn something—provided they are systematic in their records.

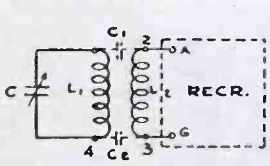


Fig. 6. Capacitance Neutralizing Condensers, C_2, with Tap at Two Turns on L_1

In Fig. 6 we have a sample set of measurements as follows: Tap *5* is at two turns on L_1. Condenser C_2, which is calibrated, is set at 1 micro-mfd. The wavelength in L_2C goes—say from 200 to 400 meters or 1 to 2. This is marked on the chart shown in Fig. 6 for wavelength range—the square root of R_e—in terms of the capacitance of C_2. Now change C_2 to 2 micro-mfd. and the range goes from —say—180 to 450, or 1 to 2.5. Again, with C_2 set at 3.75, we get *W. L.* (wavelength) range is 3.25; with C_2 equal to *5*, the *W.L.* range becomes 2.75. It is now decreasing as the capacitance C_1 is over-neutralized and we are not gaining. Hence by a few trials of C_2 near 3.75 micro-mfd. we convince ourselves that this is the best we can do. We replaced C_2 by a fixed condenser of 3.75 micro-mfd.

The next step is to change the position of the top at *5* and we then do the above tests all over again. This takes about 5 minutes, if anything is calibrated, for direct reading. If we now get a better *W.L.* range than 3.25 we are improving matters and should keep on. If not, stop—the work is probably correct. The final step is to determine if another tap at *6* on L_1 as shown in

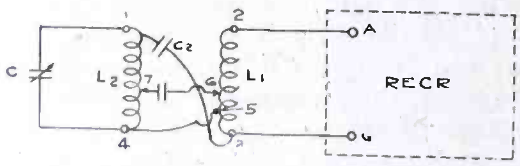


Fig. 7

Fig. 7 can be led through a second neutralizing condenser C_3 to a second point 7 on coil L_2. Some juggling of the connections may be necessary to improve the neutralizing action of condenser C_2, but if any improvement is possible it should certainly be tried for.

What is the net result? The tuning out of undesired stations is just as sharp with 12 turns as it would be in an ordinary wave trap with 5. Moreover, the signals are not weakened on account of the greater inductance of the shunting "pick-up" coil L_1 which can have 3 times the usual turns for this purpose.

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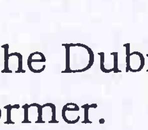
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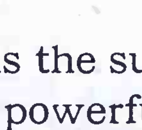
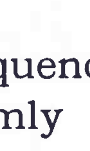

Dubilier Variadon


Dubilier Ducon

WHY BLOOP

Continued from page 33

trol regeneration in the good old way, the circuit would oscillate without it, and it is used in the reverse sense and coupled backwards to prevent oscillations. At the extremes of the band of frequencies which the impedance covers, the circuit may require some additive tickling, therefore the ball type is desirable, as a rotation of 180 degrees takes in the full range of adding and bucking. Normally the coupling will be near zero, or with the windings nearly at right angles. It will be found that if the circuit is kept in a regenerating condition as tuning progresses, and not actually oscillating, louder response will be had. If the coupling is made too tight, after oscillations are established, even the beat note from the carrier wave will disappear, unless the transmitter is very near and powerful. Even a local station cannot be received with the circuit oscillating without such horrible distortion that a flute could not be distinguished from a bull fiddle. Any one using this circuit who causes interference, does so maliciously, unless it is for a few seconds, during which time he is finding the approximate tune of a distant transmitter. If he is even moderately skillful, he need not allow the circuit to oscillate at all.

In choosing the vario-coupler, it should be selected for the small number of turns on the ball. Thirty turns are sufficient, and while more will not do any particular harm, the number given will be found to give easier control for the same reason that a vernier on a control does the same thing.

The variometer and vario-coupler should not be mounted closer together than 4-in. between centers and a grounded shield should be placed between them. In connecting, be sure that the wiring is such that the knob end of the variometer is connected to ground, and the knob end of the vario-coupler ball shaft connects to the *B* battery.

Unless you are a confirmed knob twirler, select dials with stops, then pigtail the shaft connections on both variometer and vario-coupler.

Exclusive of the cabinet, panel and wiring, the material required for this circuit is as follows:

1 Variometer.
1 Vario-coupler, ball type with the necessary tap switch.
1 Murad T II radio-frequency transformer, 150 to 500 meters.
2 6-ohm. filament rheostats.
4 Tube sockets.
2 .00025 *mica* grid condensers.
1 Grid leak, without grid condenser.
2 Audio-frequency transformers.
1 Detector tube.
3 Amplifier tubes, quarter ampere tubes recommended.
1 Loud-speaker.

The secondary of the Murad transformer is used as the r.f. impedance. If slight improvement in the selectivity is desired a point switch may be used to cut in either the primary or secondary of this transformer. Used in this manner, the primary will be at its maximum efficiency at about 360 meters, and the secondary at about 400 meters. Either will cover the whole broadcast range, but both used in this manner will give better results.

The one stage of r.f.a., as shown, compares quite favorably with two stages of transformer-coupled r.f.a. with the best available transformers. With an antenna 35 ft. high and 75 ft. long, stations 500 miles away at night come with practically the same strength as local stations, that is to say, the detector and second audio-frequency tube may both be loaded. The writer has obtained loud-speaker signals from these same stations using a loop.

The use of dry cell tubes is not recommended for this circuit, unless used with an extremely small antenna or a loop, because even moderately long distant stations would overload them and produce distortion.

There is a peculiarity in this circuit, in that if the radio-frequency tube is removed from its socket, and the coupling is made rather tight, signals may still be heard. If the station is near by, better quality may be had in this manner, because the detector tube will not in this way be overloaded. When operated in this manner, it becomes a coupled circuit, with the antenna tuned, and the secondary tuned broadly but not entirely aperiodic. The stabilizer becoming the coupling unit.

The writer has found it advantageous to mount the terminal block so that the terminal screws protrude through holes in the back of the cabinet, the block being fastened to the sub base. In this way, by removing the connections, the whole set may be removed from the cabinet, and at the same time all connections are kept in the rear.

If the tube sockets are mounted on the sub base, in two rows, the panel dimensions may be kept down to 6 by 19 in. This requires careful placement of the sockets, transformers and jacks if they are used.

Particular attention is directed to the manner of using the grid leak. This cannot be placed across the grid condenser because so doing would place the potential of the *B* battery on the detector grid.

V. T. OSCILLATOR

Continued from page 30

ously; in the spark transmitter, at intervals. Herein lies the great difference between the two, and the reason why the one is undamped and the other damped.

Let us go another step farther. A similar action could be obtained if the circuit were as in Fig. 10.

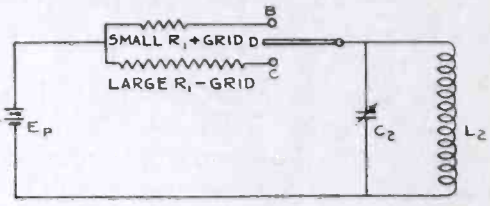


Fig. 10

However, in this case the alternating current produced would be superimposed on a small direct current. The continuous or direct current would be dependent on the voltage E, and the average resistance of the circuit. This assumes, of course, that the contacts are never open when the switch passes from C to B, which is of course impossible in practice. Now it will be recalled that the grid potential can vary the apparent resistance of the plate filament circuit. The grid may be looked upon as the above switch, changing the resistance of the path as its potential is changed.

In electromagnetically-coupled circuits such as the Hartley the grid potential is controlled by means of an inductance placed near the plate inductance. The changing flux in the plate inductance L_2 interlines the grid coil L_1 and induces in it a voltage in the proper direction to produce and maintain the oscillations. The action is usually started by a shock or a transient. Simply closing a switch or a key will generally produce enough of a shock to start the circuit oscillating instantly.

In electrostatically-coupled circuits the grid potential is controlled by means of induced voltages in the coupling condensers.

Although many refinements might have been introduced into this simple explanation, the writer hopes that this will serve to give the reader some general ideas pertaining to the action of a vacuum tube oscillator. In concluding this chapter we shall describe some of the equipment to be used.

All fixed condensers should be mica insulated. Use such condensers as the Radio Corporation puts out. In some cases, on smaller sets, Dubilier micadons serve very well. The variable condensers should have enough clearance between plates to prevent spark over. There are many suitable condensers on the market. The grid leak is the standard heavy transmitting type, 5000 to 10,000 ohms.

There are numerous ways in which a transmitting inductance may be made. One way is to procure a heavy tube of 4 to 5-inch diameter and cut a winding

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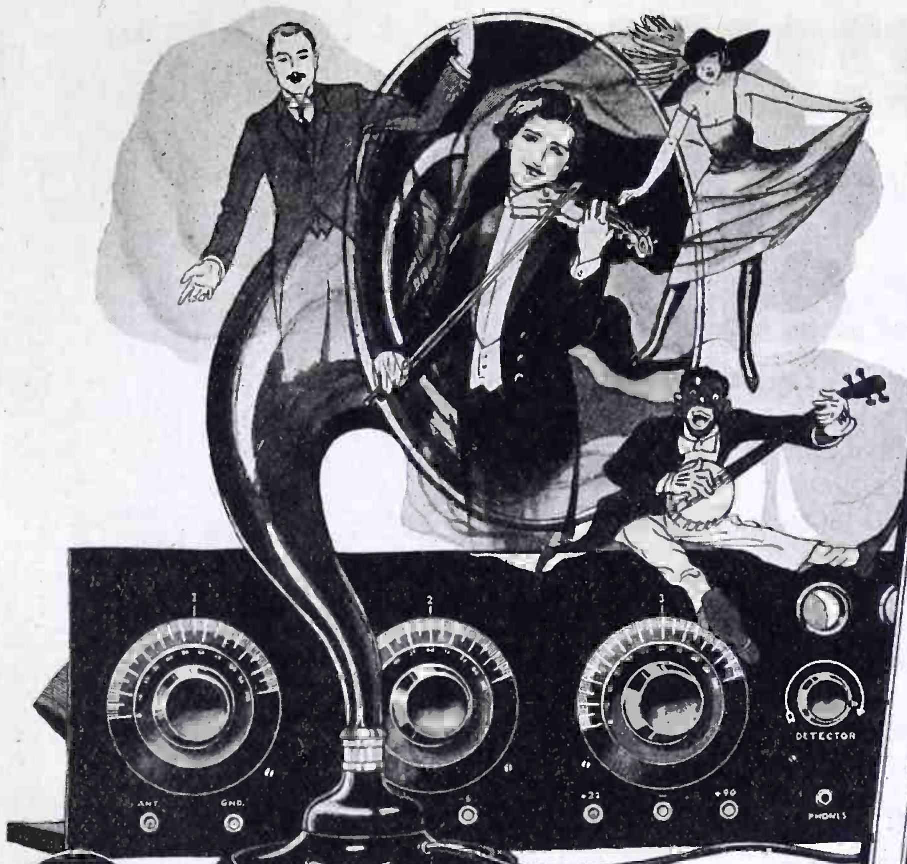

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MR. B. W. DOWNS TELLS HIS EXPERIENCE

Bertram W. Downs of St Paul, says:—

"A word in appreciation of the Neutrodyne parts and your instruction booklet. I just finished building a 5 tube set according to your instructions. Herewith are some of the results obtained last night, between the hours of 9 and 10 P. M.

"Direct comparison was made with a 3 tube regenerative set on the same aerial, using the same batteries and tubes. The test was made at Bald Eagle Lake, 20 miles from WLAG, the Twin City Station, which was in operation all during the test.

"The 3 tube regenerative set brought in Chicago and Omaha with poor to fair strength. The Neutrodyne brought in on the loud speaker Chicago, Omaha, Schenectady, Ames, Iowa, Philadelphia, Cleveland, St. Louis and others that we did not wait for. The remarkable things were signal strength and selectivity. Minneapolis came in without aerial or ground too loud for comfort. Omaha and St. Louis were good without either aerial or ground connections.

"No interference between stations was noticed at all. The quality of the signals from the three strongest stations, Minneapolis, Omaha and St. Louis, was perfect, despite the fact that the tubes were being worked to their utmost capacity, speech being intelligible fully a block away.

"Comparison of notes with other experimenters this morning shows that last night was poor radio weather, and regenerative sets failed to bring in any stations but Omaha and Chicago. Needless to say we did not use the phones at all with the Neutrodyne."

Hundreds of similar enthusiastic letters are being received from men who have built Neutrodyne Receiving Sets.

YOU CAN ASSEMBLE THIS SET YOURSELF

This handsomely printed book, "How to Build Hazeltine's Neutrodyne Circuit Radio Receiver" that sells for 50c. tells simply and clearly exactly how to assemble this set. Nothing is left in doubt. The directions are written in simple, easily understood language. An actual size pattern is included that can be laid over the front panel and used as a guide for drilling the holes for the rheostats, phone jacks, pull switch binding posts and neutroformers, etc. Photographs show every step in assembling, adjusting and operating the receiver.

SEND FOR YOUR COPY TO-DAY

Take the first step towards owning the most up-to-date and efficient radio set ever made by mailing the coupon to-day. This book not only tells how to assemble Hazeltine's Neutrodyne Set but it also shows specifically the FADA parts required and costs.

Be the first one in your town to construct a Hazeltine Neutrodyne Set using FADA parts—send the coupon today for this wonderful book.

PACIFIC COAST REPRESENTATIVE
GLOBE COMMERCIAL CO., 709 Mission St., San Francisco, Cal.

F.A.D. ANDREA, INC.
MANUFACTURERS OF FADA RADIO EQUIPMENT
1581-F Jerome Ave. NEW YORK CITY

F. A. D. Andrea, Inc.,
1581 F. Jerome Ave.,
New York, New York.

Enclosed is 50c for a copy of "How to Build Hazeltine's Neutrodyne Receiving Set." If this book is not exactly as represented money will be refunded.

Name ....

Address ....

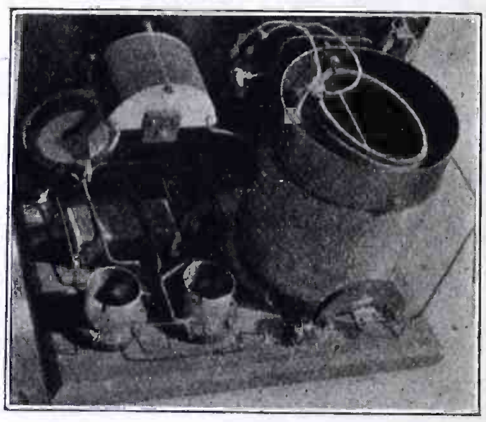
City .... State ....

Continued from page 74

groove on it in a bench lathe. No. 10 bare copper wire can be wound in and lugs for clips can be soldered on every two turns. Another method is to space the winding with heavy twine. The straight inductances should have between 35 and 40 turns, requiring between 40 and 50 feet of wire.

For the feed-back circuits the inductances can contain less turns, say 25, and provision should be made for mounting the feed-back coil on a rod inside the stationary inductance so that it can be rotated, or pulled in or out. Build it somewhat as you might a single-circuit regenerative tuner, or a loose coupler. The movable coil may be wound with insulated wire for convenience, and a few taps may be brought out. These coils need not have more than 25 turns, the right number can be easily found by trial, and in this case no taps need be brought out.

Note that in the reverse feed-back connection the movable coil has the direction of winding reversed, and note also the manner in which the two coils are connected together.



Typical 10-Watt C. W. Set with Hartley Circuit, Antenna Inductively Coupled

The 1 mfd. by-pass condensers are of the paper type rated to stand 1750 volts. This condenser furnishes a very low impedance path for the radio-frequency current in the plate circuit. This condenser is very important where the plate supply is applied between the plate and the inductance. Without it the circuit usually does not oscillate. Smaller capacities will also work. In one instance .002 mfd. was used. However, the large condenser offers lower impedance and at the same time helps to smooth out the ripples in the direct current supply.

In the circuits in which the plate voltage is applied to plate and filament directly, a radio-frequency choke coil is connected in the plate lead. This prevents the radio-frequency current in the plate circuit from becoming short-circuited through the source of plate voltage; especially when filter condensers are connected across the source. The radio-frequency choke consists of about 100 turns of No. 28 D.C.C. wire on a 2 or 3-in. tube. A small honeycomb coil may be used.

Rheostats and sockets should be of the heavy transmitting type. Some receiving tube sockets contain very little metal; such sockets may be used without danger of breakdown.

There are several methods of keying. One is to break the antenna or ground circuit. Another is to place the key in series with the grid leak. This method is in common use on medium power sets. For the large sets a one microfarad condenser shunted by a key is often placed in the grid lead. In all of the above methods the plate voltage is on continuously during transmission.

A very satisfactory way for low power sets is to break the plate supply. A key is placed in the negative lead of the high voltage. If the key arcs too much, connect a condenser across the contacts. This method allows the tubes to be pushed beyond their rated output, since the plates have a little time to cool off between letters and during pauses. The writer uses this method on his present set.

A little should be said about tuning. The set should have some kind of a radiation indicator in the ground or antenna lead. A small light is the most inexpensive. For small sets use auto dimmer lights, and for 10-watt sets up to 20-watt sets, auto headlights can be used. Some kind of a radio-frequency ammeter is to be preferred, since comparative readings are often desired. The thermo-coupler type of hot wire ammeter is ideal because it is quite accurate and indicates rapidly. Straight hot-wire ammeters are very sluggish.

The following is a list of ranges desirable for different-sized sets:

Up to 5 watts—range 0—1 A to 0—1.5 A.
10 watts—range 0—2.5 A.
20 watts—range 0—5 A.
50 watts—range 0—5 A.

A little patience will be required in first setting up the set and getting it to oscillate. Some kind of a wavemeter should be procured to aid the tuning. The diagrams show the approximate positions of the different taps. The experimenter will usually find that his first adjustment is too high in wavelength. Work down on the antenna taps and adjust the others for maximum radiation as you proceed. Follow with the wave meter. Continue this process until you are down to 200 meters or slightly less. Then adjust again for maximum radiation, leaving the antenna or ground clip where it was. In some cases it will be found that the set will not go down to 200 meters. In that case it will be necessary to place a series condenser in the ground lead. The use of a counterpoise in place of a ground, because of its lower resistance will generally increase the radiation. Using both the ground and the counterpoise will increase the radiation still more. In this case it is necessary to either tune the ground to the counterpoise or the counterpoise to the ground. This will require the use of either a condenser or an external inductance, depending on which is being tuned to the other, and which has the greater natural period with the antenna. No definite directions can be given because no two conditions are alike. A certain amount of experimentation will be necessary.

In the next article the author will take up the problem of obtaining a suitable high voltage plate supply. Several methods will be described and directions will be given for the construction of a transformer and rectifier.

In the meantime the reader can use a few *B* batteries. Ordinary a.c. can also be supplied to the plates for C. W. transmission. If a.c. is used some kind of a transformer, other than an auto-transformer, should be used. This we shall call an insulating transformer. One side of the lighting supply is grounded and it is obvious that if the other side should be connected to a grounded portion of the oscillator trouble would ensue. A step-up transformer is to be preferred if its secondary voltage is not over 500 volts. Never try to use a step-down transformer inverted, in an attempt to get a step-up. Something is sure to burn out. For 50-watt tubes voltages up to 1000 may be used.

If you are just starting C. W. we advise the use of 5-watt tubes. You can learn just as much, have just as much fun, work far enough, and save considerable money. Only those with considerable experience should play with 50-watt tubes. The voltages are quite high, and renewals are quite costly.

NEWS OF THE BROADCASTER

Continued from page 37

Coast, ship, or land stations	£1
Broadcasting, transmitting	£15
Broadcasting, receiving	10/-
Dealers' license	£1
Experimental transmitting & receiving	£1
Experimental receiving only	10/-
Portable license	£1

The fees for the reception of broadcast will be in addition to the subscription payable to the broadcasting stations licensee. The term for which the broadcasting transmitting license will be issued is five years, renewable annually thereafter; and that for a receiving license, one year.

A guarantee of £1000 will be required from the broadcasting licensee that he will begin broadcasting within six months, or of such extension of time as may be granted, and that he will maintain a satisfactory service for the duration of his license.

Conditions under which the broadcasting license is issued provide that the licensee shall not:

(a) transmit any work or part of a work in which copyright subsists, except with the consent of the owners of the copyright.

(b) send out news obtained, collected, collated, or co-ordinated by any newspapers, or any newsagency, or service, except with the consent in writing, of, and upon such payment and conditions as are mutually agreed upon by the licensee and the newspaper, association of newspapers, agency or service.

To insure that the broadcast receiver will not receive from any other station than the one to which he pays a subscription, the receiving apparatus must be so constructed that it will only receive one wave, the one of the particular station licensed for. Also, it must be so encased that the user cannot alter the adjustments of it without breaking seals.

Owing to the rather stringent nature of the regulations, those holding experimental licenses have formed the "Relay League of Australia," which is to be run on similar lines to that of the A.R.R.L., with which the young league will be affiliated.

The government looks upon the league favorably, and it is suggested that this body is to have charge of the policing of the ether, and it will doubtless follow that only those recommended by the league will be granted experimental licenses. A technical examination will have to be passed by the applicant in any case before his license will be granted.

LETTERS TO THE EDITOR

Continued from page 36

Confirmation of New Zealand Tests

Sir: Being a commercial operator, I was very skeptical at the results obtained by some of the New Zealand amateurs, who claim to have heard American amateurs when using only one tube. As I am attached to a vessel that trades between America, New Zealand and Australia, I set out to try and duplicate their performance. My receiver consists of a single circuit, single tube arrangement that is very common among amateurs. As a test, I listened nightly to KFI (Los Angeles) and, with the exception of two nights when static or commercial working rendered the reception of this station impossible, I was able to recognize and enjoy its programs until over 4,000 miles distant. My log for June 20th reads: Noon position 15 degrees 46 mins. South latitude 165 deg. 58 mins. west longitude. At 8 P.M. my QRB from KFI was 4,180 miles.

10:15 P.M., talk. 10:28, song (man); announcer used the words "At the Steinway." 10:35, song (lady). 10:40, song, "Back home in Carolina." 10:43, piano solo. 10:45, song (jazz song). 10:50, announcement "Radio KFI radio central station, etc." 10:51, song. 10:55, piano solo. 10:57, song. 11:00, announcement about the Ambassador Hotel coming on by remote control. 11:04, Coconut Grove orchestral selections.

On June 25th was 5,346 miles off KFI and one of the junior engineers listened with me and enjoyed the music which was rather weak. The announcements did not carry as well as the music, and static interfered with reception.

This vessel arrived at Auckland, New Zealand, on June 27th and, owing to discharging freight, it was necessary to lower the aerial, thus preventing further testing in Auckland.

On July 7th we left Auckland for Melbourne (Australia) and I was able to hear KFI on July 7th, 8th and 9th. This was the last day upon which I was able to identify this station, the ship being then 6,326 miles from Los Angeles. This is not the record distance that KFI has been heard, a brother commercial operator having heard him when slightly over 6,600 miles from him. This was also accomplished on one tube.

Having had this success, I am convinced that the amateurs have done the distances they have claimed. There is nothing special about my set, only that every control has a vernier adjustment. Good 'phones have more to do with DX reception than most hams imagine.

Yours faithfully,
COMMERCIAL OPERATOR

San Francisco,
Sept. 27, 1923.

CALLS HEARD

Continued from page 46

At 6CLZ, Edward Doell, 2131 Grant Street, Berkeley, California

All C. W.: 5lr, 5mn, 5zav, 6acg, 6adb, 6adh, 6adn, 6age, 6ags, 6ahc, 6ahw, 6ald, 6alu, 6apw, 6avp, 6avr, 6bah, 6bbc, 6bbh, 6bbq, 6beg, 6bel, 6beq, 6bfh, 6bgc, 6bh, 6bip, 6bjq, 6bjy, 6bka, 6boo, 6bpz, 6brf, 6brs, 6bsn, 6buo, 6bv, 6bve, 6bvg, 6bvs, 6bwb, 6bwl, 6cas, 6cbu, 6ceu, 6cfl, 6cfm, 6cfy, 6cfz, 6cga, 6cgd, 6cgi, 6cgw, 6chv, 6chz, 6cid, 6ckh, 6cmr, 6cmu, 6cmv, 6cna, 6cnc, 6cnh, 6cnl, 6cm, 6en, 6eo, 6hv, 6mh, 6om, 6pl, 6qg, 6rm, 6tw, 6us, 6uo, 6zam, 6zar, 6cmx, 7abs, 7acl, 7adf, 7adm, 7adp, 7adr, 7ads, 7age, 7agv, 7afe, 7aho, 7ahv, 7aip, 7ak, 7akv, 7br, 7ge, 7gi, 7go, 7hf, 7io, 7it, 7iy, 7je, 7ln, 7lr, 7ly, 7nl, 7nn, 7pj, 7qj, 7sf, 7sy, 7tk, 7tq, 7tt, 7ut, 7ud, 7wm, 7wp, 7wx, 7zd, 7zl, 7zn, 7zu, 7zz, 8gh, 9aau, 9avz, 9bun, 9caa, 9cfy, 9ip, 9cvc, 9daw, 9dli, 9eky, 9zt.

Can.—4cl, 5go.

Daylight: 6adm, 6ael, 6ahq, 6brf, 6cgd, 6cjv, 6cmt, 7tq. All stations heard on 1 tube Reinartz and small aerial. Anyone wishing check on their sigs pse qsl crd; all crds answered promptly.

By 7AHB, Layton Schell, Anchorage, Alaska

Can.—3nl, 4hf, 5cn, 5ct, 5eb, 5go, 9aua, 9bd (spark), 9bp, 9cj.

U.S.A.—1er, 2brb, 3bva, 3bv, 4ft, 5ado, 5ah, 5akn, 5aqv, 5ga, 5gp, 5hl, 5in, 5kc, 5ll, 5lr, 5mn, 5ns, 5qq, 5qu, 5za, 5zav, 6abk, 6age, 6aos, 6awh, 6atc, 6ame, 6avf, 6aqu, 6ajf, 6ajh, 6ams, 6ao, 6aoc, 6ar, 6arb, 6aty, 6avv, 6awt, 6bov, 6buo, 6bbc, 6bcl, 6bgy, 6bfh, 6bjq, 6bmd, 6brf, 6buy, 6bvg, 6bwp, 6cbu, 6ccu, 6cf, 6cfi, 6cfy, 6chl, 6chr, 6ckf, 6cpz, 6cv, 6cvg, 6cai, 6cbd, 6cq, 6dd, 6et, 6fd, 6fy, 6gc, 6gr, 6hp, 6ii, 6ka, 6km, 6mf, 6nb, 6no, 6pl, 6rm, 6tu, 6tv, 6vk, 6xad, 6zi, 7abs, 7adp, 7ads, 7aeb, 7afe, 7afo, 7ag, 7agi, 7agv, 7ahi, 7aho, 7ahv, 7aih, 7akk, 7akt, 7akv, 7ak, 7bc, 7br, 7bj, 7ca, 7cf, 7cr, 7dc, 7eb, 7ei, 7fd, 7go, 7gp, 7hg, 7ih, 7iy, 7je, 7kv, 7ld, 7lh, 7lr, 7ly, 7na, 7nn, 7oh, 7qj, 7qy, 7rb, 7rc, 7sa, 7sn, 7to, 7wip, 7wm, 7ws, 7xi, 7yl, 7zd, 7zf, 7zu, 7zz, 8apt, 8ctp, 8cp, 8qw, 8yv, 9avv, 9aus, 9axx, 9ban, 9bj, 9bsh, 9bqy, 9caa, 9chc, 9cvc, 9cvs, 9czw, 9daw, 9dli, 9dqu, 9dqv, 9eea, 9ekf, 9eky, 9gk, 9nu, 9vm, 9zg, 9zt, 9zy.

By 6CEE, 2849 Garber St., Berkeley, Calif.

Can.—5go, 5cn, am, 6adn, 6adt, 6mfg, 6ahu, 6ahz, 6aiv, 6ajd, 6aoh, 6aph, 6asa, 6bah, 6bbh, 6beg, 6bih, 6biq, 6bjq, bkx, 6bmd, 6bmo, 6boo, 6bqe, 6brk, 6brf, 6bso, 6buh, 6buo, 6bvc, 6cas, 6cbi, 6cbd, 6ceu, 6cfl, 6cfz, 6cgq, 6chu, 6cgw, 6ckz, 6cnh, 6cnl, 6cwx, 6ec, 6fy, 6kj, 6hv, 6la, 6lu, 6oh, 6pl, 6rh, 6su, 6vd, 7aci, 7afe, 7ahv, 7aif, 7akv, 7ak, 7ca, 7ez, 7go, 7hh (sprk), 7lh, 7oh, 7om, 7sf, 7tt, 7tk, 7qy, 7zu, 7ii, 9bjk, 9bri, 9bxa, 9eky, 9lt.

Continued on page 94

THE FLIGHT OF YE BOILED OWL

Wherein an Old Question is Thrashed Out to an Unsatisfactory Result.

1.

Oh, this is the thing that's been worrying me,
Since the day that my fingers first pounded the key,
What shoveth the signals o'er mountain and sea
And Tickleth the Ham so he shouteth with glee
When he findeth his call raiseth WNP?
Is it the Aerial,
Or is it The Set?

2.

I have pounded my key on C. W. and Spark,
I have cards as far East as Asbury Park,
In other directions I've made a fair mark,
If more Hams were perchance on board ship to embark,
And would QSL cards, I'd be less in the dark,
But—is it The Aerial,
Or is it The Set?

3.

I once said to myself, I will write QST,
And inquire from the Powers as to which it can be,
That shoveth the signals o'er mountain and sea,
This question perplexing and puzzling to me.
Said the rest of the Hams, "We will all wait and see"
If—it's The Aerial,
Or if it's The Set.

4.

And by and by, the answer came;
I need not tell the writer's name,
For every ham can guess the same—
He's an old-timer at the game,
His home in Kansas he doth claim,
And this is what he said:

5.

"If you live in God's country, you don't need a set,
A first class antenna's by far the best bet;
For your ground, you should have a big wide-spreading net-
work of wires, and be sure they are always kept wet,
(You can see that C. W. had not arrived yet)
It's The Aerial,
More than The Set.

6.

"I have worked 8NH with a cart load of junk—
The set was a crime, and the meter was punk,
It drew a K W, and had not the spunk,
To tickle the meter, and this is no bunk,
Though for beauty the thing would most certainly flunk.
'twas The Aerial,
In spite of The Set."

7.

We read this advice, and we said, "It is good."
We lengthened our spreaders as much as we could;
Our poles that were made out of "two by two" wood
(On the tops of our houses they commonly stood)
Were out of the question—we agreed that we should
Put up towers, or high poles (if our Pa said we could)
And have Aerials,
To make up for Our Sets.

8.

But alas for our labors, alas for our hopes,
When we got our antennas pulled up by the ropes,
And thought we'd be heard by both Kaisers and Popes,
Along came broadcasting (abominable fashion).

Coto

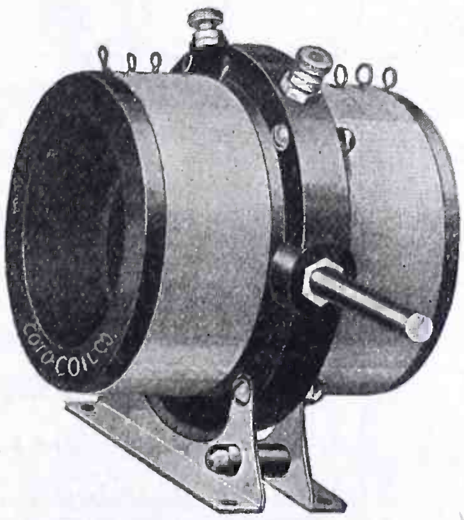
"Built First to Last"

You Double the Real Fascination of Radio

when you *build your own set*. You find it comparatively easy to equal and usually surpass the best results from your neighbors' expensive ready made sets. And what a thrill to reach out hundreds of miles across hill, stream and mountain range perhaps and bring in the distant stations in full rich volume. All this with your own personal set! It's a triumph you'll talk about.

Demand Coto! Get Coto!

If your dealer does not yet stock Coto Radio Apparatus, write us giving his name. We will see that he supplies you.



New Coto Compact Moulded Bakelite VARIOCOUPLER

Especially designed to handle wave lengths from 200 to 600 meters and to supply the nation wide demand for compactness and portability in radio sets. Size only 3¼ x 3 x 3¾ inches. Mounts on panel or base. Ask your dealer to let you see and handle it. Type 9000. $5.50.

DEALERS! JOBBERS!

Your customers are already sold on Coto Quality. All you have to do is to display the Coto line and sales volume will astonish you. Write for folders and latest price lists.

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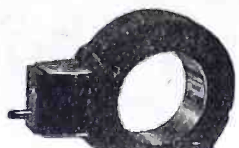
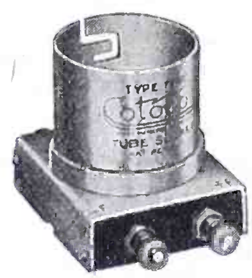


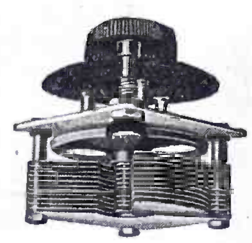
The Original Coto Honeycomb Wound Radio Inductances

Popular low priced favorites of the amateur and experimenter. Allow easy variation of set for all wave lengths. Sold mounted or unmounted.



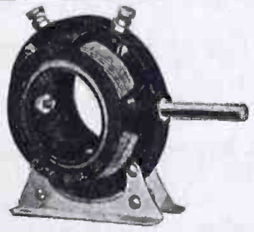
Cotogrip Tube Socket

Has unique double positive grip of tube terminal posts. Best hard rubber insulation. Type 7000. 85c.



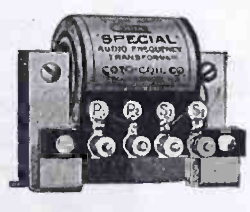
Coto Compact Air Condenser with Vernier

Only 2⅞ inches square. Rotor plates soldered to shaft. Stator plates soldered at three points. .0005, $5.00. .001, $6.00.



Coto Compact Moulded Variometer

Size only 3¼ x 1¾ x 3¾. In moulded bakelite. Stator is honeycomb wound. Range 200 to 600 meters. Base or panel mount. Type 8000, $5.00.



Coto Special Audio Frequency Transformer

Turn ratio of 3 to 1. Coto quality throughout but made to sell at a popular price. Type 4500, $2.50.

Coto Compact Audio Frequency Transformer

Compact and efficient. Handles large volume with uniform amplification and minimum distortion. Approved shell type. Ratio 5 to 1. Type 4000, $5.00.

We spark hounds were often with listeners clashing—
In fact, we were cussed all over the nation—
Our Aerials,
And also, Our Sets.

9.

To C. W. we've had our transmitters to change,
We've been pestered and kicked, and new waves they arrange;
Quiet hours they demand, and it will not be strange,
As a logical outcome of wrangling and friction,
To find ourselves tied by still more restriction.
To keep in the game, then, in spite of the ruction,
We'll keep after DX by still better construction!
In Our Aerials,
And also, Our Sets.

10.

For the day of bum sets, it is certainly past,
I'm afraid that the old times were too good to last;
No longer we dream of an Arlington mast,
Nor of huge buried grounds covering area vast,
On the spark set disgrace is continually cast
By Our Aerials,
And C. W. Sets.

11.

For although on our purses C. W. is tough,
And the life of a power tube is not half enough,
And we can't, for our lives, sell our ancient spark stuff,
A five or ten-watter is quite up to snuff,
And C. W. treats DX surprisingly rough
On Our Aerial,
And C. W. Set.

12.

If you find that you haven't abundance of cash,
And to China you're itching your signals to flash,
Through the ether choked up with the usual hash,
Your set must supply kick sufficient to mash
Through the ether between you with dot and with dash
From your Aerial
And C. W. Set.

13.

So the question of old, that we frequently stirred,
To dope out the answer, has now been transferred—
The "Hook-up" is now the all-powerful word,
(In my dreams, I have often attempted to murd-
er the guy who invented them)—Well, be it so!
In wireless, there's one thing I never shall know—
Was it The Aerial,
Or was it The Set?

14.

Spare the profane exclamation,
And the long interrogation,
When before your Royal Highness this peculiar scribble comes;
Guess it is a trifle woozy,
I'll admit, it may be boozy—
That's the natural condition of a bunch of wireless bums;
But a word of explanation
May make clear the situation:
Read the twelfth verse over carefully, as though you had a thirst,
Kick to Mash,
Dot and Dash—
In the list of new requirement, kick is bound to be the first. Q.E.D.

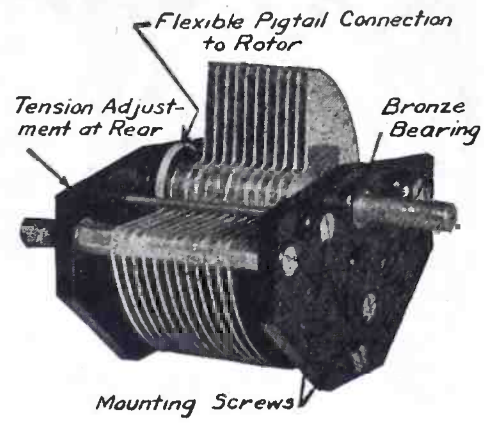
An Engineering Achievement

K & C NEW VARIABLE CONDENSER IS 100 PER CENT

THE day of the unstable variable condenser has passed. The Kilbourne and Clark Mfg. Co. hastened it and now have passed it. The new type K-C variable condenser is the answer. This condenser is the outcome of months of study of the faults of all variable condensers. It is the embodiment of all that is desirable. Objectionable, faulty features have been eliminated down to the most minute point.

The K-C variable condenser of the new type is mounted on two pure bakelite moulded end plates, this high grade non-hygroscopic insulating material preventing the leakage so common with cheap moulded substitutes. The shaft of the rotor plates revolves in bronze bushings that are moulded in. These bushings give a wear-proof permanent bearing that obviates enlarged shaft holes and resulting short circuits and explosive noises in the head phones. There are no sliding contacts. The rotor plates are correct connected with a lug by means of flexible Belden braid, affording a direct and positive contact.

The K-C vernier condenser comes with dial, correctly marked from 0 to 100, and a separate control knob for the vernier adjustment. The vernier is a two-plate extension on the condenser that has been designed to give the greatest breadth of movement in tuning in the faintest of signals.



View Showing Typical Construction

Kilbourne & Clark Mfg. Co.

Head Office & Works, Seattle

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Your Guarantee

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Cat. No.	Capacity	No. of Plates	List Price
3	.00003 mfd.	3	$2.50
7	.0001 mfd.	7	2.75
13	.0002 mfd.	13	3.25
17	.0003 mfd.	17	3.35
23	.0005 mfd.	23	3.50
31	.0007 mfd.	31	4.75
43	.001 mfd.	43	5.00
63	.0015 mfd.	63	7.75

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3/16 x 6 x 14	3/16 x 9 x 14
3/16 x 6 x 21	3/16 x 10 x 12
3/16 x 7 x 9	¼ x 10 x 12
3/16 x 7 x 10	3/16 x 12 x 14
3/16 x 7 x 12	3/16 x 12 x 21
3/16 x 7 x 14	3/16 x 14 x 18
3/16 x 7 x 18	3/16 x 20 x 24
3/16 x 7 x 21	¼ x 20 x 24

These are published for the benefit of amateurs who build their own sets. They include the standard sizes of other manufacturers.

HANDY HINTS ON RADIO

By D. B. McGOWN

A bit of paraffine, with a moderately warm soldering iron, will often help out in the form of an insulating "solder" where honeycomb, or bank-wound coils tend to fall apart.

Break up all wire clotheslines and chimney guys near a transmitting station, as they often absorb a large amount of energy.

Never try to send any faster than is comfortable to your hand. If you do, you'll lose more than you gain, as you will soon get "glass arm."

Gage glass, or other heavy walled glass tubing makes a first class lead-in insulator.

Remember, that when mixing battery acid from C. P. sulphuric, always pour the acid into the water, as otherwise it will "spit" and you may get a bad burn.

Don't cuss up the B.C.L. for his dumb-bell tuner (?). Give him a hand, and you'll probably gain a good friend instead of a sore-head.

Always remember that although sky-hooks are probably simpler, it is better to use too many guys to hold a pole up than too few.

Never give an OK for a message unless it is absolutely OK. You will do more harm in guessing than you will cause in QRM needed for another QTA.

If you connect a 150-watt lamp in series with your *B* battery and the amplifier, you'll not have fireworks if you happen to short the leads.

REFLEXING

Continued from page 14

flux is likely to collect. If it does not actually run or leak onto the panel, it is very easily thrown there by the hot soldering copper, which "spits" the flux in all directions in a fine spray, often not noticed while doing this kind of work. Use only the very best grade of varnished cambric tubing for covering the connection wire.

There is much worthless "insulating"

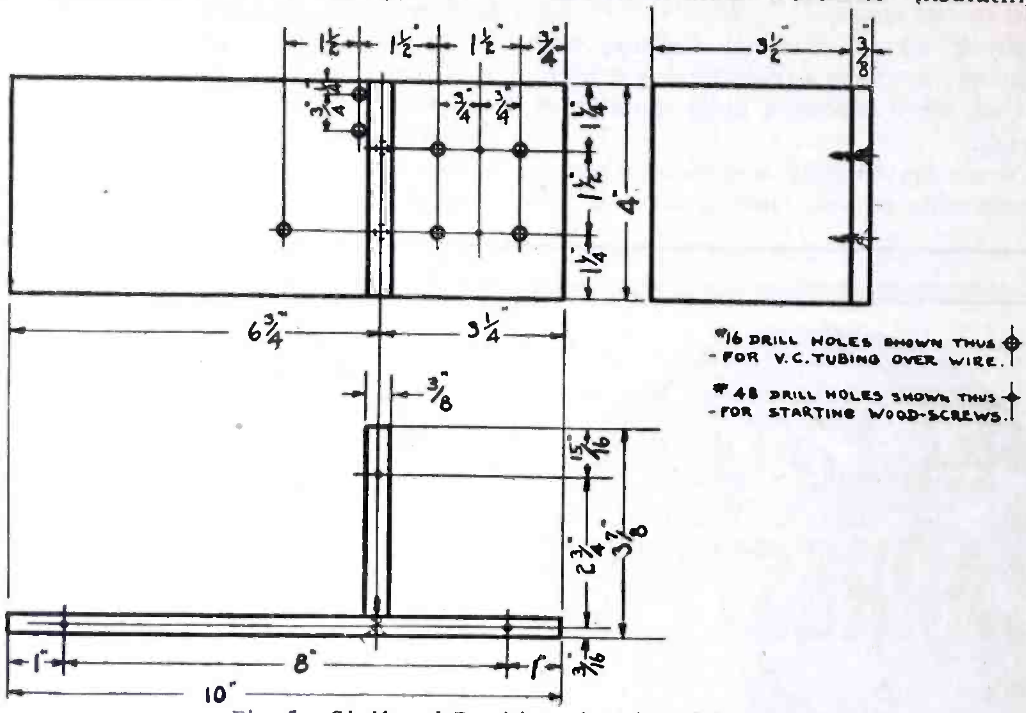

Fig. 5. Shelf and Partition of 3/8-in. Plyboard

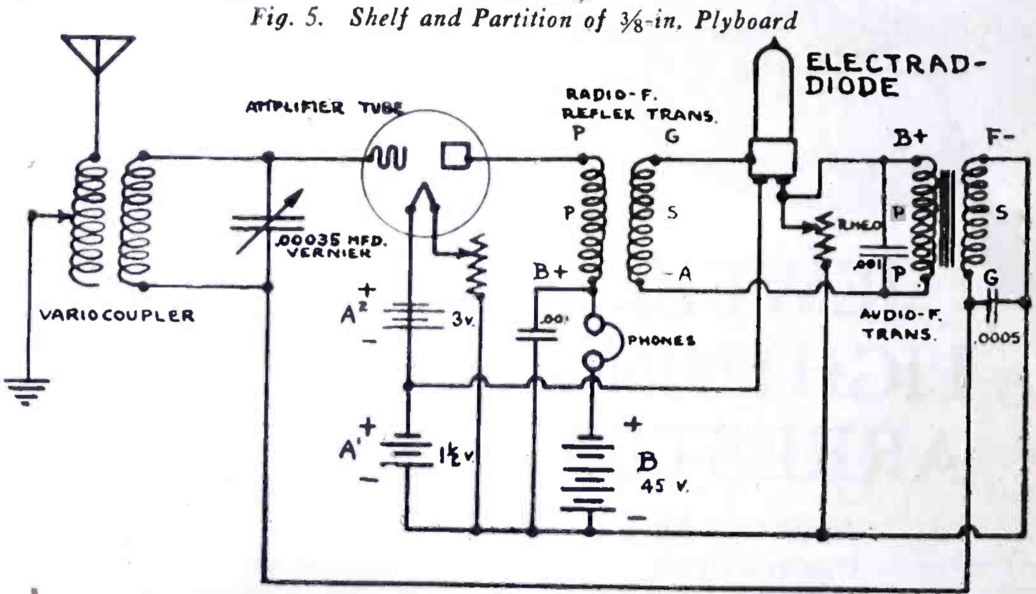

Fig. 6. Circuit Diagram for Set with Tube Detector

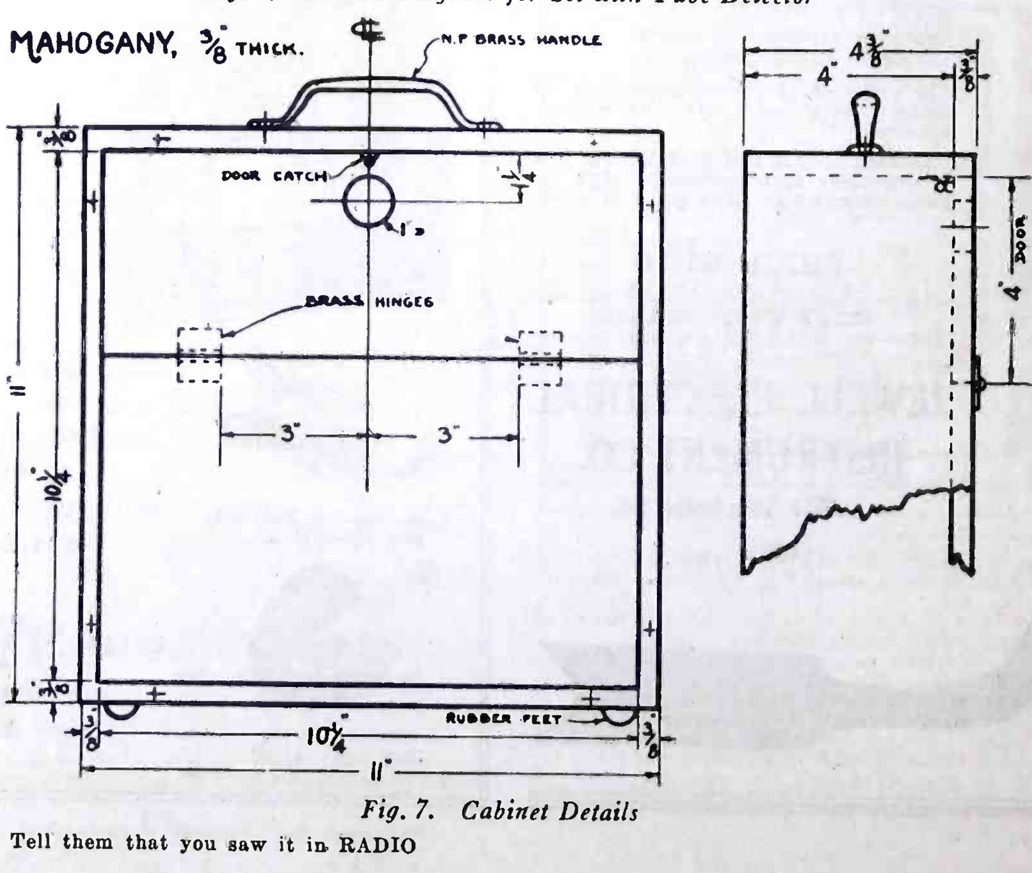

Fig. 7. Cabinet Details

tubing on the market, of no electrical value whatever, and this material should be given a wide berth. The actual leakage through this tubing can be measured with an ordinary battery and low reading voltmeter, and it should certainly be avoided in radio-frequency work. Good varnished cambric tubing can ordinarily be distinguished from the poor kind by the inexperienced person by the "feel" of it in one's hand. The poor grade always feels "clammy" and damp (which it really is), and the good grade feels like a well dried and hard coat of varnish, crisp and glassy. The gelatine coating on the poor tubing can easily be peeled off the cotton underbody, while the good grade of tubing will not peel. This point of obtaining good insulating tubing should be given the proper attention, as many instances of failure in various kinds of radio receiving sets lately have been traced to this cause.

Having finished the wiring of the set, next connect the *A* and *B* batteries to the loose leads left for this purpose, and place these batteries in their positions on the shelf. Now fasten the panel onto the front of the cabinet with the eight screws provided for the purpose, and insert the vacuum tube in its socket through the door in rear of cabinet. Place crystal in detector cup, plug phones into jack or connect same to two binding posts at right of panel, connect antenna to upper left post and ground to lower left. Now the set is ready for operation.

Listening-in with headphones, light up the vacuum tube with the rheostat till it reaches moderate brilliancy, and adjust crystal detector to hear static (if any), or, in the absence of static, a slight hiss will be noticed. Set variable condenser to about half capacity, and rotate vario-coupler rotor slowly one way and the other, switching from one tap to another at same time. If anything is "on the air" it will thus be picked up, and further adjustment of crystal detector and variable condenser can then be made to bring up the volume. It will be found that maximum volume can be obtained more readily with the vernier device on the variable condenser, after the signal has been once picked up, and while the filament temperature of the vacuum tube does not require fine adjustment, it should be of course burned at the lowest value in keeping with maximum volume, when maximum volume is desired, otherwise it is more advisable to cut down on volume by reducing filament temperature, than by "detuning."

If it is desired to eliminate the crystal detector, which of course requires adjustment, if it is a real sensitive one, the circuit shown in Fig. 6 may be employed, everything being the same, except for the substitution of an Electrad-Diode tube in place of the crystal detector. This will not accomplish any increase in volume, sensitivity, or distance, but will avoid the necessity of crystal adjustment, and, unlike the crystal, is not subject to being "knocked out" of adjustment by heavy bursts of static or mechanical shocks, jars, or vibration. This tube and its socket may be mounted beside the U.V.199 on the same shelf, can be fed by the "end cell" of the same battery (it requires only 1½ V. on filament) and can be controlled by a five or six-ohm rheostat mounted behind the panel on a level with the tube itself. No *B* battery is required on this tube, for, as its name implies, it is a two-element tube, similar to the Fleming Valve, and can not be used as an amplifier.

After the set has been placed in operation, the user should experiment with various fixed condenser values as by-passes across the primary and secondary of the audio-frequency amplifying transformer, as various equipment will give best results with different values. If the user is interested in getting the very best out of his set, condensers of .00025 mfd., .0005 mfd., and .001 mfd. should be tried in place of .002 mfd. condensers shown in diagram. It does not necessarily follow that if .001 mfd. gives best results across the primary, that the same value should be used across the secondary, but various combinations should be tried. A few moments spent attending to this detail will more than repay the experimenter for his trouble.

In mid-summer, this set, using crystal detector, brings in the Chicago broadcast stations at the New York laboratory clearly on the headphones (about 800 miles) and Schenectady is brought in on the loud-speaker (about 150 miles). In these experiments, the Western Electric loud-speaker No. 10-D was used, operating direct from the set without the use of any amplifier unit. Local broadcast reception is very successful on cheaper types of loud-speakers, and it is often only necessary to clamp the headphones onto a horn fitted with a bifurcated throat in order to get the local stations with perfect loud-speaker satisfaction.

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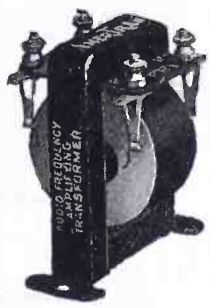

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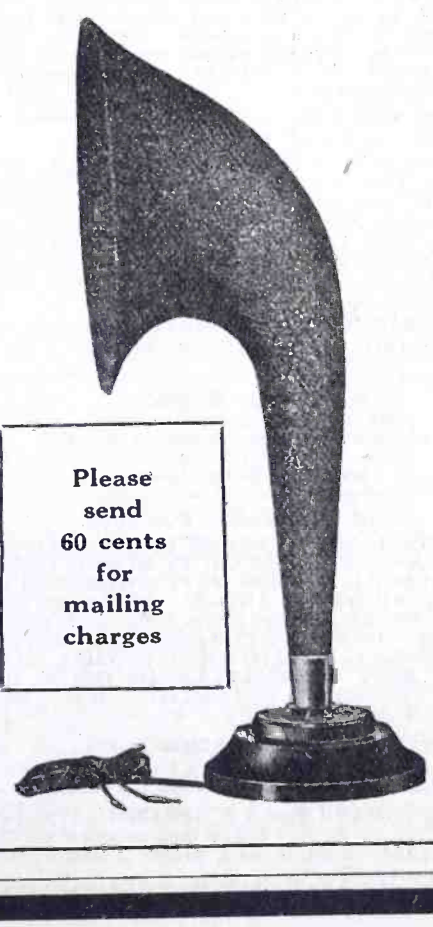

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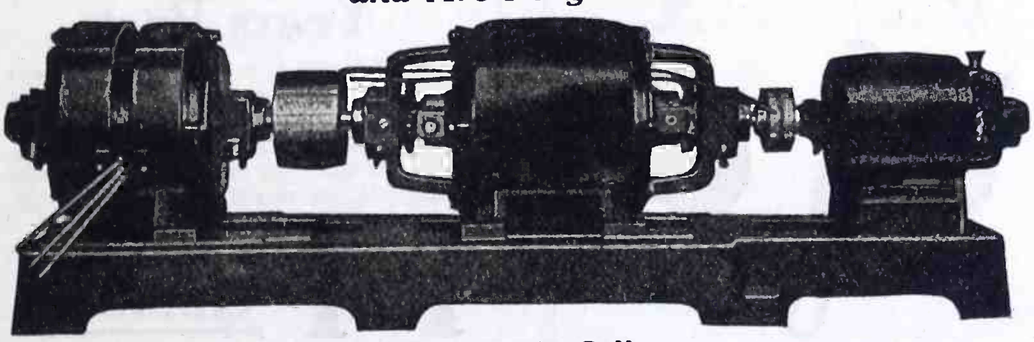

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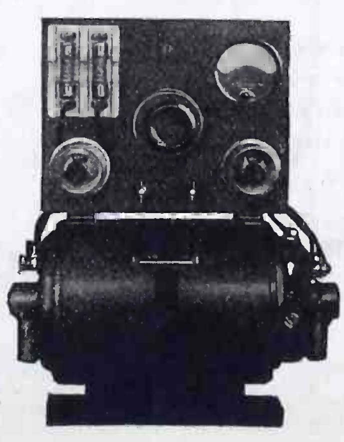

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Continued from page 81

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5ct, 6ea, 6km, 6om, 6pl, 6ags, 6aho, 6beg, 6beq, (6bgc), 6bgv, (6biq), 6bjq, (6bks), 6blv, (6bpz), (6brf), (6brk), 6bvx, 6cbu, (6cfz), 6cfy, (7bj), 7eb, 7go, 7gw, 7hr, 7io, 7iy, 7kj, 7lu, 7mf, 7nn, 7pj, 7wm, 7ws, 7zf, 7zl, 7zm, 7ads, 7agv, 7bdw, 9amb, 9bjk, 9bum, 9ceu. Anyone hearing my 5-watt C. W. and fone, pse qsl crd and qrk. All crds answered.

By 7VF, 419 N. 12th St., Corvallis, Ore.
1bbo, 1bcg, 1bwj, 2afp, 4dn, 4ku, 5aag, 5ado, 5ae, 5afq, 5ahd, 5akn, 5dw, 5ek, 5hl, 5lg, 5lr, 5mn, 5qq, 5sk, 5uo, 5zas, 5zav, 5zax, 8ajh, 8amm, 8apt, 8apy, 8bci, 8bda, 8blx, 8cur, 8dat, 8dha, 8dkm, 8hv, 8ju, 8kg, 8wa, 9aar, 9aau, 9aaw, 9ae, 9aic, 9aim, 9amb, 9aoa, 9apf, 9aus, 9auu, 9auw, 9avu, 9avz, 9awm, 9axx, 9baf, 9ban, 9bav, 9bbr, 9bhd, 9bjk, 9bmx, 9bqq, 9bsq, 9bun, 9bxa, 9bzi, 9caa, 9cbj, 9ccs, 9ccz, 9cdv, 9cfy, 9ckw, 9cld, 9cr, 9cvc, 9cvs, 9ddp, 9dgv, 9dis, 9djq, 9dky, 9doc, 9drk, 9dsw, 9ebt, 9eea, 9ekf, 9eky, 9gd, 9ir, 9lz, 9nu, 9ox, 9ql, 9qr, 9ve, 9ym, 9zg, 9zt, 9zv.
Can.—3ge, 3ni, 3xn, 4cl, 4dq, 4er, 4hf.

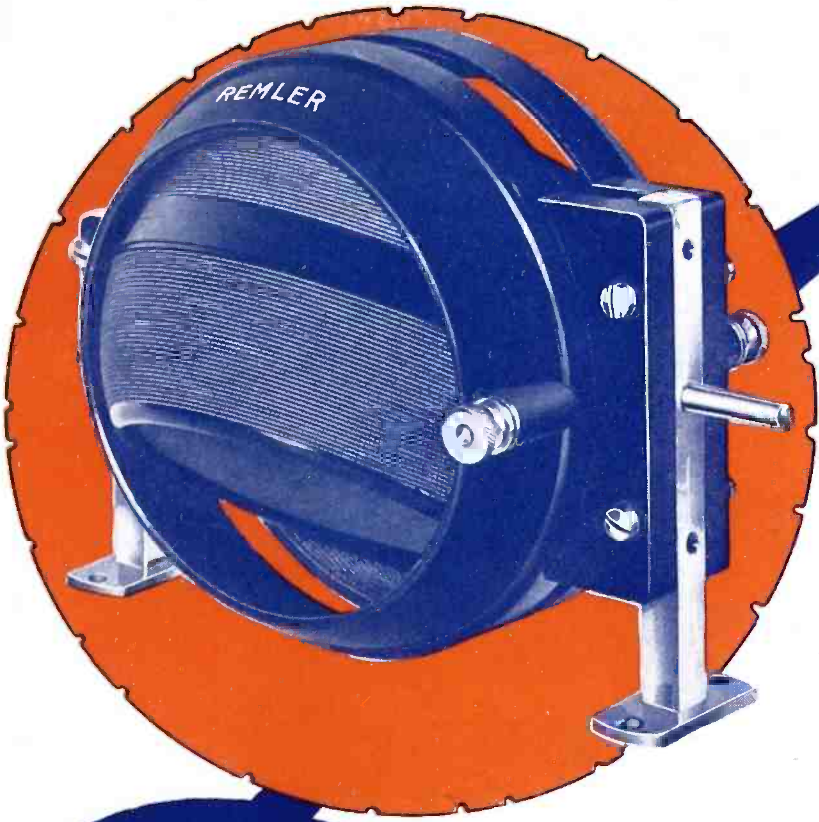
At 3ADI, Allen R. Muncey, 659 N. Markoe St., West Philadelphia, Penna.

1aao, 1abw, 1aby, 1aco, 1acu, 1ain, 1ajp, 1ajt, 1ana, 1anj, 1amr, 1arp, 1aur, 1avk, 1bbo, 1bcg, 1bga, 1bgc, 1bns, 1bom, 1bwj, 1cmp, 1cmx, 1con, 1cou, 1ckp, 1cpn, 1crw, 1cue, 1aw, 1ef, 1fb, 1fq, 1gk, 1hx, 1ii, 1kx, (1rr), 1sn, 1ts, (1uj), 2acd, 2acu, 2agb, 2agd, 2ahm, 2apd, 2aql, 2avg, 2awh, 2bim, 2bir, 2bmr, 2bnc, 2bnz, 2bqd, 2byc, 2byv, 2cdq, 2cee, 2cei, 2cfb, 2cim, 2cjp, 2cmk, 2cnk, 2cor, 2cph, 2cpq, 2cqd, 2cqz, 2cvu, 2cwp, 2au, 2be, 2by, 2fp, 2gk, 2iu, 2rb, 2rg, 2wa, 2wr, 3ahp, 3ajg, 3atg, 3bdo, 3blf, 3bof, 3brf, 3buc, 3bva, 3cbm, 3cdk, 3cfv, 3gy, 3iw, 3lk, 3mo, 3mu, 3oh, 3su, 3tj, 4ai, 4dn, 4eb, 4mb, 4om, 4qf, 4rx, 5ab, 5dw, 5ek, 5hk, 5hl, 5hp, 5mo, 5zas, 5zav, 5zk, 6ka, 6zh, 7adp, 7ha, 8adk, 8aeg, 8ago, 8agp, 8alf, 8amm, 8anp, 8apt, 8apx, 8apy, 8aqd, 8are, 8asv, 8ath, 8ats, 8aux, 8avd, 8awf, 8awp, 8axn, 8azp, 8bah, 8bbf, 8bci, 8bcu, 8bda, 8bdo, 8bhf, 8bkb, 8bky, 8bkz, 8bln, 8bno, 8boa, 8boe, 8boi, 8brm, 8bsi, 8bsx, 8bum, 8bux, 8bwp, 8bwz, 8byu, 8ccq, 8ccr, 8ccx, 8cej, 8cfe, 8cfs, 8chg, 8cjy, 8clk, 8cmt, 8cnw, 8con, 8opo, 8cpp, 8crw, 8csj, 8cth, 8ctp, 8cux, 8cwu, 8czd, 8czk, 8czz, 8dcz, 8djh, 8dkc, 8dki, 8dkm, 8dku, 8dkz, 8dla, 8dsa, 8dsv, 8ab, 8al, 8bf, 8ef, 8en, 8es, 8fm, 8gh, 8hn, 8hv, 8ij, 8kg, 8kh, 8kj, 8kr, 8pd, 8pj, 8px, 8rg, 8rj, 8rv, 8se, 8sr, 8th, 8tt, 8uk, 8un, 8ut, 8up, 8vm, 8vq, 8vt, 8xae, 8xan, 8zae, 8zo, 8zr, 8zz, 9aau, 9aaw, 9aen, 9aps, 9arc, 9aus, 9auy, 9awk, 9bac, 9bak, 9baz, 9bed, 9bmu, 9bov, 9bqq, 9brk, 9bze, 9bzi, 9cdu, 9che, 9cku, 9ctb, 9cui, 9dek, 9dhm, 9dhq, 9dis, 9dky, 9dro, 9dta, 9dtu, 9dzy, 9edo, 9efl, 9elf, 9eky, 9bc, 9cr, 9hw, 9lz, 9mc, 9mm, 9uq, 9uz, 9vm, 9vz, 9zg, 9zt, 9zv, 9zy.

Can.—1arff, 2bn, 3bp, 3co, 3ds, 3ge, 3he, 3ko, 3ni, 3oh, 3op, 3rg, 3tb, 3ty, 3xn, 3xx, 3yh, (3zs).

Spark: 1oe, 2om, 3acy, 8bda.

I would appreciate getting cards from those who hear 3ADI 5-watt spark coil C. W. qrk? Will gladly qsl cards to any of the above.



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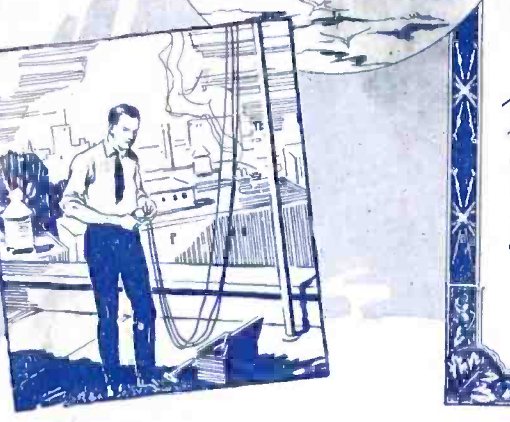

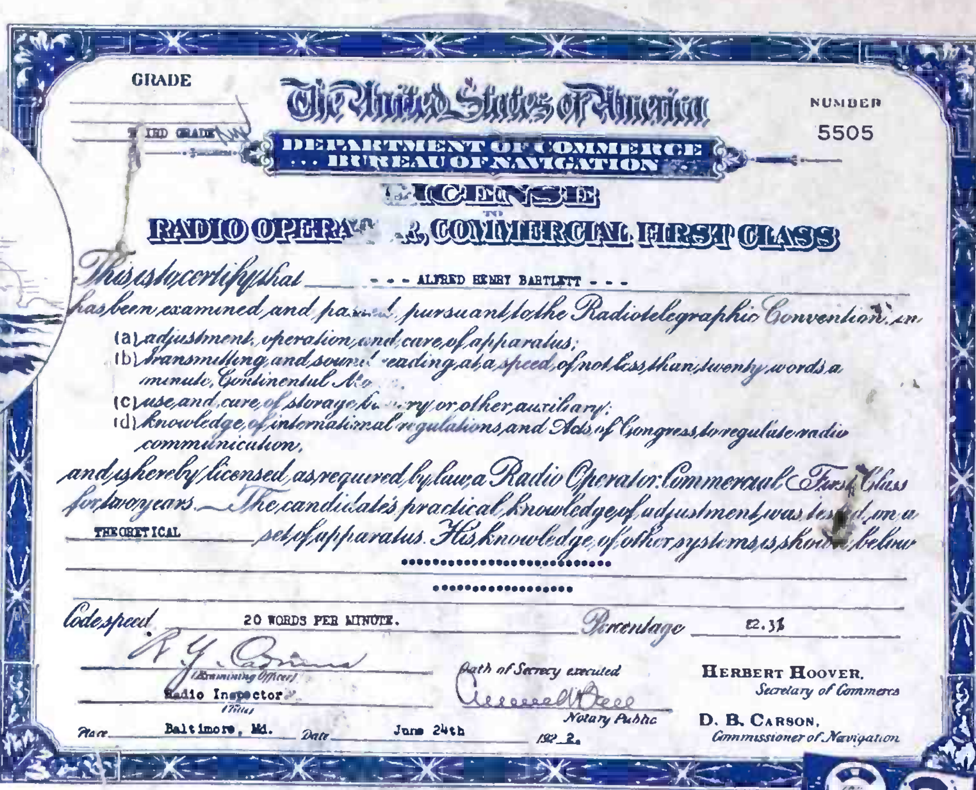

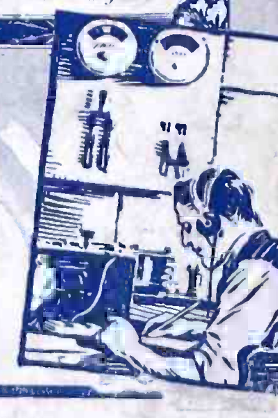

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Radio Auditor, $1,200 to $1,800 a year.
Radio Salesman, $2,000 to $10,000 a year.
Radio Engineer, $3,500 a year and up.
Radio Executive, up to $15,000 a year.
Radio Instructor $200 to $500 a month.
Radio Draftsman, $7 to $15 a day.
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Commercial Land Station Operator, $150 a month and up.
Broadcasting Station Operator, $125 to $250 a month.

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W. W.
St. Louis, Mo.

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