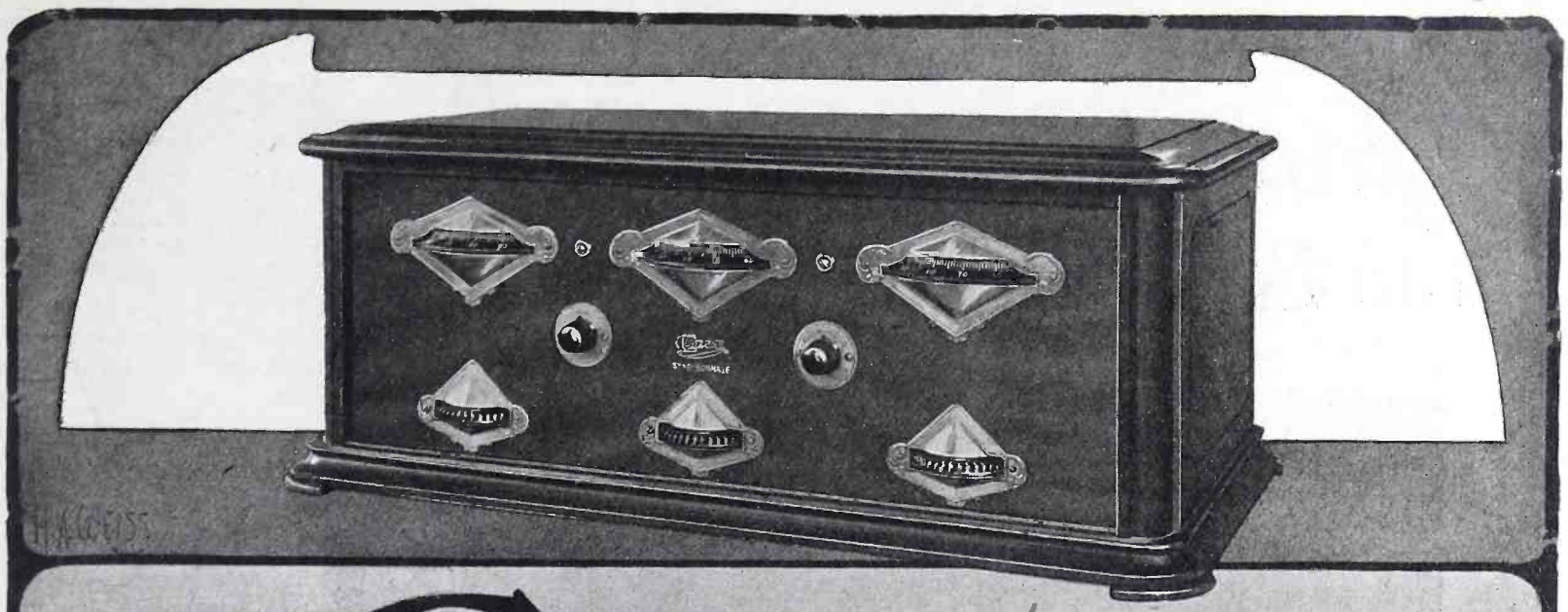
Oct 1924



GREBE

SYNCHROPHASE

TRADE MARK

"If a house is crammed with treasures of gold and jade, it will be impossible to guard them all."

—Lao Tzu

Of worth far greater than things of gold and jade is your Grebe Synchrophase. Highly will you treasure it; zealously will you guard it.

Doctor Iffy

THE high degree of selectivity and over-all efficiency attained in the design of the Grebe Synchrophase is rivalled only by its rare craftsmanship and thorough ease of dependable operation.

Write for literature

A. H. GREBE & COMPANY, INC.

Van Wyck Blvd., Richmond Hill, N.Y.

Western Branch: 451 East 3rd St., Los Angeles, Cal.

GREBE RADIO

TRADE MARK
REG. U.S. PAT. OFF.

All Grebe apparatus is covered by patents granted and pending.

MAGNAVOX Radio
BROADCAST RECEIVER

The new Magnavox TRF-5 Receiver is here shown with Magnavox M4 Reproducer, ($25.00) which insures clearest tone.

The long awaited Broadcast Receiver

Combining supreme efficiency, convenience and beauty, produced at a low cost which brings it within reach of all.

HERE at last is the perfected instrument permitting you to enjoy *simultaneously* the most desirable elements of broadcast reception—features which no one model ever combined before.

The distinctive Magnavox tuned radio frequency circuit is characterized by exceptional clearness and volume as well as selectivity. The Magnavox Unit Tuner does away with all complicated dialing and places the novice on the same footing as the radio expert.

Magnavox Broadcast Receivers and other Magnavox Radio Products are sold by reliable dealers everywhere. Write for new illustrated catalog.

THE MAGNAVOX CO., Oakland, Calif.

New York: 350 West 31st Street *San Francisco:* 274 Brannan Street

Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg

TRF-5

A 5-tube tuned radio frequency receiver consisting of two stages of tuned radio frequency of special design, detector and two stages of audio frequency.

Cabinet measures: height, 9⅝ in.; length, 20½ in.; depth, 14¾ in.

Without tubes, batteries or reproducer $125.00

TRF-50

This model is identical with TRF-5 but encased in larger carved cabinet with built-in Magnavox Reproducer.

Handsomely carved cabinet measures: height, 14¾ in.; length, 20½ in.; depth, 18¾ in.

Without tubes or batteries $150.00

GAROD

ANNOUNCES THEIR NEW POWERFUL NEUTRODYNE MODELS THE GEORGIAN AND THE V

The Garod Georgian

Rich brown burled walnut, with door-panel borders of inlaid ebony and holly —5 tube model—built-in loud speaker—battery compartments and accessory drawer. Will grace the finest drawing room—provide the best in radio reception. Size 35½" long—16⅝" deep—42½" high.

$400.00

The public wants **Power**

Power—to produce great volume.

Power—to bring in distant stations.

Power—to work through local stations.

Power—to moderate or intensify volume.

Power—to render the original quality of tone transmitted.

Power—to select programs.

Power—to get the best out of the program.

The Garod V

Genuine mahogany highly finished cabinet—graceful 15° sloped genuine mahogany panel—carved feet—five inch dials—double reading Weston volt-meter—5 tube model. Size 34⅜" long—13¾" deep—11⅜" high.

$195.00

These models have power plus—and then more power. They are full voiced—with tonal quality of exquisite timbre. They can be controlled to meet the capacity of the small living room, or manipulated to take full advantage of the acoustic possibilities of the large hall.

In every respect, they are worthy of bearing the name GAROD.

The Garod RAF

The receiver that made GAROD famous. Added mechanical improvements — 4 tube model — with which you are familiar. Size 19½" long—7⅞" deep—10" high.

$135.00

We are now ready to enter orders, and grant jobbers of standing, exclusive non-conflicting territories, where open.

GAROD LICENSED BY INDEPENDENT RADIO MANUFACTURERS INC.
NEUTRODYNE
UNDER HAZELTINE PATENTS NOS. 1490,080 AND 1497,218 OTHER PATENTS PENDING
TRADE MARK REG. U.S. PAT. OFF.

SEE OUR EXHIBITS AT

First Radio World's Fair
Madison Square Garden, New York
September 22 to 28, 1924

Third Annual Chicago Radio Show
Coliseum, Chicago, Ill.
November 18 to 23, 1924

The GAROD *Corp.*
120 Pacific Street, Newark, N. J.

WHEN you buy a Crosley it means that you have obtained the greatest amount of radio receiving efficiency for the least money. Every Crosley is a leader in its line.

Crosley makes and sells more radio receivers than any other manufacturer in the world because, in new invention, new simplified devices, and new ways and means of giving greater radio value at a lower price, Crosley continually leads.

You are always assured of the most satisfaction for your money when you buy a Crosley.

For Sale By Good Dealers Everywhere

Crosley owns and operates Broadcasting Station WLW

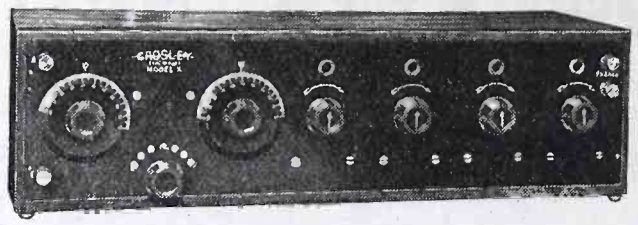
Write for Complete Catalog

THE CROSLEY RADIO CORPORATION

Powel Crosley, Jr., *President*

1019 Alfred Street **Cincinnati, O.**

Tuned Radio Frequency Receivers



Crosley Model X-J, $55.00

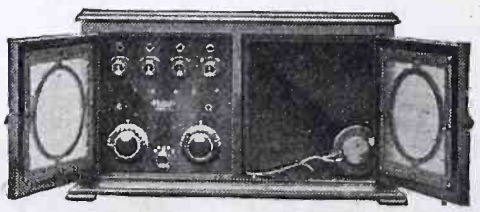
The famous Crosley four-tube receiver consisting of one stage of radio frequency amplification, detector and two stages of audio frequency amplification. Probably the greatest single feature of this receiver is its remarkable selectivity. It will tune through powerful local broadcasting stations and bring in distant stations clearly and with great volume. One of the most popular receivers on the market today.

Crosley Model VI, $24.00

A two-tube receiver with a reputation for long distance with pronounced clearness. It consists of one stage of Crosley tuned radio frequency amplification and detector. This Crosley combination multiplies the receiving range of the set.

Crosley Super VI, $29.00

This two-tube receiver is so coupled up as to combine both the Tuned Radio Frequency amplification and the regenerative detector licensed under Armstrong U. S. Patent 1,113,149.



Crosley Model X-L, $120.00

This beautiful Consolette Model is an addition to any home. It is the same receiver as the Model X-J except as to arrangement of panel and the consolette cabinet with its built-in loud speaker and separate compartments for dry cell "A" and "B" batteries and other accessories.

Crosley Type 3-C, $110.00

This set does not contain Tuned Radio Frequency Amplification but is a three tube regenerative set licensed under Armstrong U. S. Patent 1,113,149. It is built into the same consolette case as the Model X-L.

A beautiful stand to match these two consolette models can be supplied at an extra cost of only $25.00.

Add 10% West of Rockies

Prices quoted are without Accessories

CROSLEY

Better-Cost Less Radio Products

Tell them that you saw it in RADIO

The PONY EXPRESS OF TODAY

DISTANCE covered in record time while all the world wondered. News received in one part of the country only a few weeks after it was sent from another. That was the pony express.

Today, news, messages, entertainment—all are instantly brought from all over the land right to your home by the Pony Express of the air—Crosley Radio Receivers. New York hears California. Florida listens to Hawaii. Canada converses with Mexico. North Dakota keeps in close touch with the MacMillan expedition at the North Pole. Such are the daily performances of Crosley Receivers as told by hundreds of unsolicited letters from happy users.

At bringing in distant stations in a clear, enjoyable manner, Crosley Instruments, each in its own class, have proven themselves unexcelled. Yet they are the lowest priced radio receivers ever offered.

For satisfactory results, real radio value, you can't beat a Crosley.

Listen In On A Crosley Before You Buy.

For Sale By Good Dealers Everywhere

The Crosley Radio Corporation

POWEL CROSLEY, Jr., *President*

1019 Alfred Street **Cincinnati, Ohio**

CROSLEY
Better-Cost Less
Radio Products

CROSLEY TRIRDYN 3R3 **$65**

The Trirdyn 3R3 incorporating radio frequency amplification, regeneration, reflex and additional audio frequency amplification will, with only three tubes, give performance equal to the customary four and five tube set. Will easily tune through local broadcasting to bring in long distant stations on the loud speaker.

Other Crosleys each a leader in its line.

One tube Crosley 50. The regenerative set with which Leonard Weeks of Minot, N. D., kept in almost daily touch with the MacMillan Expedition at the North Pole. Money cannot buy better radio value. . **$14.50**

Two tube Crosley 51. The little wonder regenerative set that in just 24 days became the biggest selling radio receiver in the world. Represents wonderful radio value **$18.50**

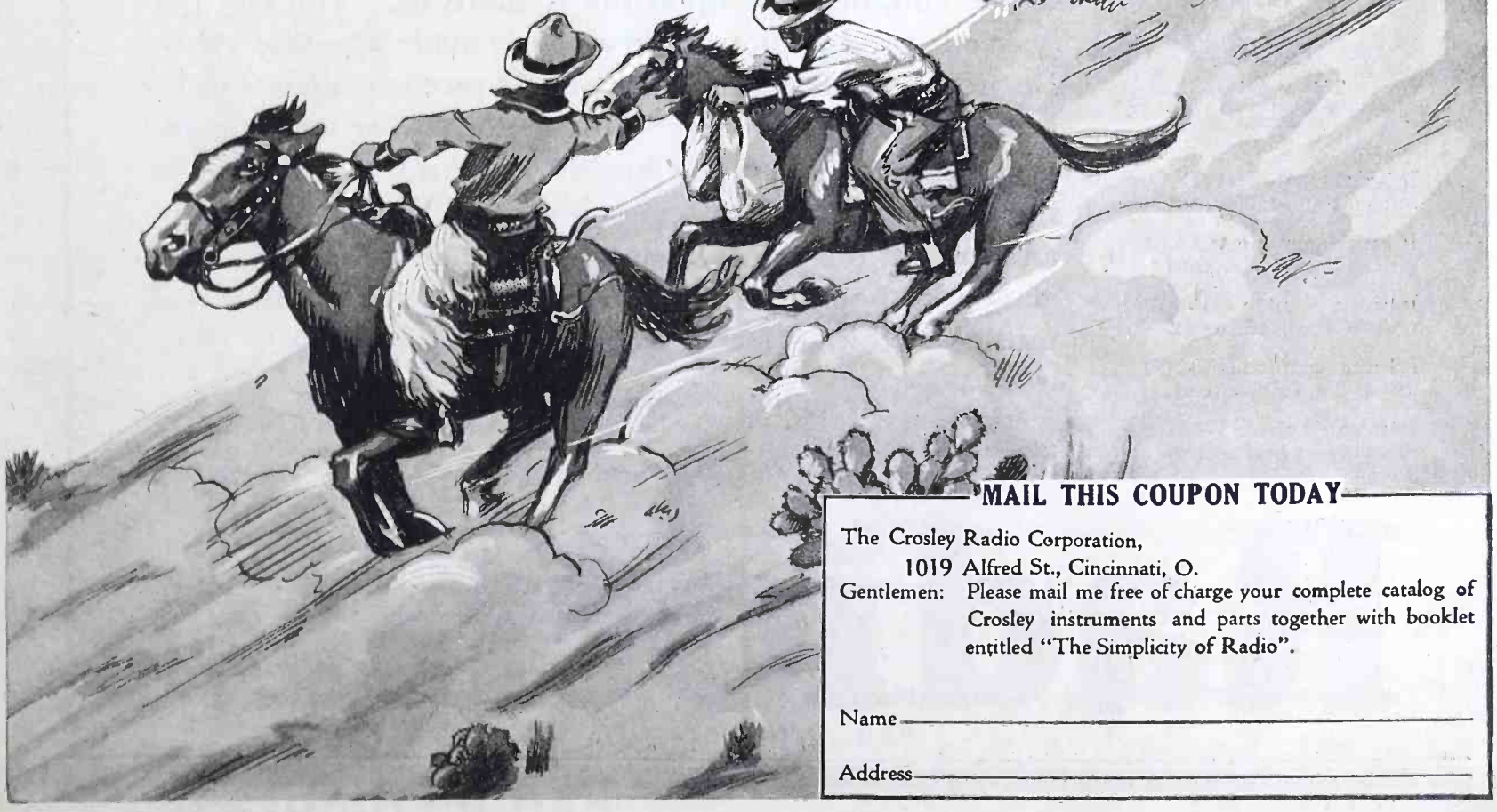
Three tube Crosley 52. This regenerative set consists of regenerative detector and two stages of audio frequency amplification. Gives loud speaker volume on distant stations under practically all conditions **$30.00**

All Crosley Regenerative Receivers licensed under Armstrong U. S. Pat. 1,113,149

The Crosley Radio Corporation owns and operates Broadcasting Station W L W

Prices as given are without accessories

For West of the Rockies, add 10%



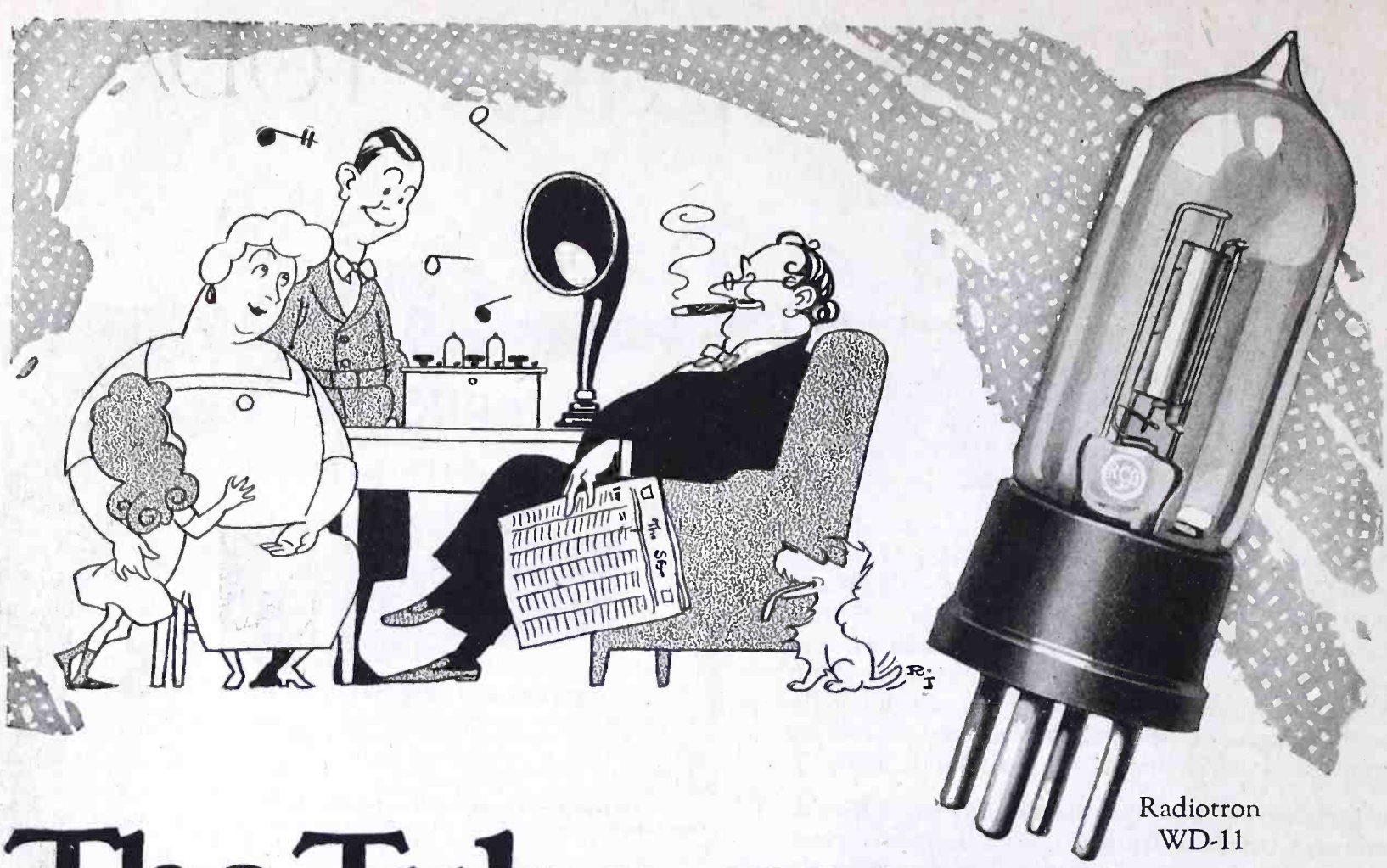
MAIL THIS COUPON TODAY

The Crosley Radio Corporation,
1019 Alfred St., Cincinnati, O.

Gentlemen: Please mail me free of charge your complete catalog of Crosley instruments and parts together with booklet entitled "The Simplicity of Radio".

Name _____

Address _____



Radiotron
WD-11

The Tube *means* Music or Noise

This symbol of quality is your protection

It isn't a genuine WD-11 unless it's a Radiotron.

It isn't a genuine WD-12 unless it's a Radiotron.

It isn't a genuine UV-199 unless it's a Radiotron.

It isn't a genuine UV-200 unless it's a Radiotron.

It isn't a genuine UV-201-a unless it's a Radiotron.

Buying anything but the best in vacuum tubes is like trying to run a car on gas that is half water. In radio, everything, in the end, depends upon the Radiotrons. You can put perfectly good Radiotrons in a poorly made set—that's true. But the point is that the very finest receiver made can be no better than its tubes. This is no new or startling announcement. Everyone knows it. And that's why, at the radio counter, you see each man pick up a Radiotron, and look at the base for the word "Radiotron", and at the glass for the "RCA" mark. For best reception — real music—nothing short of the best in tubes will do.

Radio Corporation of America
Sales Offices: Suite No. 510
233 Broadway, New York City — 10 So. La Salle St., Chicago, Ill.
433 California Street, San Francisco, Cal.

Radiotron

REG. U. S. PAT. OFF.

RADIO

Established 1917

Volume 6 OCTOBER, 1924 Number 10

Radiotorial Comment

THE success of any radio receiver depends upon the conservation and efficient utilization of the very small amount of energy picked up by the aerial, usually less than one-millionth of a watt. Unless there is a proper and delicate balance between the inductance and capacity in the circuit, unless the resistance is at a minimum, and unless the output impedance of the tubes match the input impedances of the transformers and 'phones or loudspeaker, much of the energy is wasted and ineffective in sound reproduction.

It is entirely feasible to calculate the proper values of these several factors so as to give the greatest efficiency for a selected band of wavelengths. Some receivers have been so designed, their constructional directions calling for certain values of inductance, capacity and impedance. Others just as well designed by the "cut and try" method likewise call for definite specifications.

The builders of home-made sets trustingly follow these directions and usually get good results. But, when they do not, they are often inclined to blame the circuit diagram for their lack of success. Although some diagrams are at fault, the trouble usually comes from some defective part, a wrongly-labeled condenser, an inductance coil with too many or too few turns, poor insulation, a high impedance transformer, a poor tube, or even an open circuit.

Such faults are likely to occasionally develop in the product of any manufacturer trying to keep up with the demand. The wonder has been that so many parts have measured up so closely to specification. And, now that the radio industry is becoming stabilized, some manufacturers are beginning to test each piece of apparatus before it is delivered.

Recently, as these facts become better known, a marked improvement has been made in the design and construction of parts. This is frequently reflected in higher prices, which seem well justified in view of the better results secured. An exceedingly low price is good ground for suspicion as to electrical efficiency.

INADVERTENTLY and without malice, the money-earning ability of the Jewish race was unpleasantly emphasized by the cover of September RADIO. Intended to call attention to the value of radio to the farmer, a few of our friends have interpreted it as a slur on the Jews.

Consequently we hasten to say that no offense was intended. Some of the foremost radio engineers of the world are Jews and they are leaders in the commercial development of radio. The illustration might better have been that of a dapper young salesman of Irish persuasion, for the Irishman enjoys a joke at his expense.

RECOGNITION of the amateur radio operator has been tardy. Here is an enthusiastic group of young men working for the pure joy of it. Trained by their own efforts, they are proficient in a technical art which required months of intensive effort to impart to men in the Army and Navy training courses during the war. They are ready, able and willing to co-operate as a great reserve corps of defense.

But, because their work, which they regard as play, interfered with the play of the broadcast listener, and because some few of them disregarded the entertainment privileges of others, they were told to keep quiet.

So, obediently, they kept still, until thinking men began to realize that one of the nation's greatest assets was being stifled. The restrictions were discouraging those who should be encouraged. Interest in amateur radio, instead of leading, was lagging far behind interest in broadcast reception.

But last month the problem was solved by giving a new playground to the boys, for boys they are in heart even when not in years. And what a wonderful playground it is! Greater in size than all the space devoted to governmental and commercial uses, filled with new and unexplored heights and depths, the most desirable location in the entire field of radio communication, it offers a new stimulus to the best amateur effort.

A further stimulant and an additional evidence of the recognition of the amateur is the Navy's request to the A. R. R. L. to furnish the names of qualified men from whose number fifty officers may be appointed in the communication service of the Naval Reserve. This assures the utmost co-operation on the part of the Navy with amateur work. Would not the Signal Corps of the Army be wise in making similar overtures?

We confidently anticipate renewed interest in amateur radio transmission, and through these columns will continue to give a worth-while service to those interested.

Some Problems of Radio Broadcasting

An Authoritative Statement as to Governmental Regulation of Interference, Monopoly and Programs

By Herbert Hoover

THERE are probably 5,000,000 radio receiving sets in the United States and a radio audience of over 20,000,000 people. Already this new means of communication has become secondary only to print, and is indeed the greatest development in communication since the invention of type.

As most radio fans know, the Department of Commerce, over which I preside, has taken the utmost active interest in the development of the radio. There are a great number of intricate problems to be solved if the art is to become of the great service to the public of which it is capable.

The first of these problems is the regulation to prevent interference between stations. There can be no adequate development of the art unless there is very positive Federal regulation. It is the one industrial service that is anxious to be regulated, for, without regulation, we will have absolute chaos in the ether and no adequate service can be developed.

The Federal law on the subject was passed a dozen years ago when the telegraph was the only radio manifestation in the field. The Department of Commerce has been unceasing for three years in endeavor to secure the passage of adequate legislation to govern the radio telephone field. Congress has been too crowded to deal adequately with so intricate a subject, but it is probable that such legislation will pass in the next session.

In order, however, that the development of the art should not be destroyed in the meantime, three years ago I called a conference of the different amateur associations together with the representatives of radio broadcasting stations and the public, and we formulated a series of regulations largely voluntary in character which have served greatly to prevent interference and to secure the rights of radio listeners. These voluntary and semi-voluntary regulations have been carried out in the radio world with extraordinary fidelity. In order to meet the new developments in radio broadcasting during the past twelve months, I have issued a call for another conference to be held in Washington, in September, when we propose to review the entire situation and take such other steps as will promote the development of the art.

Herbert Hoover, Secretary of Commerce, Whose Address at the Opening of the Pacific Radio Exposition is Herewith Presented

THE scientists have determined that radio messages ride through the ether on electrical waves. The ether is defined as the inert medium which penetrates all space. It is what remains in your amplifying tubes when the air is pumped out. In fact, all of the molecules of nitrogen and oxygen that make up the air, the molecules of hydrogen and oxygen that make up the water, and the molecules of everything that make up the little grains of sand and everything else—are supposed to move around in the ether like suns and stars in the heavens.

Up to a few years ago, no one dreamed that the ether had any special importance in law or in government. It was surely inert from the point of view of public interest. When it was discovered that radio messages are transmitted by an electrical wave through the ether, it at once developed some very important public questions equal almost to water rights and land rights. The ether has very definite property values. It has become the vehicle of public services, presents questions of limitation of free speech; it is the possible scene of monopolies, it has boundaries, rights of way, rules of the road—functions that have hitherto been confined to the land and the water.

Today there are literally 20,000 people trying to traverse the ether with all sorts of messages and 20,000,000 people listening to them, and inasmuch as there would be utter pandemonium if there were no traffic rules, and as there are no interstate boundaries in ether the job must fall to the Federal Government.

It is during the last three years that this job has become of some difficulty.

Everybody knows that if messages are sent by two neighboring stations on the same wavelength they destroy each other. The assignment of wavelengths and preventing duplication and interference in their use is the first step in regulation of the traffic.

The use of radio for telephone purposes became a practical thing only within the last few years, with the discovery of the vacuum tube for amplifying the electric currents which are controlled by the voice and which are made to produce sound. But the transmission of sounds in this way so far can only be practically applied in the lower wavelengths. Our telephone broadcasting and ordinary receiving sets are today limited to the range from 200 meters to about 800 meters. In this range we can so far only safely venture fifteen or twenty wave bands. Some of the bands in this range are reserved by international agreement for ships; some of them have been reserved for military and scientific purposes and for amateurs, so that we have only about ten or twelve wave bands left for public purposes and we have 600 telephone broadcasting stations or more than fifty stations for every wavelength.

There is not much trouble in telegraphic use as they use the many wave bands above 800 meters, and although there are 19,000 sending stations there is not much interference. There is also an-

Continued on page 46

Radio in the Antipodes

An American's Viewpoint of the Broadcasting and Amateur Radio Situation in Australia

By H. A. Highstone

THE popular conception of Australia is that of a fairly large island, consisting for the most part of a dry and arid plain and inhabited by kangaroos, wild men, duckbilled platypuses (or should it be platypi?), rabbits, ex-convicts and radio amateurs. And for all the news we see or hear of concerning this far-off land, radio amateurs might well be the only civilized inhabitants, and the logging of the American amateur radio signals their sole occupation.

Like most popular conceptions, this is incorrect—quite.

Australia is larger in area than our United States. Sydney, the largest city, can truthfully lay claim to 1,000,000 inhabitants. Everything from lemons to apples are grown commercially in this land where real honest-to-goodness bushmen are as scarce as the American Indian.

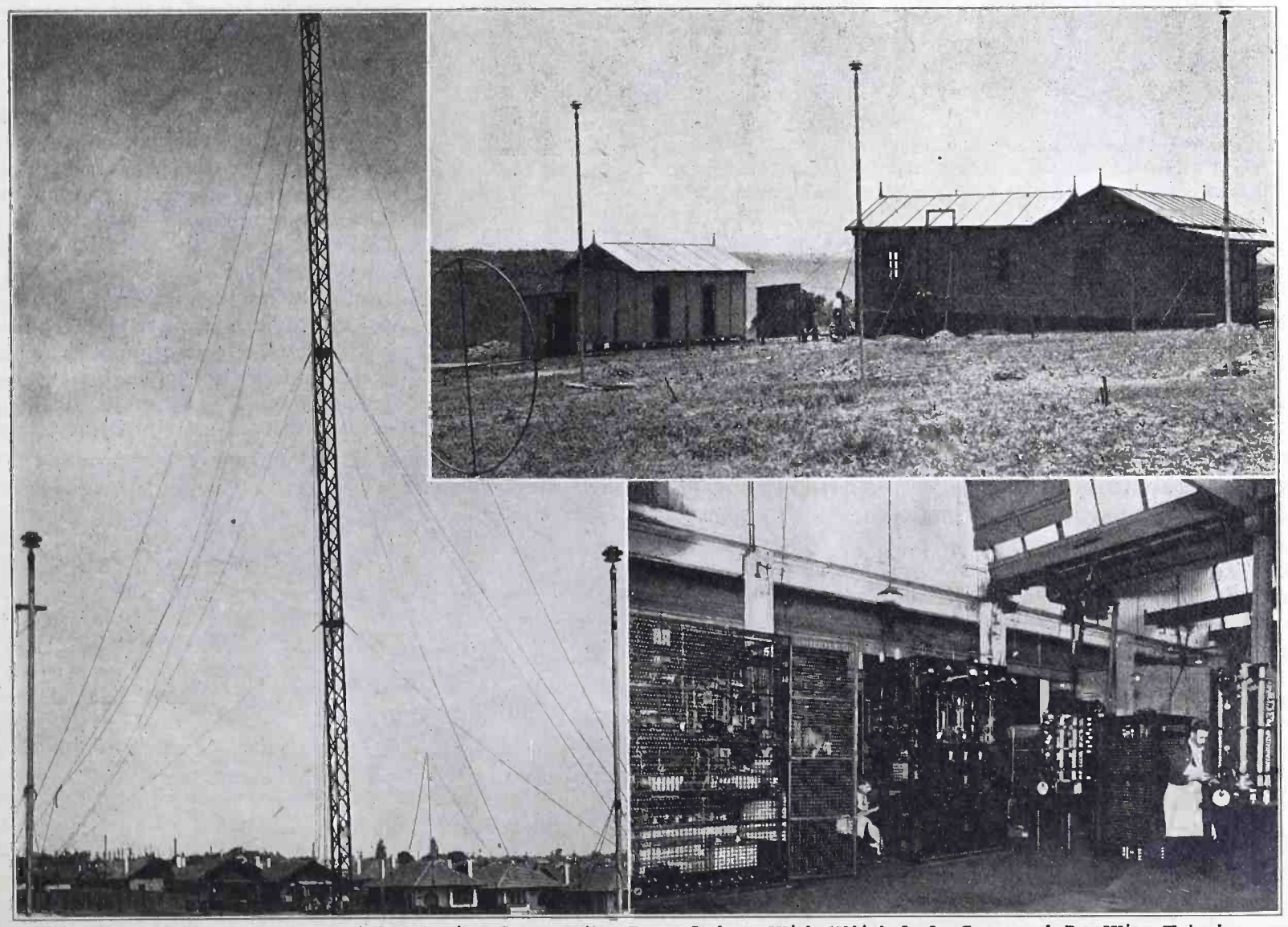
Separated by 6000 miles of water from their nearest seaport, we are out of touch with them in both a commercial and a social sense, for what they can not manufacture themselves they buy from England; and a letter requires two months to make a round trip from San Francisco, and ten weeks from New York. So it is only natural that we should be a little hazy concerning the conditions existent in this new America, including of course radio.

Australian radio laws and regulations are not stable. Changes take place frequently, some regulations are strictly enforced, others are not, and cases of actual punishment for violations are unknown. At the time of writing (July), it was believed that a drastic change in the regulations governing broadcasting was to be effected shortly, although amateur regulations were to be modified very little.

Broadcasting, while only a recent development in Australia, with but two actual stations in operation, is a dozen times more complicated than in the United States, and considerably more expensive to the listener. And these two stations, Farmers' Broadcast and the Sydney Broadcasters, Ltd., are running in a deadly and bitter-end opposition which will possibly result in their being absorbed by the government and incorporated into one large company together with the other stations now in the course of construction, after the system used in England. Both operate upon a sealed-set licensed service, Farmers paid and the Broadcasters free.

The former station, 2FC, is owned and operated by Farmers, Ltd., a nation-wide chain of department stores. It is a 5000 watt affair, using a wave-length of 1100 meters and claims a distance record of 7000 miles.

No expense has been spared in the perfection of the studio and the station, both of which in efficiency and elegance compare favorably with the best American installations. The studio is located on the roof of the Farmers' store in Sydney,



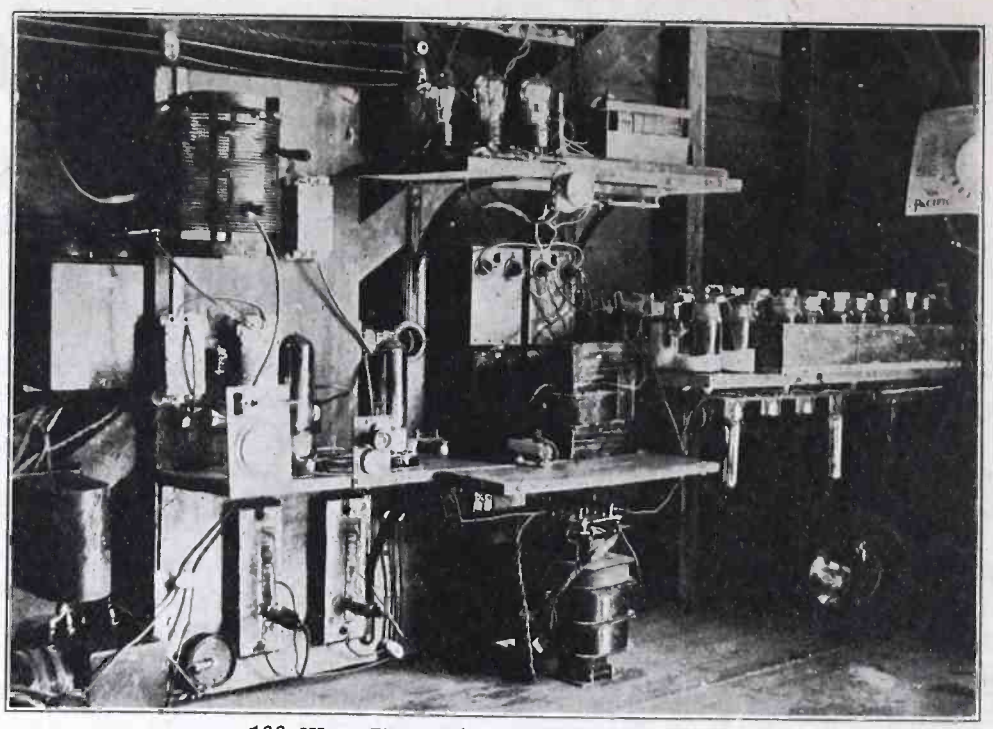
2FC, Farmers' Broadcast Transmitting Station, Seven Miles From Sydney With Which It Is Connected By Wire Telephony.

operating the transmitter at Willoughby, seven miles distant, by remote control. A switchboard in the studio connects with a number of theatres, public halls, hotels and churches in Sydney and its environs.

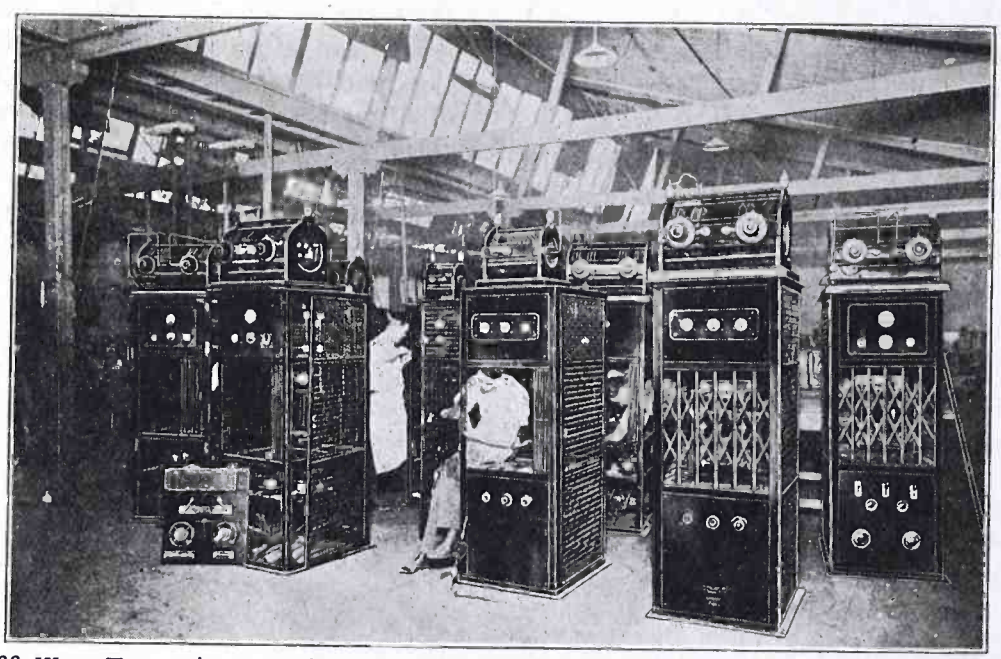
At Willoughby two lattice steel towers more than 200 feet high support an elaborate cage antenna 600 ft. long, and a small forest of fifteen-ft. steel masts holds the counterpoise in place. Over £30,000 (about $125,000) has been spent in the construction and perfection of the station and studio.

The competing station 2BL, which is owned by a group of radio dealers and other interested persons, operates on a wavelength of 350 meters. Two 250-watt tubes of British manufacture are used and a maximum distance record of 3500 miles was reported.

The present studio is temporary, located on the roof of the Smith Newspapers building in Sydney, where the apparatus is also housed. Twenty-seven private wires run to various halls, theaters, etc., in the city, allowing them to run almost continuously if they so desired. A new and permanent studio and operating room is now in the course of construction, and when completed will have cost approximately $25,000.



100-Watt Transmitter at Australian 2CM



500-Watt Transmitters Under Construction at Amalgamated Wireless Shops in Sydney

However, radio broadcasting as it is at present in Australia has proven a dismal failure, as have the laws governing its operation. According to a number of competent authorities Farmers' broadcasting station has never even approached commercial success. According to a government official in Sydney, this station, after spending well over £30,000, has little more than one hundred subscribers who have paid their three-pound tax for the privilege of listening. Nothing more need be said.

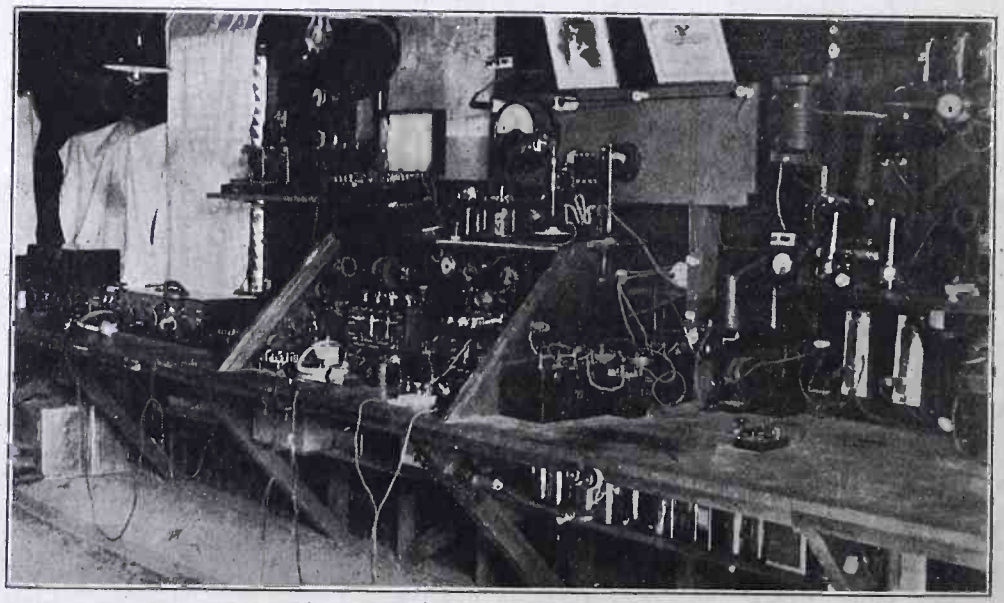
[The complete text of the new revisions in the radio laws appears elsewhere in this issue.—Editor.]

AUSTRALIA is divided into six states, New South Wales, Victoria, Queensland, South Australia, West Australia and Tasmania. These, in their respective order, comprise the amateur radio districts, beginning with 2 and ending with 7. There is no first district, it having been originally intended to allot this to New Zealand, but this idea was never put into effect.

High-priced apparatus, a heavy tax for a license, and stringent power restrictions have a discouraging effect upon amateur radio, to the extent that there are less than 500 transmitting amateurs in all Australia. A policy of secretiveness, adhered to by not a few of those owing transmitters, also tends to discourage the erection of new amateur stations.

The license to operate a transmitting and receiving station is issued after the applicant has passed a written examination and a code test of twelve words per minute. A charge of one pound per year is exacted. Within five miles of any coastal or "defense" station a maximum power consumption of 10 watts is allowed, and within twenty-five miles not more than 25 watts can be used. Power consumption is measured in the plate circuit of the tubes—impressed volts multiplied by milliamperes — instead of by the manufacturers' rating, as we do. The maximum power allowed is 250 watts, with exceptions in the case of special licenses. Apparatus in general, including tubes, is from 50 to 100 per

Continued on page 74



General View of Australian 2CM

A Radiocast Receiver with Choke Coil Amplifiers

A Set Economical in Construction and Operation and Giving the Best Quality of Reproduction

By G. M. Best

CONSIDERABLE publicity has been given recently to amplifiers employing resistance coupling between audio-frequency stages, instead of the conventional transformer coupling. It is indeed surprising that the resistance-coupled amplifier has attracted so much attention, in view of the fact that another type of amplifier, known as the impedance or choke coil-coupled amplifier, is superior in results, more economical to operate, and cheaper to construct.

In a resistance-coupled amplifier, high resistances, of the order of 100,000 ohms, are inserted in the plate circuit of each amplifier tube, to prevent the passage of audio-frequency, which is bypassed through a fixed condenser to the grid of the next tube, as is shown in Fig. 1. Due to the presence of a very high

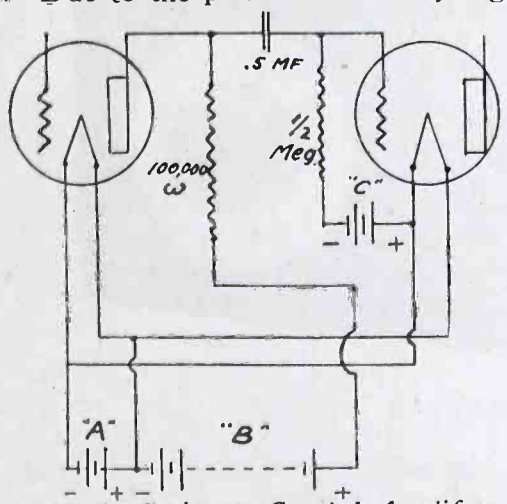


Fig. 1. Resistance-Coupled Amplifier

d.c. resistance in the plate circuit of the tube, a large voltage drop across this resistance occurs, and the plate of the tube receives only about 60% of the voltage applied at the *B* battery terminals of the set. With a given negative grid potential, therefore, it is necessary to raise the *B* battery voltage sufficiently to overcome the drop in the high resistances, and provide the tube with its proper plate potential.

This voltage drop due to the resistance in the circuit can be overcome by the use of choke coils in place of the resistances, as the average direct current resistance of a 25-henry choke coil is not over 1000 ohms, and causes practically no loss in plate voltage. Where choke coils are used, as is shown schematically in Fig. 2, the high impedance of the coil to audio-frequencies prevents the various frequencies of music or speech from reaching the filament via the *B* battery, and causes them to follow the relatively easy path through the ½-mfd. condenser to the next tube.

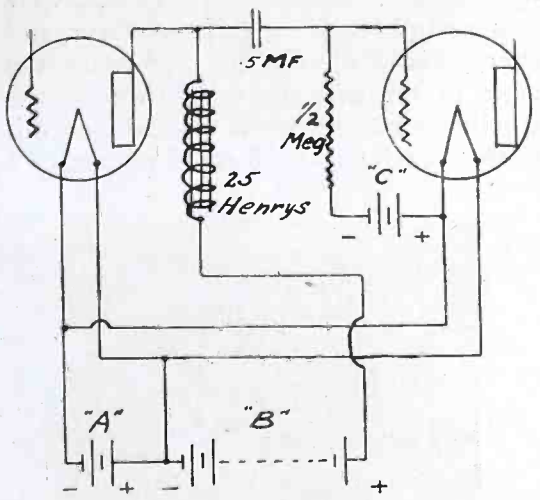


Fig. 2. Schematic Diagram of Choke Coil-Coupled Amplifier

Good choke coils can be made from the ordinary bell-ringing transformer commonly used in connection with the house lighting system, the smallest size, 5 watts, being good enough for radio purposes. The primary winding of this transformer is designed to be bridged across the 110-volt house lighting wires continuously, the secondary winding being closed through the doorbell only when the push-button is operated. Hence, the primary winding is of very high impedance, so as to cause no drain on the 110-volt line when not in use.

In the set herewith described, these little transformers are used to furnish the high impedance in the plate circuit, and enable the construction of a very economical amplifier, as well as one having a very fine frequency characteristic, passing all frequencies from 100 cycles to 5000 cycles without introducing distortion.

The tuned circuit associated with the detector tube is especially selective, and, while the range of the set will not be as great as those employing radio-frequency amplification in some form, it will be sufficient to enable reception on a loud speaker over a distance of several hundred miles at night, without having to use too much regeneration, with the risk of radiation, and consequent interference with the neighbors.

A list of the parts used by the author in constructing this set is given below, with a number of suggested substitutions:

3	C-299 or UV-199 Vacuum tubes @ $4.00	$12.00
3	Benjamin sockets—spring suspension type, @ $1.00	3.00
2	Remler capacity units @ $5.00	10.00
1	75-turn unmounted honeycomb coil	.90
1	50-turn unmounted honeycomb coil	.80
1	Chelten Midget Condenser	1.50
1	Remler No. 620 Oscillator-coupler	3.00
2	Jefferson Wizard Bell Ringing transformers @ $1.50	3.00
2	½-megohm grid leaks @ 30c	.60
1	2-megohm grid leak	.30
2	grid leak mountings @ 35c	.70
2	.5 mfd. Condensers @ 90c	1.80

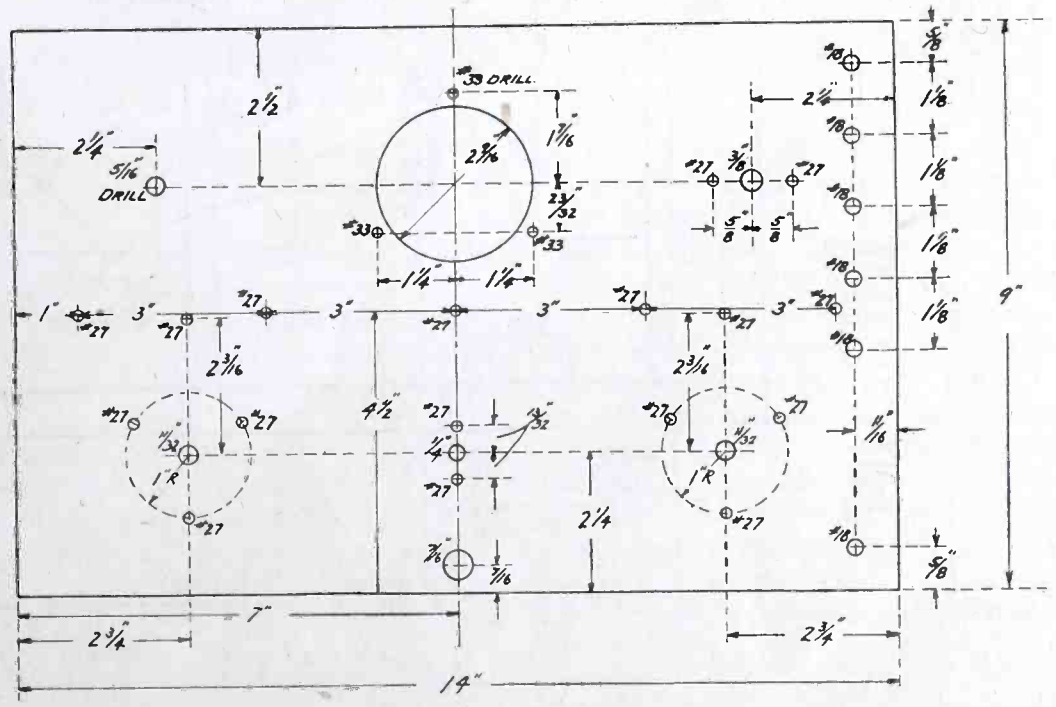


Fig. 3. Panel Layout

1	1-mfd. Condenser	1.25
1	Micadon No. 601-G. .00025 mfd.	.45
1	Weston Voltmeter, 0-5 volts	8.00
1	Federal No. 22, 25-ohm rheostat	1.50
1	2½-in. dial	.40
1	Federal No. 1421-W phone jack	.60
6	Eby Commander Binding Posts @ 25c	1.50
1	Bakelite Panel 9 in. x 14 in. x 3/16 in.	3.00
1	Eveready No. 751 Battery	.35
8	ft. Spaghetti	.80
	Wire	.25
	Total	$55.70

A good three-plate air condenser can be used in place of the Chelten Midget condenser, but will require a larger dial. Any bell-ringing transformer besides the Jefferson, such as the G. E. Wayne types, the Dongan Midget and numerous others, will do for the impedances. Federal or Kellogg paper condensers will do in place of the Dubilier, although, on account of their large size, it would be difficult to mount them in as small a space as the Dubilier. The Jewell voltmeter can be substituted for the Weston, and any 4½-volt small-size battery can be used in place of the Eveready No. 751. The Eveready No. 771 *C* battery is too large for so compact a layout, and, as only one *C* voltage is desired, the 4½-volt unit without taps is all that is necessary.

Fig. 4 shows the circuit diagram of the set in schematic form, with the designation of values of the various pieces of apparatus. If WD-11 or WD-12 tubes are used in place of the 299 type, the filament battery should be 1½ volts, or, in case of the large storage battery tubes, 6 volts should be specified. For the latter tubes, a voltmeter having a scale of 0-8 volts should be used instead of a 0-5-volt scale.

The antenna tuner consists of a series air condenser, a 75-turn loading coil, and the rotor of a variocoupler. In view of the fact that several excellent oscillator couplers used in super-heterodyne receivers are now being manufactured, such a coupler was used in this set, as it is compact, and, with the small number of turns on the rotor, very good selectivity can be obtained with a minimum chance of radiation. The stator of the coupler is used as the secondary of the tuner, with a second air condenser shunted across its terminals.

In order to obtain a small amount of regeneration, without resorting to a moving coil arrangement, an additional winding of 5 turns of No. 24 DCC wire was wound on one end of the stator, and energy could then be fed back from the plate of the detector tube, through the Chelten condenser and the 5-turn coil, to the secondary of the tuned circuit.

In order to prevent the radio-frequency from having an easy path through the distributed capacity in the windings of the 25-henry choke in the plate of the detector tube, a 50-turn honeycomb coil was placed between the plate and the 25-henry choke, thereby forcing the radio-frequency to return to the filament through the Chelten condenser. This 50-turn coil has no effect on the audio-frequency component, which passes through it, and through the .5 mfd. condenser to the grid of the first audio-frequency amplifier.

C potential for the audio-frequency tubes is provided by the 4½-volt flashlight battery, through the two ½-megohm grid leaks. A 1-mfd. condenser is placed across the 90-volt *B* battery to prevent coupling due to a high resistance cell in the battery, and to provide a ready path for the audio-frequency to pass from the plate of the last tube

Panel View of Complete Set

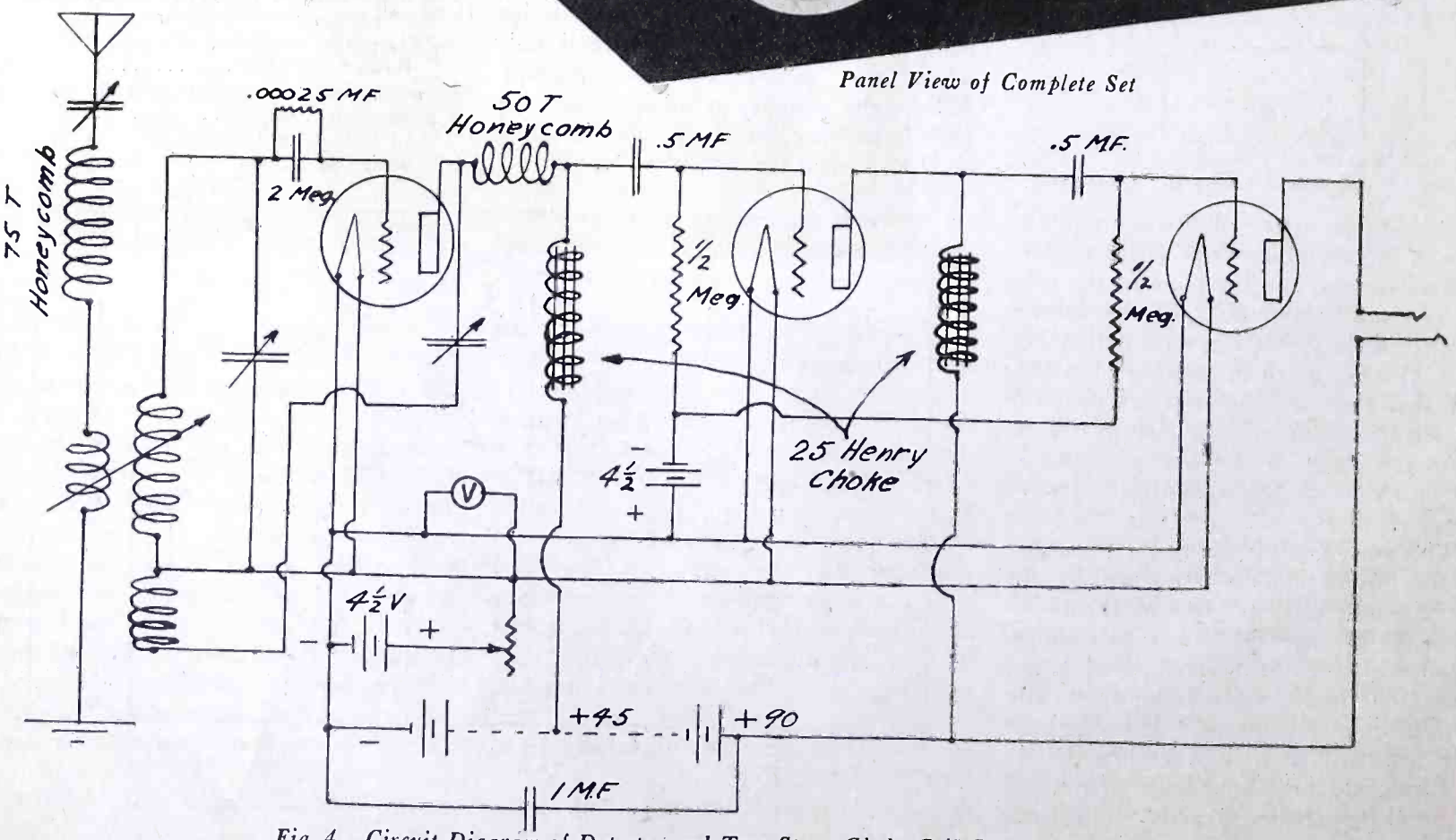
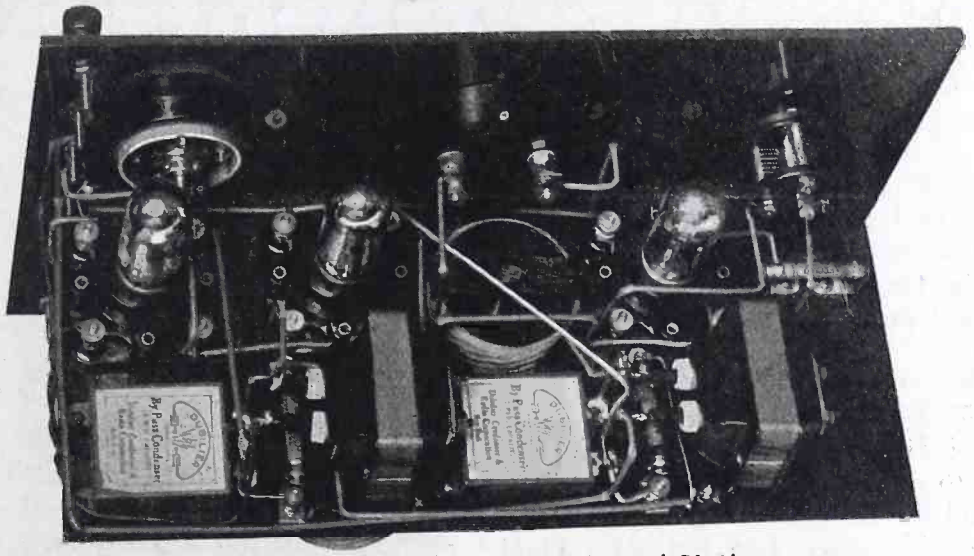


Fig. 4. Circuit Diagram of Detector and Two-Stage Choke Coil-Coupled Amplifier

through the phones or loud speaker, and back to the filament.

A voltmeter is shunted across the filament circuit of all three tubes, to enable the most efficient operation of the tube filaments. A 4½-volt battery should be used with the set, and the voltage at the filaments maintained at 3 volts, by means of the filament rheostat. If the voltage at the filaments is continued at a value over 3 volts, for any great length of time, serious damage to the tubes will result.

The panel layout is shown in Fig. 3, with the proper size drills for the various holes indicated. This panel was designed to slide in grooves cut in the sides of the cabinet, as is shown in the illustrations, and no holes were provided for wood screws at the sides or bottom of the panel, since none were necessary. The two air condensers, the antenna coupler, filament rheostat, voltmeter, Chelten condenser, binding posts and shelf are mounted on the panel, and the remaining apparatus placed on the top and bottom of the shelf. The ground binding post is at the bottom of the panel, with the antenna post directly above. The four battery terminals, reading upward, are: "Negative *A*," "Positive *A*," "Positive 45-volt *B*," and "Positive 90-volt *B*." The negative *B* battery lead is connected to the negative *A* battery post.



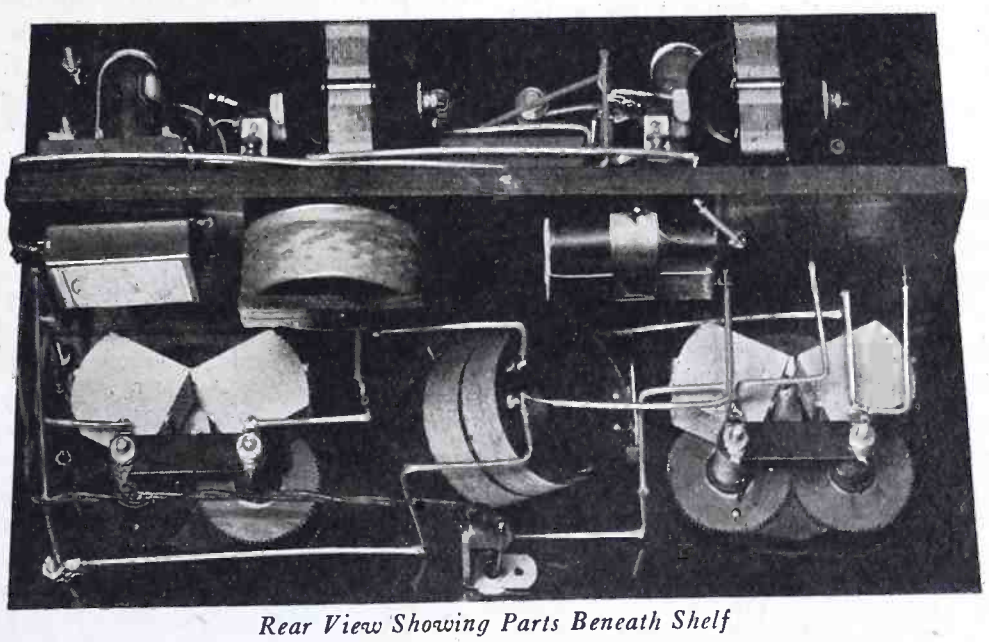
Rear View Showing Parts on Top of Shelf

In wiring the oscillator coupler, it will be noted that there are two stator windings, each of 35 turns. These two windings should be connected in series, and the entire stator used as the secondary coil. The shelf for mounting the sockets and miscellaneous apparatus should be of a good grade of seasoned hardwood and should be cut to 6½ x 13 x ⅜ in. On the top of the shelf are mounted the three sockets, bell transformers, grid leaks, paper condensers and 50-turn honeycomb coil.

Underneath the shelf the 75-turn load coil and *C* battery are placed in position as shown in the picture. Wires leading to the *C* battery are run through holes drilled in the shelf, the same being true for the leads from the secondary condenser to the detector tube. The high-frequency section of the set is entirely under this shelf, and, if trouble from lack of selectivity due to close proximity to high-powered stations is experienced, it might be well to shield the top of the shelf and inside of the cabinet with sheet brass or copper, connecting the shield to the ground binding post.

No. 19 tinned copper wire was used for all the connections except to the phone jack, which was connected to the plate of the last audio-frequency tube by means of a twisted pair of No. 19 insulated wire. Spaghetti was used to insulate the tinned wire where insulation was necessary, although many of the leads can be run in bare wire if desired. Where the wires run through holes in the shelf, spaghetti is particularly necessary, as the wood might not be well seasoned and leakage would result. The 75-turn load coil should be placed on the bottom of the shelf, between the antenna condenser and the coupler, so that it is nearly at right angles with the secondary of the coupler. If it is not placed in this manner, the minimum point of coupling will not be at the zero mark on the coupler dial. Broadness of tuning may also result in this case, especially from nearby stations.

Two long leads of heavily-insulated wire are provided on the bell transformers and these are the primary terminals. These leads should be shortened, the insulation skinned close to the transformer, and the wires well tinned, for connection to the circuit. The secondary of the transformer is not needed and should be abandoned. It can be readily recognized by the binding posts. Do not under any circumstances use this winding in place of the primary, as it is of relatively low inductance and would have little effect in the plate circuit of the tube to which it was connected. In mounting the 50-turn honeycomb coil on the top of the shelf, be sure that it is not too close to the 75-turn load coil underneath the shelf, as considerable regeneration might thus result, with loss of control over the tuned circuit.



Rear View Showing Parts Beneath Shelf

In tuning the set, the rotor of the coupler should be set at a point between zero and 10 on the coupler dial for local stations. For more distant stations, the coupling should be increased, provided that interference from local stations does not result. The two capacity-unit dials provide the main tuning controls, and these settings will be found to have about the same location for both antenna and secondary circuits, for a given wavelength, with the average antenna. Due to the straight-line wavelength characteristic of the capacity units, no vernier adjustment is necessary for the lower wavelengths, and no difficulty should result from lack of vernier control. Where a distant station is involved, the feed-back can be be controlled by means of the Chelten condenser, care being observed not to force the tube into oscillation.

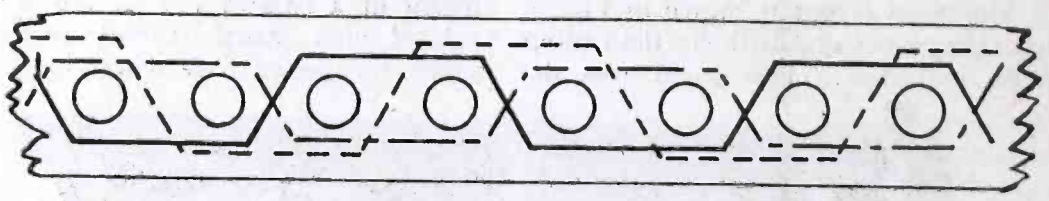
As the set described in these columns is essentially an "entertainment" set, and not one for the "distance fans," it may be that the tuned circuit will not interest certain readers, although it is desired to use the impedance-coupled amplifier. In this case, where a separate tuner is employed, the set can be very much condensed in size, a panel 5 in. x 10 in. x

Continued on page 54

Duo-spiderwebs and a Simplified Reinartz

Complete Directions for Winding Coils and for Assembly in a Simple Receiver

By E. F. Kiernan



IN spite of the flood of super, hyper, and reflex wonder circuits that are ever swamping current radio periodicals, the original regenerative hook-up in its various forms still holds its popularity with the experimenter. This article contains data obtained from a set built by the author; a set which is hard to beat for simplicity, selectivity, efficiency, and last, but not least, cheapness.

Duo-spiderweb coils have been on the market for some time. The fact that this type of coil has all the merits of the honeycomb, or duolateral, and is self-supporting and extremely easy to make, should recommend it to the "roll your own" radio man.

The now-famous "Reinartz" is too well known to need an introduction; however, the author finds it possible to greatly simplify the circuit without detracting from its merits.

Fig. 3 shows the simplified hook-up; the total absence of taps is at once evident. The condensers, C and C_2, are ordinary 23-plate variables, preferably with verniers. The coil is a 45-turn duo-spiderweb. By eliminating the taps, the construction is simplified, while the losses ever present in a set containing numerous taps and switches are largely eliminated. A radio choke, at X, Fig. 3, may or may not be included in the assembly. The writer's set contains a 100-turn duo-spiderweb of No. 28 DCC.

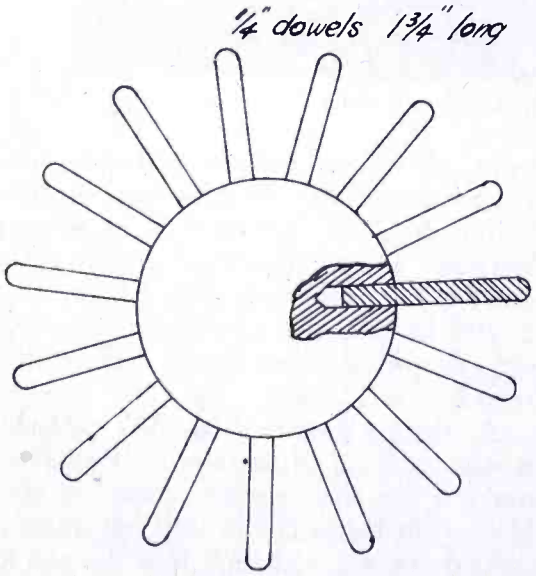


Fig. 1. Winding Form

The coil is wound on the form shown in Fig. 1. The disk is a piece of ¾-in. soft wood 4⅛ in. in diameter. The diameter on one side is made slightly less than 4⅛ in. to facilitate removal of the finished coil. Fifteen ¼-in. dowels 1¾ in. long, rounded at both ends, are inserted in the holes and complete the form.

The winding is shown graphically in Fig. 2, No. 26 DCC being used. Start the winding by fastening an end of the wire to one of the dowels and continue around the form, crossing the wire over every other space (see Fig. 2). Hold the wire fairly taut while winding. It is expedient to lash the first two or three turns together at intervals with thread, thus insuring these turns against unraveling. A tap is taken out at the tenth turn (T, Fig. 3) and the winding continued until 45 turns are completed. The last two or three turns should be lashed together as were the first.

To bind the turns together, paraffin is the cheapest material obtainable. (The Bureau of Standards recommends Du Pont's household cement, obtainable at drug stores.) Various other liquids, such as Ambroid cement, may replace the paraffin. The binder is applied to the coil sparingly at those points where the turns cross each other on the sides of the dowels. It is well to twist the dowels in their sockets before the binder completely sets, otherwise the coil may be cemented to the form.

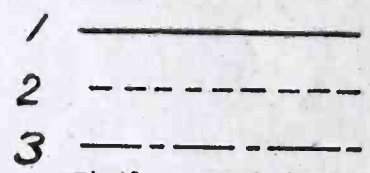


Fig. 2. Method of Winding

To remove the coil from the form, the dowels are removed by twisting and pulling simultaneously, using a pair of pliers, and the coil is gently forced from the disk. A little care will produce a product equal to the manufactured article.

The assembly and wiring of the set is left to the individual builder, though the author strongly recommends bus-bar wiring, soldered joints (rosin flux), and A-1 parts. The author's set contains UV-201A tubes fed by three No. 6 dry cells.

With a 60-ft. wire under the ceiling in an upstairs apartment, and a gas-pipe ground connection, all the west-coast broadcast stations are brought in to Pasadena, Calif., on a loud speaker and one step of audio-amplification.

The wave range is from about 275 meters to 800. Incidentally, the best DX from near Los Angeles was Salt Lake City; not so worse considering the aerial and ground.

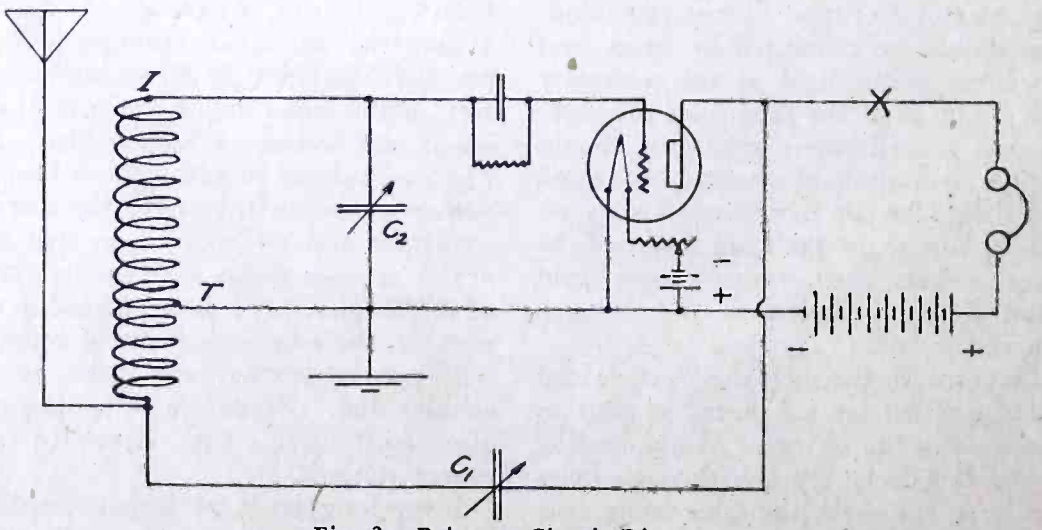


Fig. 3. Reinartz Circuit Diagram

Vacuum Tube Transmitting and Transformer-Coupled Receiving Circuits

A Simple Explanation of How and Why They Function, Illustrated by Typical Examples

By C. M. Jansky, Jr.

ANY device which will amplify can be made to produce oscillations by feeding a portion of the output back into the input. In the electron tube oscillator this is accomplished by the use of either electrostatic or electromagnetic coupling between the grid and plate circuits. This divides oscillator circuits into two groups: capacitive-coupled circuits and inductively-coupled circuits. A thoroughly technical explanation of the operation of electron tube oscillator circuits would be out of place here. The following discussion should serve to give the reader satisfactory understanding of the operation of such circuits.

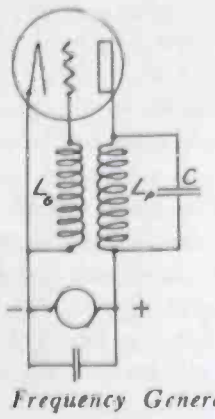


Fig. 1. High Frequency Generating Circuit

Fig. 1 is a typical inductively-coupled circuit. The magnitude of the plate current which passes through L_p depends upon the voltage of the grid with respect to the filament. Any change in the plate current will induce a voltage in L_g. If the directions of the windings are such that an increase in plate current will induce a voltage in L_g which makes the grid positive with respect to the filament we have the conditions necessary for the production of continuous oscillations. The increase in grid voltage produces a still more rapid increase in plate current, which in turn reacts upon the grid circuit still further. The increase in grid voltage and plate current may continue until an increase in grid voltage ceases to produce an increase in plate current due to saturation or some other cause.

As soon as the plate current ceases to increase the induced grid voltage will drop to zero, as a changing current is necessary to produce an induced voltage. Since the grid voltage has dropped to zero, the plate current will decrease back to the normal value. However, a decreasing plate current will induce a negative voltage on the grid, which in turn decreases the plate current below normal value to a point where a decreasing grid voltage produces no change in the plate current. The induced grid voltage will then rise to its normal value and the cycle is completed.

The frequency of the alternating current produced is largely determined by L_p and C. Although the plate current may be but a few milliamperes, the high frequency alternating current in L_p and C may be many times as great.

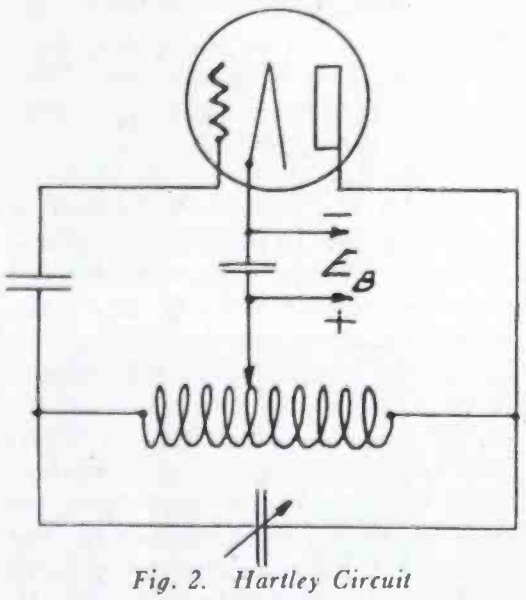


Fig. 2. Hartley Circuit

Many of the generating circuits are known by the names of those who presumably first used them. Figs. 2 and 3 are two well known inductive feedback circuits. If large amounts of high frequency power are desired, large tubes are used and the plate voltage E_b may be as high as 20,000 volts. The proper negative grid voltage is supplied by the grid condenser and a grid leak.

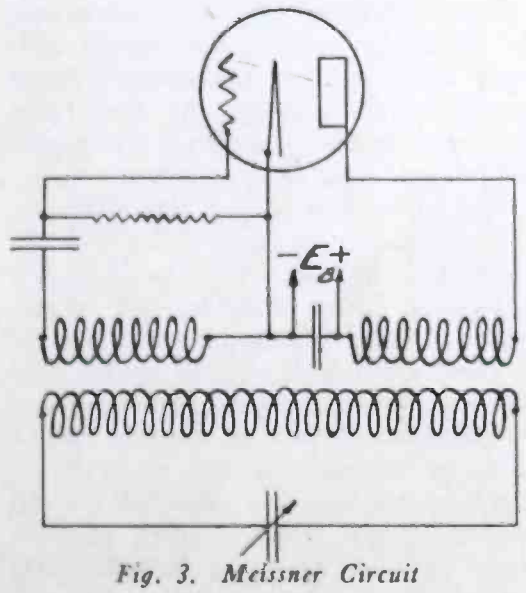


Fig. 3. Meissner Circuit

Fig. 4 shows a very efficient circuit for the transmission of continuous wave telegraph signals which was used by the writer as early as 1918. The power

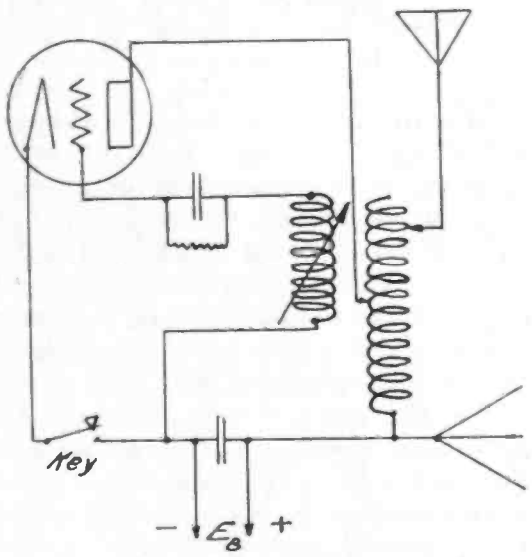


Fig. 4. High Efficiency Undamped Wave Transmitter

supplied by the high voltage generator E_b is dissipated in two ways, (1) as useful output in the antenna, (2) as heat in the plates of the tube. The heating of the plates occurs because of the velocity and mass of the electrons which strike it at the end of their journey through the space between filament and plate. The plate efficiency of an electron tube high-frequency generating circuit may be defined as the ratio of the power delivered to the antenna to the total power delivered by the high voltage generator. It is easily possible to operate the circuit shown in Fig. 4 at an efficiency of 65 or 70%. Adjustments for efficiency are made by the plate tap on the coil in the aerial circuit. The frequency generated is adjusted by the aerial tap. (See article by the author on "A High Efficiency Undamped Wave Transmitter" in QST for December, 1921). A more complete discussion of the operation of tube transmitters may be taken up later.

The operation of capacitively-coupled feedback circuits is similar to that of inductively-coupled circuits, in that a change in the plate circuit induces a change in the grid circuit such that the change in the plate circuit is accentuated. Fig. 5 is a well-known capacitively-coupled generating circuit. The plate voltage is applied in parallel through a choke coil L_c. The frequency generated is largely determined by the capacitance

of C_g and C_p in series and L. The heavy oscillatory currents occur in this circuit. A slight increase in the plate

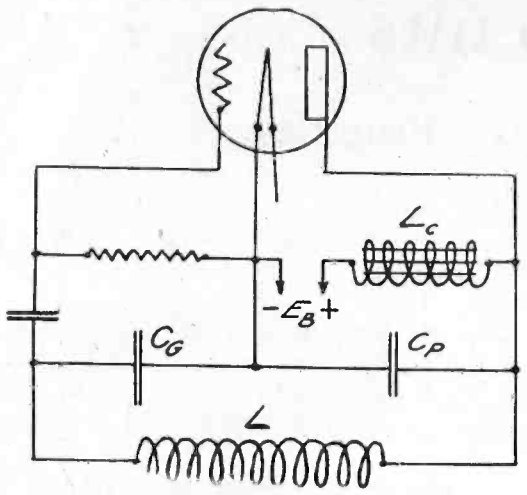


Fig. 5. Colpitts Circuit

current through the choke coil will cause the voltage of the plate with respect to the filament to drop, due to the reactive effect of the choke. This will make the right side of C_p minus with respect to the left side and this will by electrostatic induction make the right side of C_g minus and the left side plus. The positive grid voltage thus produced will tend to increase the plate current through the choke still more. As a matter of fact the inductance of the plate circuit choke is so great that the plate current is practically constant and the changes in plate current are supplied by the charging cur-

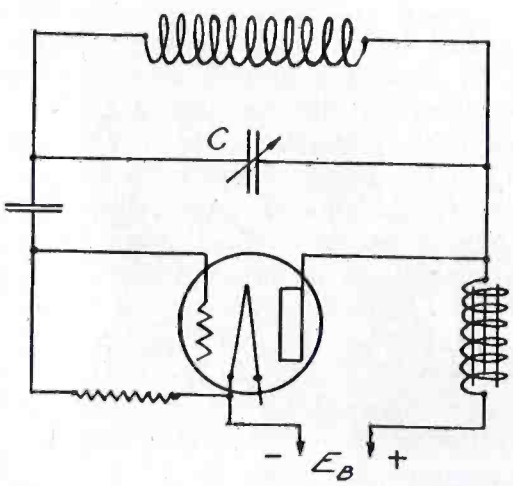


Fig. 6. De Forest Ultra-Audion Circuit

rent of the condensers. Fig. 6 shows another well-known capacitively coupled circuit which uses only one condenser.

Modern Receiving Circuits

WE have now reached a point in our discussions where we may discuss the operation of modern receiving circuits of the electron tube type. The operation of crystal receiver circuits has been discussed and will not be considered further. For convenience we will classify receiving circuits under six heads as follows:

(1) Regenerative receiving circuits.
(2) Transformer coupled radio frequency amplifier circuits.
(3) Tuned circuit radio frequency amplifier sets (includes the neutrodyne circuits).
(4) Superheterodyne or intermediate frequency amplifier circuits.

Although there have been many circuits with new names brought out within the past few years, nearly all of them can be classified under these heads. In our discussion we will consider only the radio frequency circuits and the detector circuits, it being understood that audio frequency amplification can always be added. A complete discussion of audio frequency amplifier circuits was given in July RADIO.

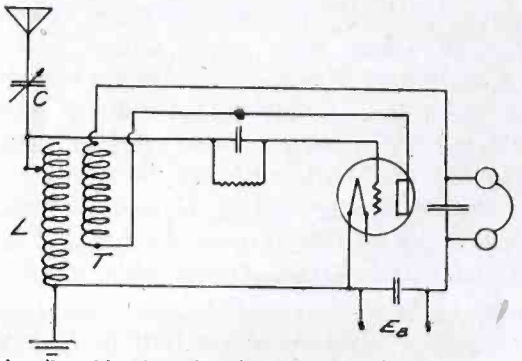


Fig. 7. Single Circuit Regenerative Receiver With Tickler Feedback

Fig. 7 shows a very simple single circuit regenerative receiving set. This circuit will give more signals per dollar investment than any other the writer knows. In common with all regenerative circuits and some superheterodyne circuits it is open to the objection that it will act as a small transmitting set if improperly operated, and will cause interference with other nearby receiving sets. This type of interference will be considered in detail a little later when we discuss the reception of continuous waves by the heterodyne and autodyne method. Tuning is accomplished by varying the tapped coil L and the condenser C. The tickler coil T has somewhat fewer turns than L and is usually placed on a rotating shaft inside L so that the coupling between the two coils can be easily varied.

With the tickler coil so placed that its coupling with the tuning coil is a minimum, the strength of signals received will be but little better than with a good crystal set. If now the coupling between tickler and tuning coils is increased gradually, the strength of signal will increase greatly up to a point where the incoming radio phone speech suddenly loses its clear characteristics and becomes unintelligible. At this point the circuit begins to produce continuous oscillations in the manner which was described in the first part of this article.

This increase in signal strength as the feedback is increased may be explained as follows. The aerial and the receiving set circuits contain a certain amount of resistance which absorbs energy and decreases the signal strength. Coupling the plate circuit back to the grid circuit produces voltages in the grid circuit which accentuates the effect of the incoming signal. This is called regeneration. If this coupling is sufficiently great oscillations are produced as we have seen, but even if the coupling is not sufficient to produce oscillations the feeding back of energy is still called regeneration. The effect of this regeneration is to offset the damping effect of resistance. Regeneration is, therefore, sometimes called resistance neutralization.

As the coupling between tickler and tuning coil is increased more and more, the effect of resistance is neutralized and the signal strength increased still further. This continues as the coupling is increased until the effect of resistance is entirely neutralized, at which point the circuit begins to produce oscillations. *The loudest radio phone speech will be heard just before the point is reached where oscillations are produced.*

Resistance in the aerial and receiving circuits not only reduces the signal strength but also broadens the tuning. *Regeneration not only increases the signal strength, but also makes the receiver more selective.* However, regeneration will not make a high resistance receiving circuit as good as one in which care has been taken to eliminate resistance losses. This is due to the fact that while regeneration neutralizes the effect of resistance, in high resistance circuits, the adjustment for maximum signal strength is so critical that the proper adjustment is almost impossible to obtain.

It will be worth while to consider in detail here a fault found in many regenerative receiving sets which can be easily remedied if the operator but understands the principles involved. It has been stated that the loudest signals will be heard just before the point is reached where oscillations are produced. In many receivers it will be noticed that as this point is approached, the receiver starts to produce oscillations with a violent click before the point of maximum signal strength is reached. This is usually due to an incorrectly adjusted grid leak.

In September RADIO we discussed a method of making a variable grid leak with the aid of a strip of cardboard and a soft pencil. Let us assume that a strip of cardboard about 1 in. by 2 in. has been thoroughly blackened with a soft pencil around the holes which are 1½ in. apart and that the leak is fastened in place by bolts or screws through these holes. See Fig. 8.

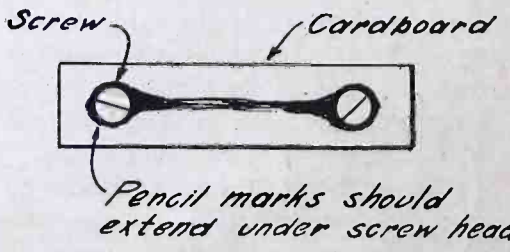


Fig. 8. Cardboard Grid Leak

The resistance of the leak will be very great as no lines have yet been drawn connecting the two blackened areas. Now increase the regeneration until

Continued on page 68

The Regenerative Reflex

Constructional Details of an Efficient Radiocast Receiver Using Three Dry Cell Tubes

By O. B. Scott

WITH the appearance on the market of the new type of radio sets embodying the principles of both reflexing and regeneration, there has arisen a demand for information on how to "build your own." The set described is extremely sensitive, for it permits full regeneration in the tube detector. The one stage of radio-frequency builds up weak incoming signals, increasing the range considerably. The regenerative plate circuit allows the fan to "fish" for distant stations by the good old-fashioned "squeal" method, without causing disturbance in neighboring receivers. The first stage of audio-frequency is reflexed, conserving tubes and batteries.

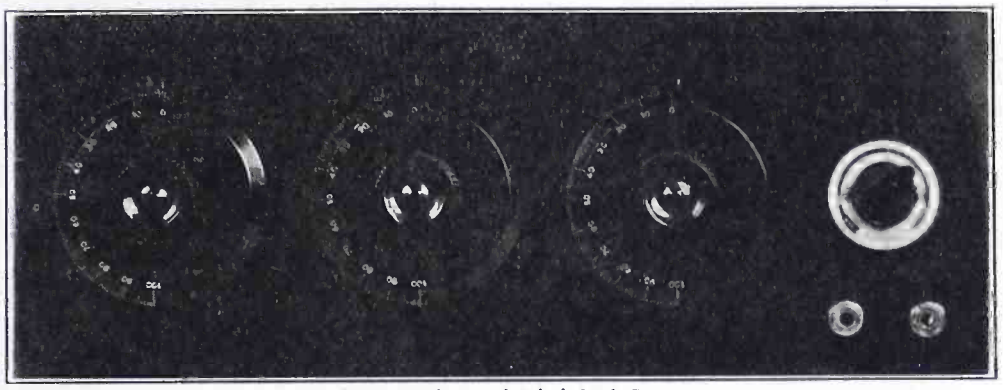
Among the many advantages of this receiver is the use of the economical UV-199 or C-299 tubes, using dry cells for lighting the filaments. Neutralization of the capacity coupling in the second frequency transformer is not necessary when the small tubes are used.

The parts necessary for construction are as follows:

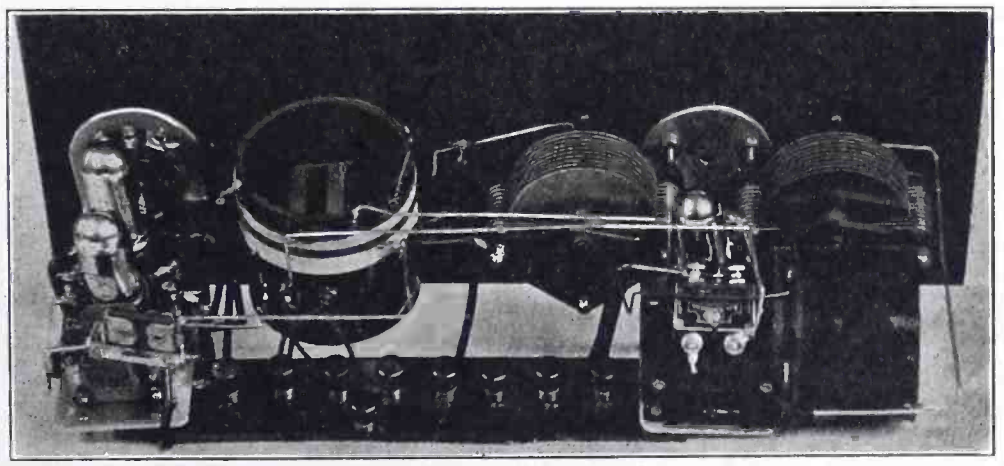
1 Panel, 7x18 in.
3 4-in. dials to match.
2 23-plate variable condensers.
1 Special radio-frequency transformer R_1.
1 Special radio-frequency transformer R_2 with tickler.
1 20-ohm rheostat with knob or pointer.
1 30-ohm rheostat. (Only one rheostat is needed if filament control jacks are used.)
3 UV-199 tubes.
1 .00025-mfd. grid condenser.
1 3-megohm grid leak.
1 .00025-mfd. micadon.
1 Single-circuit jack (with or without filament control).
1 Double-circuit jack (with or without filament control).
Sockets, brackets, nuts, bolts, bus wire, etc.
1 4½-volt *C* battery.
A and *B* batteries.

The first radio-frequency transformer, R_1, is made by winding 15 turns of No. 26 or 28 DSC on a 3-in. tube, spaced about ⅜ in. from a 40-turn winding of the same size wire. The 15 turns is the primary or antenna circuit *P*, while the 40-turn winding comprises the secondary or grid circuit *S*. No collodion or other solution is used.

This transformer is mounted on the first 23-plate condenser, by means of strip brass, as shown in Fig. 2. The strips must be bent and drilled to suit the particular condenser used. The builder can get an idea of how the task was performed from the illustration, and can then apply the method to his own parts.



Panel View of Finished Set



Rear View of Finished Set

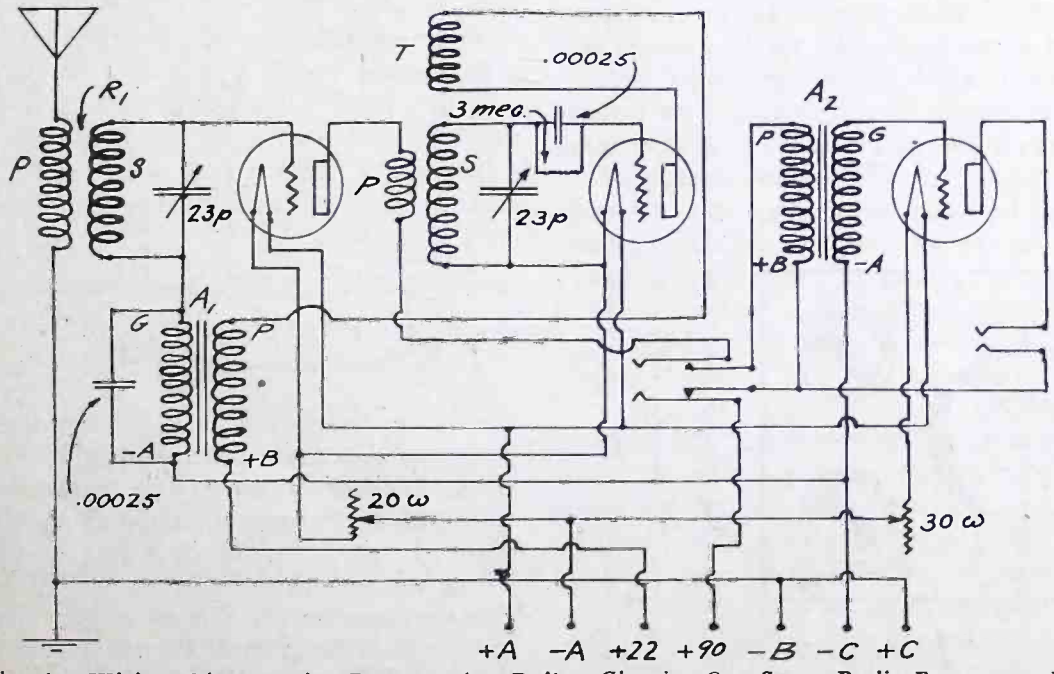


Fig. 1. Wiring Diagram for Regenerative Reflex Circuit—One-Stage Radio-Frequency, Regenerative Detector, Two-Stage Audio-Frequency, First Step Reflexed

The second radio-frequency transformer, R_2, with the tickler feed-back, may be made from a old variocoupler, or the forms can be purchased at any

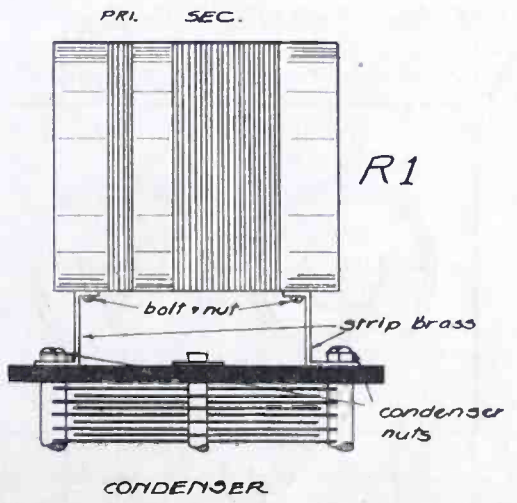


Fig. 2. Method of Mounting First Radio-Frequency Transformer on Condenser

radio store and wound at home. The primary, *P*, consists of 10 turns of No. 26 or 28 DSC wound over the secondary, *S*, which is 40 turns. A thickness of tracing cloth or cambric tape will suffice to separate the windings. The tickler, *T*, is wound on the rotor and contains 20 turns. The number of turns on the secondary is for a 3-in. tube. Smaller diameters will require more turns, while larger tubing will require less. The amount is not critical, for slight changes will be reflected only in the condenser settings.

A few details must be given careful attention to assure the best results. Low ratio audio-frequency transformers should be used, for distortion is eliminated and the tone improved. A 5-1 All-American was used in the first stage of the set described, while a 3-1 Pacent was placed in the second stage. A .00025 micadon was shunted across the secondary winding of the first stage to by-pass radio-frequency currents.

After a number of experiments, a 3-megohm grid leak was found to be best for this circuit, for higher resistances caused the detector tube to block easily.

The circuit shown in Fig. 1 calls for two rheostats. The 20 ohm controls the detector and reflexed amplifier; the 30 ohm regulates the filament of the second audio-amplifier. The set illustrated, however, employs only one rheostat, of 20 ohms resistance. Filament control jacks were used to light either two or three filaments at a time, the rheostat governing only the filament voltage. The novice will find the wiring easier, though, if he uses two rheostats. There is ample room to mount them on the right hand side of the 18-in. panel, one above the other.

The builder may either fasten the sockets and transformers to a board and screw the panel to the board, or he may purchase aluminum brackets on which to mount them. The finished job is much neater if all parts are mounted on the panel and brackets. The panel layout of the set employing two rheostats is shown in Fig. 3.

The established rules of good wiring practice must be observed if the builder wants to obtain satisfactory results. Other than that, he can vary the design to whatever parts he has available. It is possible to convert either a crystal reflex or a standard regenerative capacity-tuned circuit in a regenerative reflex of this type.

The results obtained from the set were indeed surprising. With the UV-199 tubes, sufficient volume was obtained to furnish dance music for a houseful of young people. Loud speaker volume is possible even with only one stage of audio-frequency amplification.

For distance, this regenerative reflex is equal to any four-tube set providing loud speaker operation. This sensitivity is accompanied with remarkable selectivity, for the tuning is very sharp.

For local reception, and for bringing in powerful distant stations, this set is excellent to say the least. The tone is pure and sweet, and the operation decidedly quiet and simple. The first and second dials may be calibrated and stations brought in by setting the dials accordingly. The third dial will then function as a volume control, or, if the operator wishes, he may tune in his station by the "squeal" method, as mentioned before.

The radio fan who wants to build an economical, efficient set for home entertainment, a receiver that will give ample volume with a pure tone, one that will be simple enough for the "wife and kiddies" to operate, will find this regenerative reflex admirably suited to his requirements and his purse.

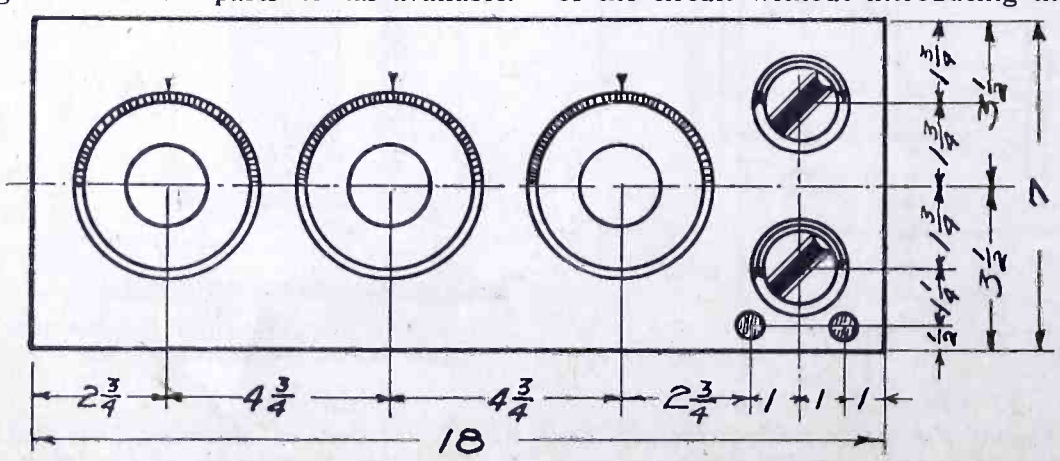


Fig. 3. Panel Layout

VERNIER VARIOMETERS

By CASSIMER WM. RADOS

In the modern receiver, vernier controls in the grid and plate circuits are necessary to get the best results. Practically all receiving sets use either a small vernier condenser, in shunt with the tuning condenser, or else a mechanical vernier. As a vernier condenser may be poorly made or inexpertly used, it may introduce undesirable losses and limit the minimum wave to which the receiver will tune. These difficulties can be eliminated by using a mechanical vernier, either geared or rubber tired.

However, if the receiver has a large wavelength range, such as 200 to 2000 meters, a vernier variometer can be used to advantage to vary the constants of the circuit without introducing these losses. In a variometer which I have used for ten months and found very satisfactory for broadcast listening the stator is untreated cardboard tube 1¼ in. outside diameter and 1 in. long. Wind 25 turns No. 24 dcc. The rotor

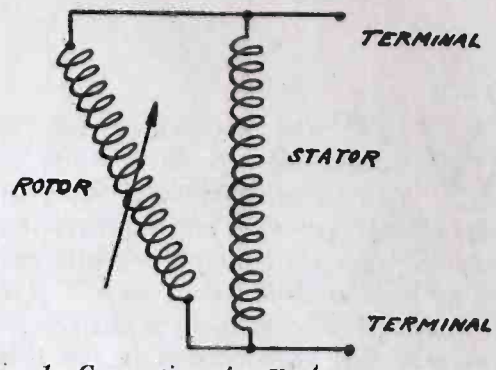


Fig. 1. Connections for Variometer Windings

is a cardboard tube ⅞ in. outside diameter and ⅞ in. long with 20 turns No. 24 dcc. Connect the windings as in Fig. 1.

Fig. 2 shows how the variometer may be mounted. Use no shellac or other

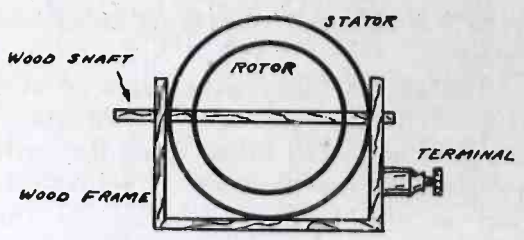


Fig. 2. Variometer Mounting

liquid on the coils. The cardboard tubes are to be untreated as also the frame. This cuts down losses. The wires will hold if wound tightly. After the wires are soldered, wipe off carefully any grease which remains. Keep the variometers as far from the panel and other instruments as possible.

The two windings of the variometer are connected in parallel. When the variometers are ready they should be connected as shown in Fig. 3. Never

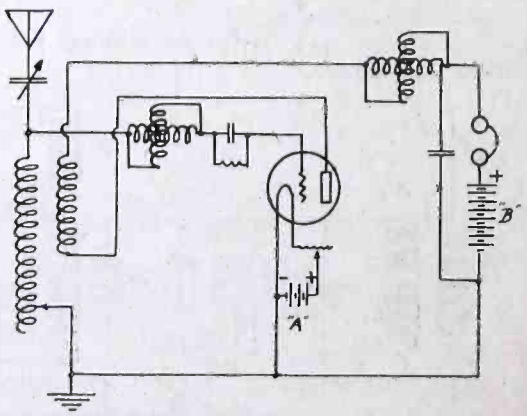


Fig. 3. Hook-up Using Two Vernier Variometers

connect in shunt to a variable condenser. In the grid circuit (secondary or tuning circuit) it goes into the wire just before the grid condenser and leak. In the plate circuit (tickler) it is put in one of the wires so as to be in series. While two variometers are not necessary, they are a great help and anyone building them will be more than repaid for the effort.

"About a radio instrument on the table was the king and his entire entourage"

A Royal Hiatus

By Earle Ennis

THE Princess Nervana sat on the of Dreams and bit viciously upon a edge of the fountain in the Garden wad of royal gum with her tiny, perfect teeth. Beside her, under the punkah of a Nubian servant, sat the Queen, her mother, weaving bright colored beads into a cubist stomacher. There was a steely glitter in the Princess' eye and she tapped the yellow flagstones with a wrathful toe.

"There are times," said the Queen, softly, "that thy father, the King, is—well, trying!" She sighed.

"My distinguished male parent gives me the weeping willies!" snapped the Princess. "I am in rags. I haven't had a new gown since the wedding of the Prince of Mazda. And all because the Governor has gone cuckoo over radio broadcasting. He gives me a large, thick pain!"

The Queen raised a gentle hand.

"Prithee, Nervana, control thyself, child. Remember thou art the daughter of a King!"

"I'll be as naked as the snake of the King if he doesn't blow himself to a couple of garters and a hair ribbon for his darling child," snapped the Princess. "Honestly, maw, it's the limit. I can't go anywhere anymore—not even to the souse party of the Lady Naught at Wazzit-on-the-Level. But if I wanted a couple of diamond-studded amplifiers or a solid gold grid leak, I could have 'em in a minute."

"Ho, boy! Ah'll say you could!" The Nubian underling burst forth with unconscious emphasis.

"You're fired," said the Queen. "You're not supposed to horn in on the royal family's conversation. On second thought, you'd better keep fanning. It's too hot to fire you just now."

"Yas'm," said the Nubian, respectfully. "Ah'm ver' sorry mah face slipped, m'am."

"Well, see that it doesn't occur again or I'll slough you, sure," said the Queen, with dignity.

The Princess waved a protesting hand.

"Oh what difference does it make, maw?" she asked. "The whole kingdom is aware of the facts. Not a charboy within fifty miles but what knows that I haven't had a change of pearls for three weeks!"

It was even so, gadzooks! Steeped in the joy of a new fad, radio broadcasting, the King had neglected affairs of state and matters of home. He had diverted funds from the royal treasury to maintain three giant broadcasting units in various parts of the kingdom. Night after night, he sat before his Stupidiodyne receiver and tuned them in and out, one after another. And the people were beginning to grumble.

"The King is mad!" they said, and tapped their heads.

"His Majesty has a screw loose," whispered the courtiers and shook their heads.

"The Most High has gone fluey!" shivered the clergy.

When church and state agree, at any time, on a single thing, a kingdom, as every student of world affairs knows, is in a bad way. But when the people agree with church and state, then rolls the course of empire upon a devious path, or something like it. It was indeed as the Princess Nervana had said. The whole nation was hip to the King's obsession.

"I'll talk with thee again apace—pick up them beads for me," said the Queen, and she arose to attend a meeting of mothers' clubs in the left wing of the palace. "I'll have a talk with thy father, the King. * * *"

"Huh!" the Princess snorted. Not

a nice thing for a beautiful, young girl to do, but it certainly covered the situation. "Huh! I wish you luck! I think the old man's getting feeble minded. I tried it, and he shushed me. Said I cost him 3000 miles on his distance handicap."

The Queen sighed. Children were so hard to manage! Within the palace, she trod softly upon the heavy velvet carpets of the listening chamber in which the King had installed his different radio sets. A harsh voice interrupted her progress.

"Damn it all, Maggie," said the King, "haven't I asked you not to come in here stamping your feet that way?"

The Queen fled. Husbands were so hard to please!

On the stairs she met Lord Watts, secretary of the interior, and minister of canals—the King's brother. In a few, well-chosen words, she passed the buck to him.

"I understand, your Majesty," said Lord Watts, when she had finished. "I shall speak with him today!"

She thanked him and he bowed over her hand. The Queen was certainly a popular old girl with the boys around the Palace—as long as the Princess remained unwed. The Queen went to her quarters well pleased. A brother-in-law can often get action where a wife fails. She hoped for the best.

Lord Watts stood for a moment outside the King's listening room before he entered. He was a kindly man and he did not relish the dirty work the Queen was always shoving off on him. Ah, well! Maggie had always been that way. He recalled her as a girl * * * Abruptly, he thrust aside the purple hangings and entered the room.

The King was humped over a table in the corner of the room, talking to himself.

"There—now * * * by gosh.* * *"

Lord Watts crossed the room softly and stood beside him.

"Sire!"

"Oh, hello Ed!" said the King, absently. "You haven't a four-megohm leak on you, have you?"

The Minister of Canals felt in his pockets.

"Here's a three and a five."

"Gimme the five," said the King. "This tube is too critical."

"Cut down your lamp a bit and bring that tickler in closer," said Lord Watts. "It will clear up the mush."

The King's face lighted.

"So? By my halidom—it does for a fact! Mihercule! Thou hast a bean for this stuff."

"Oh, I've played a bit with it, sire," said the King's brother-in-law, respectfully.

Joyfully the King dragged a vellum-bound book from a table drawer.

"Look!" he said. "Last night * * * XSXS on 67 meters—one tube and no regeneration!"

"The hell!" said Lord Watts. "That beats me. I got XSOW but I had to use radio frequency."

The King went to the door and softly turned the key in the lock.

"Say Ed, listen," he said. "Do you find that a choke coil is any help when you by-pass to the positive side of the A filament?"

And Lord Watts, his mission forgotten in the lure of the King's madness, took out the stub of a pencil and began to dig into the intricacies of the fad that had practically disrupted the kingdom. Forgotten the Queen, forgotten the depleted finances of the empire. In the minds of both was only one thought—how to keep a tube from oscillating without a neutralizing condenser.

FAR across the King's demesne, behind the embattlements of Joblots Castle, the Duke of Peruna sat with his chin on his chest and his hands trailing on the floor in an attitude of complete mental bankruptcy. It had been so long since he changed his mind that his brain might just as well have been a shirt. At his feet lay the great hounds of the castle waiting for their evening bones. Beside him the Duke of Veronal sucked on an unlighted cob-pipe and stared at the fireplace. It was all quite genre.

"And tomorrow, if all goes well, thou wilt be King," mused the Duke of Veronal, flipping an ash from his vest.

"Aye—if all goes well." The head of the house of Peruna spoke slowly. "We seize the broadcasting stations at dawn, say you?"

"That is the arrangement. We have a man who can impersonate the King's voice exactly. We figure by the time the housewives tune in for the market returns at 8:00 o'clock, we will be in control. Ten minutes later the revolution will be in full swing."

One of the great stag-hounds yawned and turned over on his side. The Duke of Veronal went on.

"While the common people are tearing the palace to pieces, we shall proclaim a new government here at Joblots. Methinks the crown will sit royally upon thy noble head, Peruna."

"Oh, simlich, simlich!" said Peruna, modestly. "And the King suspects nothing?"

"Nothing."

"Good! He is running true to form." 'Tis history we write these parlous days, my good Veronal—history."

"Aye, Duke—it will read like a broadcast program in after years."

From the folds of his official burnoose, he withdrew a scroll and unrolled it before the eyes of the man who would be King. The other leaned forward. He read aloud:

"6:00 a. m.—Seize broadcasting stations; General Defeat at YAWP; General Disorder at YAWK; General Dismay at YAWS;

"7:00 a. m.—Raise royal flag Joblots Castle; music by Joblots' orchestra, Mulva Wulser conducting; "Our Flag," by Duke of Veronal;

"7:30 a. m.—Salute; solo: 'O Joyous Day;' acclaim to Duke of Peruna as King; presentation of keys of castle by chamberlain; response: 'My People,' by newly installed King; incidental music by Joblots' orchestra.

"8:00 a. m.—Joe Brfgh imitates King from station YAWP, announcing 85 per cent raise in taxes.

"8:30 a. m.—Complete change of administration; signing off until tomorrow!"

The Duke of Peruna leaned back and closed his eyes. It was a masterly plan. Before him rose the vision of maddened populace, tax ridden for the radio vagaries of a fad-mad King, wreaking vengeance with torch and sword within the palace gates. He saw the slaughter of the guards, the futile effort to stem the tide of revolution. He saw * * *

"My God!" screamed the Duke of Peruna, jumping suddenly to his feet. "Save the Princess! Save her, I say! By the Black Oxen of my rich estates, I'll enrich the man that protects yon blonde * * *"

"Aw shut up," said the Duke of Veronal, inelegantly. "You've waked all the dogs!"

He had. They were woofing and yawping around the room.

The Duke of Peruna sank down trembling in his chair.

"Gosh!" he exclaimed. "It was so real, I thought the mob was about * * * Say—what about Nervana, anyhow?"

The Duke of Veronal shut one eye.

"The chamberlain is working with us," he said, softly. "He will save the Princess, the Stupid-iodyne, and the Queen's rubies. The mob may have the rest!"

"Ah-h-h!" The Duke of Peruna sank back. I thank thee, Veronal that hast always an eye for beauty."

The scroll on which the Duke of Veronal had written the program of the revolution slid from his fingers unnoticed by all save one in that castle room, as he went back to his dreams of conquest. Cautiously that one began to crawl along the floor toward the Duke's chair, stealthily, slowly * * * the leader of the great stag-hounds of Peruna hall—Fido, the terror!

He was a massive brute was Fido—broad of beam and deep of keel, with a high, noble prow, and classic features like Disraeli, the statesman. He could gnaw a catiff into mincemeat with one crunch of his powerful jaws. Bones snapped between his teeth like matches. In the language of scullery, he was a "twelve-minute egg."

Twelve years before, the King had done him a favor. He had belonged to the Countess of Aught then—a prisoner on a cushion. He wore a ribbon in his hair, and kid booties on his feet.

Continued on page 56

The Nature of Static and Its Elimination

An Analysis of Its Effect on Each Part of a Receiver and a Discussion of Practical Methods for Reducing It

By H. Diamond, Dept. of Electrical Eng., Lehigh University

IN the reception of radio signals, interfering oscillations, due to natural electrical disturbances known as static or atmospheric, are frequently set up in the receiving circuit. At times this interference may entirely drown out the desired signals. The elimination of these disturbing oscillations with the retention of the signaling oscillations in the receiving circuit is, therefore, of primary importance.

In 1923, Watt and Appleton, with the aid of a cathode ray oscillograph, took actual photographs of atmospherics and measured both their amplitude and duration. The oscillograms showed that the average duration of an atmospheric is about 1/500th second, and that the average value of the maximum field strength of the atmospherics observed was about 0.1 volt per meter, which is approximately 5000 times the field strength of the average radio signal.

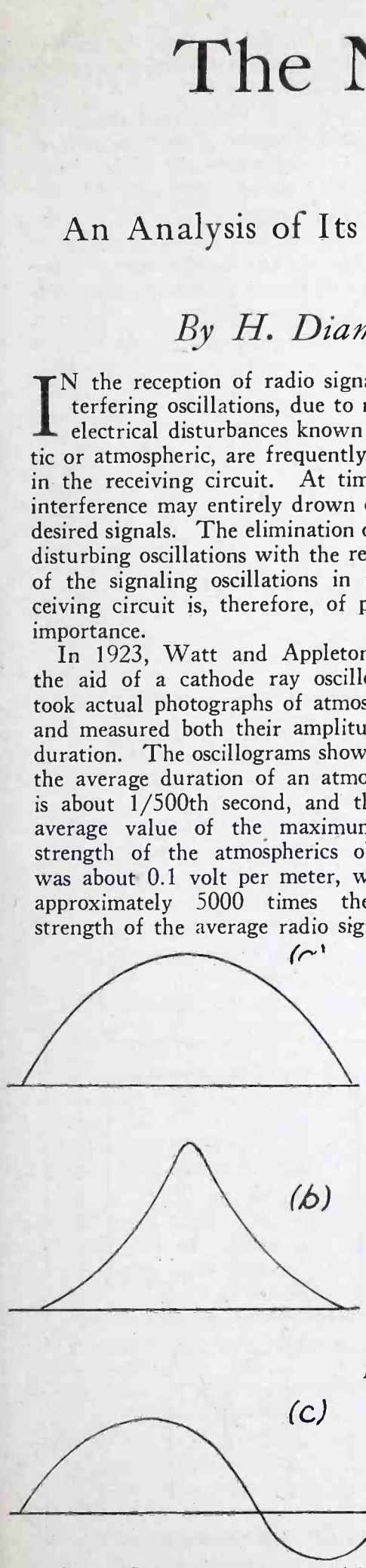


Fig. 1. Common Wave Forms of Static

The commonest wave forms observed by Watt and Appleton are shown in Fig. 1. About one-third of them closely resembled type (a), and about one-third type (c). The remaining third resembled type (b) or a modification of type (c), in which one-half wave was peaked and the second half wave rounded.

Effect Upon Antenna Circuit

SINCE the average duration of an atmospheric is approximately 1/500th second, the atmospheric frequency is about 500 cycles per second, which corresponds to a wavelength of 600,000 meters. This should be compared with the probable signal wavelengths used in transmission over a distance of say 1000 miles, which range from 600 to 6000 meters; (500,000 to 50,000 cycles per second, respectively). It is seen that, compared with the common signal frequencies, the average frequency of the atmospherics is very low. For this reason, the setting up of oscillating currents, due to atmospheric disturbances in a receiving circuit whose natural frequency is of the same magnitude as the signal frequency, is of the nature of impulse or forced excitation.

For example, consider an open antenna, Fig. 2, tuned to 6000 meters (50,000 cycles). An atmospheric of 500-cycle frequency will induce in the antenna a current of 500-cycle frequency, which will naturally be very small, since its frequency is so much

Fig. 2. Open Antenna

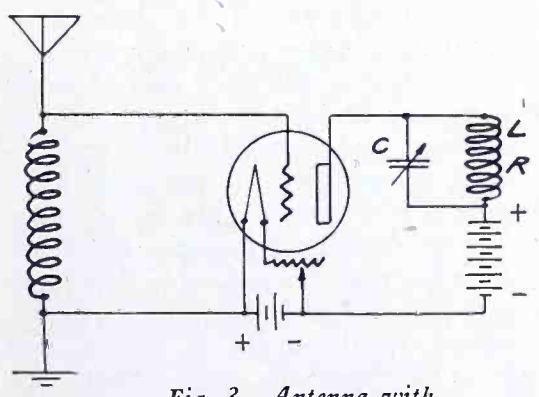


Fig. 3. Antenna with Coupled Tube

different than the natural frequency of the antenna. In addition to this effect, however, the antenna will be forced into oscillation at its natural frequency. It is this high-frequency component which is the source of interference. Obviously, selective tuning of the antenna will have little effect upon the magnitude of this component.

Now, let us assume that a three-electrode vacuum tube is coupled directly across the aerial tuning inductance, and that this vacuum tube may be either a detector or the the first tube of a chain of selective radio-frequency amplifiers operating a detector. (See Fig. 3). Let us also suppose that we can reduce the decrement of the antenna to any required degree, and, if necessary, that of all the selective amplifiers also.

The potential difference impressed upon the first tube is the potential difference developed across the ends of the aerial tuning inductance by the passage through it of the current set up by the atmospheric. It will obviously consist of a high frequency and low-frequency component.

It may be shown that the low-frequency potential difference is vastly smaller than the high-frequency potential difference, and is negligible in comparison. If the combined potential difference is applied to a selective amplifier, the high-frequency component will be amplified and the low-frequency component diminished, so that each successive stage of radio frequency amplification makes the low-frequency component less and less important.

It may be of interest to study probable numerical values for these two components. Consider an antenna tuned to a wavelength of 6000 meters and having an effective height equal to 30 meters. The maximum field strength of the atmospheric, as stated above, is 0.1 volt per meter, so that the maximum e.m.f. in the antenna is three volts. By substituting this value in theoretical formulas, it can be found that the initial value of the high-frequency component would be about 60 milli-volts and the maximum of the low-frequency component would be about 0.8 milli-volt.

It is, however, more important to consider the ratio of the signal potential difference to the atmospheric potential difference, rather than the absolute value of the latter. This ratio may be expressed as

$$\frac{\text{Signal Potential Difference}}{\text{Initial Max. P.D. of Atmospheric}} = \frac{Kf}{DF}$$

where K is a constant depending upon the magnitude of the signals, the effective height of the antenna and the prevailing atmospheric conditions, f is the signal frequency, F is the atmospheric frequency, and D the decrement of the antenna.

It is seen that, for fixed conditions of signal strength and wavelength, this ratio increases as the aerial decrement is reduced. Thus, to reduce the inter-

ed you not to come in here
r feet that way?"
n fled. Husbands were so
e!
airs she met Lord Watts,
ne interior, and minister of
King's brother. In a few,
vords, she passed the buck

and, your Majesty," said
when she had finished. "I
th him today!"
d him and he bowed over
he Queen was certainly a
irl with the boys around
s long as the Princess re-
. The Queen went to her
pleased. A brother-in-law
action where a wife fails.
the best.
stood for a moment out-
's listening room before
He was a kindly man and
elish the dirty work the
ways shoving off on him.
ggie had always been that
alled her as a girl * * *
thrust aside the purple
ntered the room.
vas humped over a table
of the room, talking to

w * * * by gosh.* * *"
crossed the room softly
le him.

Ed!" said the King, ab-
haven't a four-megohm
ave you?"
er of Canals felt in his

ee and a five."
e five," said the King.
oo critical."
your lamp a bit and bring
closer," said Lord Watts.
o the mush."
face lighted.
y halidom—it does for a
le! Thou hast a bean

to dig into the intricacies of the fad that had practically disrupted the kingdom. Forgotten the Queen, forgotten the depleted finances of the empire. In the minds of both was only one thought—how to keep a tube from oscillating without a neutralizing condenser.

FAR across the King's demesne, behind the embattlements of Joblots Castle, the Duke of Peruna sat with his chin on his chest and his hands trailing on the floor in an attitude of complete mental bankruptcy. It had been so long since he changed his mind that his brain might just as well have been a shirt. At his feet lay the great hounds of the castle waiting for their evening bones. Beside him the Duke of Veronal sucked on an unlighted cob-pipe and stared at the fireplace. It was all quite genre.

"And tomorrow, if all goes well, thou wilt be King," mused the Duke of Veronal, flipping an ash from his vest.

"Aye—if all goes well." The head of the house of Peruna spoke slowly. "We seize the broadcasting stations at dawn, say you?"

"That is the arrangement. We have a man who can impersonate the King's voice exactly. We figure by the time the housewives tune in for the market returns at 8:00 o'clock, we will be in control. Ten minutes later the revolution will be in full swing."

One of the great stag-hounds yawned and turned over on his side. The Duke of Veronal went on.

"While the common people are tearing the palace to pieces, we shall proclaim a new government here at Joblots. Methinks the crown will sit royally upon thy noble head, Peruna."

"Oh, simlich, simlich!" said Peruna, modestly. "And the King suspects nothing?"

"Nothing."

"Good! He is running true to form." 'Tis history we write these parlous days, my good Veronal—history."

"Aye, Duke, history will read like a

Before hir
populace,
ries of a
geance wit
palace gat
the guards
tide of rev
"My G
Peruna, ju
"Save the
By the Bl
I'll enrich
blonde *
"Aw shu
onal, inele
the dogs!"
He had
yawping a
The Du
bling in h
"Gosh!"
real, I thou
Say—what
The Du
"The cl
us," he sai
Princess,
Queen's ru
rest!"
"Ah-h-h
back. I th
always an e
The scr
Veronal ha
revolution s
by all save
went back
Cautiously
the floor
stealthily,
the great s
Fido, the t
He was
broad of be
high, noble
like Disrae
gnaw a cat
crunch of
snapped bet
In the lang

SINCE the average duration of an atmospheric is approximately 1/500th second, the atmospheric frequency is about 500 cycles per second, which corresponds to a wavelength of 600,000 meters. This should be compared with the probable signal wavelengths used in transmission over a distance of say 1000 miles, which range from 600 to 6000 meters; (500,000 to 50,000 cycles per second, respectively). It is seen that, compared with the common signal frequencies, the average frequency of the atmospherics is very low. For this reason, the setting up of oscillating currents, due to atmospheric disturbances in a receiving circuit whose natural frequency is of the same magnitude as the signal frequency, is of the nature of impulse or forced excitation.

For example, consider an open antenna, Fig. 2, tuned to 6000 meters (50,000 cycles). An atmospheric of 500-cycle frequency will induce in the antenna a current of 500-cycle frequency, which will naturally be very small, since its frequency is so much

Fig. 2. Open Antenna

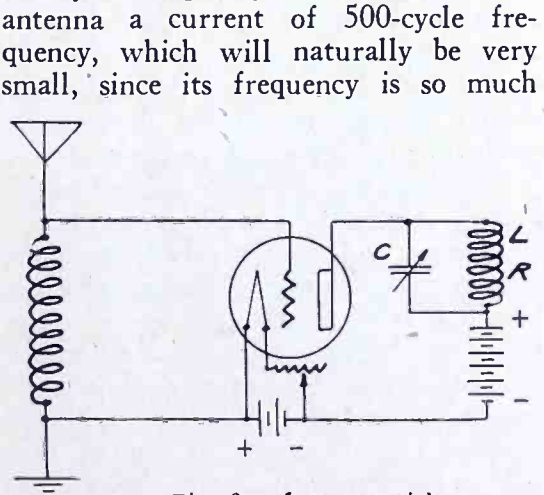


Fig. 3. Antenna with Coupled Tube

different than the natural frequency of the antenna. In addition to this effect, however, the antenna will be forced into oscillation at its natural frequency. It is this high-frequency component which is the source of interference. Obviously, selective tuning of the antenna will have little effect upon the magnitude of this component.

quired degree, and, if neces
all the selective amplifiers a

The potential differenc
upon the first tube is the p
ference developed across the
aerial tuning inductance by
through it of the current s
atmospheric. It will obvi
of a high frequency and lo
component.

It may be shown that
quency potential differenc
smaller than the high-freq
tial difference, and is negli
parison. If the combined
ference is applied to a select
the high-frequency compon
amplified and the low-fre
ponent diminished, so that
sive stage of radio frequen
tion makes the low-frequenc
less and less important.

It may be of interest to st
numerical values for thes
ponents. Consider an ante
a wavelength of 6000 meter
an effective height equal t
The maximum field streng
mospheric, as stated above
per meter, so that the max
in the antenna is three vo
stituting this value in theor
las, it can be found that the
of the high-frequency comp
be about 60 milli-volts and
of the low-frequency comp
be about 0.8 milli-volt.

It is, however, more impo
sider the ratio of the sig
difference to the atmosphe
difference, rather than the a
of the latter. This ratio
pressed as

$$\frac{\text{Signal Potential Difference}}{\text{Initial Max. P.D. of Atmos}}$$

where K is a constant dep
the magnitude of the signa
tive height of the antenna
vailing atmospheric condit
signal frequency. F is the

a nice thing for a beautiful, young girl to do, but it certainly covered the situation. "Huh! I wish you luck! I think the old man's getting feeble minded. I tried it, and he shushed me. Said I cost him 3000 miles on his distance handicap."

The Queen sighed. Children were so hard to manage! Within the palace, she trod softly upon the heavy velvet carpets of the listening chamber in which the King had installed his different radio sets. A harsh voice interrupted her progress.

"Damn it all, Maggie," said the King, "haven't I asked you not to come in here stamping your feet that way?"

The Queen fled. Husbands were so hard to please!

On the stairs she met Lord Watts, secretary of the interior, and minister of canals—the King's brother. In a few, well-chosen words, she passed the buck to him.

"I understand, your Majesty," said Lord Watts, when she had finished. "I shall speak with him today!"

She thanked him and he bowed over her hand. The Queen was certainly a popular old girl with the boys around the Palace—as long as the Princess remained unwed. The Queen went to her quarters well pleased. A brother-in-law can often get action where a wife fails. She hoped for the best.

Lord Watts stood for a moment outside the King's listening room before he entered. He was a kindly man and he did not relish the dirty work the Queen was always shoving off on him. Ah, well! Maggie had always been that way. He recalled her as a girl * * * Abruptly, he thrust aside the purple hangings and entered the room.

The King was humped over a table in the corner of the room, talking to himself.

"There—now * * * by gosh.* * *"

Lord Watts crossed the room softly and stood beside him.

"Sire!"

"Oh, hello Ed!" said the King, absently. "You haven't a four-megohm leak on you, have you?"

The Minister of Canals felt in his pockets.

"Here's a three and a five."

"Gimme the five," said the King. "This tube is too critical."

"Cut down your lamp a bit and bring that tickler in closer," said Lord Watts. "It will clear up the mush."

The King's face lighted.

"So? By my halidom—it does for a fact! Mihercule! Thou hast a bean for this stuff."

"Oh, I've played a bit with it, sire," said the King's brother-in-law, respectfully.

Joyfully the King dragged a vellum-bound book from a table drawer.

"Look!" he said. "Last night * * * XSXS on 67 meters—one tube and no regeneration!"

"The hell!" said Lord Watts. "That beats me. I got XSOW but I had to use radio frequency."

The King went to the door and softly turned the key in the lock.

"Say Ed, listen," he said. "Do you find that a choke coil is any help when you by-pass to the positive side of the A filament?"

And Lord Watts, his mission forgotten in the lure of the King's madness, took out the stub of a pencil and began to dig into the intricacies of the fad that had practically disrupted the kingdom. Forgotten the Queen, forgotten the depleted finances of the empire. In the minds of both was only one thought—how to keep a tube from oscillating without a neutralizing condenser.

FAR across the King's demesne, behind the embattlements of Joblots Castle, the Duke of Peruna sat with his chin on his chest and his hands trailing on the floor in an attitude of complete mental bankruptcy. It had been so long since he changed his mind that his brain might just as well have been a shirt. At his feet lay the great hounds of the castle waiting for their evening bones. Beside him the Duke of Veronal sucked on an unlighted cob-pipe and stared at the fireplace. It was all quite genre.

"And tomorrow, if all goes well, thou wilt be King," mused the Duke of Veronal, flipping an ash from his vest.

"Aye—if all goes well." The head of the house of Peruna spoke slowly. "We seize the broadcasting stations at dawn, say you?"

"That is the arrangement. We have a man who can impersonate the King's voice exactly. We figure by the time the housewives tune in for the market returns at 8:00 o'clock, we will be in control. Ten minutes later the revolution will be in full swing."

One of the great stag-hounds yawned and turned over on his side. The Duke of Veronal went on.

"While the common people are tearing the palace to pieces, we shall proclaim a new government here at Joblots. Methinks the crown will sit royally upon thy noble head, Peruna."

"Oh, simlich, simlich!" said Peruna, modestly. "And the King suspects nothing?"

"Nothing."

"Good! He is running true to form." 'Tis history we write these parlous days, my good Veronal—history."

"Aye, Duke—it will read like a broadcast program in after years."

From the folds of his official burnoose, he withdrew a scroll and unrolled it before the eyes of the man who would be King. The other leaned forward. He read aloud:

"6:00 a. m.—Seize broadcasting stations; General Defeat at YAWP; General Disorder at YAWK; General Dismay at YAWS;

"7:00 a. m.—Raise royal flag Joblots Castle; music by Joblots' orchestra, Mulva Wulser conducting; "Our Flag," by Duke of Veronal;

"7:30 a. m.—Salute; solo: 'O Joyous Day;' acclaim to Duke of Peruna as King; presentation of keys of castle by chamberlain; response: 'My People,' by newly installed King; incidental music by Joblots' orchestra.

"8:00 a. m.—Joe Brfgh imitates King from station YAWP, announcing 85 per cent raise in taxes.

"8:30 a. m.—Complete change of administration; signing off until tomorrow!"

The Duke of Peruna leaned back and closed his eyes. It was a masterly plan. Before him rose the vision of maddened populace, tax ridden for the radio vagaries of a fad-mad King, wreaking vengeance with torch and sword within the palace gates. He saw the slaughter of the guards, the futile effort to stem the tide of revolution. He saw * * *

"My God!" screamed the Duke of Peruna, jumping suddenly to his feet. "Save the Princess! Save her, I say! By the Black Oxen of my rich estates, I'll enrich the man that protects yon blonde * * *"

"Aw shut up," said the Duke of Veronal, inelegantly. "You've waked all the dogs!"

He had. They were woofing and yawping around the room.

The Duke of Peruna sank down trembling in his chair.

"Gosh!" he exclaimed. "It was so real, I thought the mob was about * * * Say—what about Nervana, anyhow?"

The Duke of Veronal shut one eye.

"The chamberlain is working with us," he said, softly. "He will save the Princess, the Stupid-iodyne, and the Queen's rubies. The mob may have the rest!"

"Ah-h-h!" The Duke of Peruna sank back. I thank thee, Veronal that hast always an eye for beauty."

The scroll on which the Duke of Veronal had written the program of the revolution slid from his fingers unnoticed by all save one in that castle room, as he went back to his dreams of conquest. Cautiously that one began to crawl along the floor toward the Duke's chair, stealthily, slowly * * * the leader of the great stag-hounds of Peruna hall—Fido, the terror!

He was a massive brute was Fido—broad of beam and deep of keel, with a high, noble prow, and classic features like Disraeli, the statesman. He could gnaw a catiff into mincemeat with one crunch of his powerful jaws. Bones snapped between his teeth like matches. In the language of scullery, he was a "twelve-minute egg."

Twelve years before, the King had done him a favor. He had belonged to the Countess of Aught then—a prisoner on a cushion. He wore a ribbon in his hair, and kid booties on his feet.

Continued on page 56

The Nature of Static and Its Elimination

An Analysis of Its Effect on Each Part of a Receiver and a Discussion of Practical Methods for Reducing It

By H. Diamond, Dept. of Electrical Eng., Lehigh University

IN the reception of radio signals, interfering oscillations, due to natural electrical disturbances known as static or atmospheric, are frequently set up in the receiving circuit. At times this interference may entirely drown out the desired signals. The elimination of these disturbing oscillations with the retention of the signaling oscillations in the receiving circuit is, therefore, of primary importance.

In 1923, Watt and Appleton, with the aid of a cathode ray oscillograph, took actual photographs of atmospherics and measured both their amplitude and duration. The oscillograms showed that the average duration of an atmospheric is about 1/500th second, and that the average value of the maximum field strength of the atmospherics observed was about 0.1 volt per meter, which is approximately 5000 times the field strength of the average radio signal.

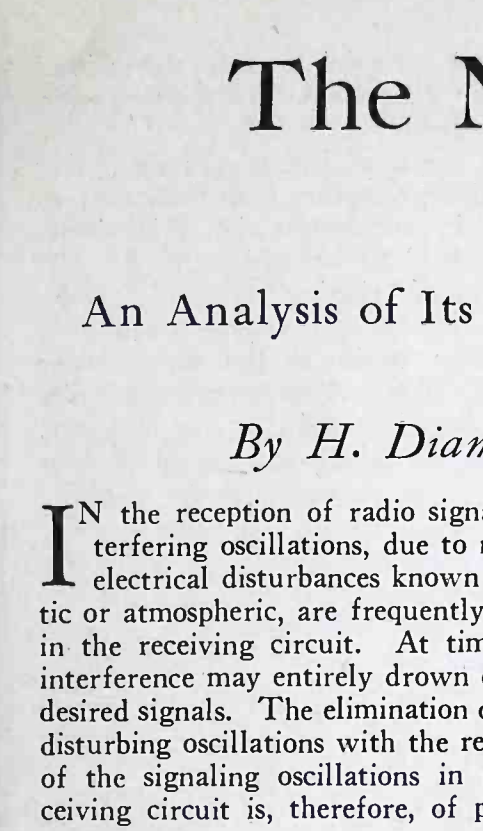


Fig. 1. Common Wave Forms of Static

The commonest wave forms observed by Watt and Appleton are shown in Fig. 1. About one-third of them closely resembled type (a), and about one-third type (c). The remaining third resembled type (b) or a modification of type (c), in which one-half wave was peaked and the second half wave rounded.

Effect Upon Antenna Circuit

SINCE the average duration of an atmospheric is approximately 1/500th second, the atmospheric frequency is about 500 cycles per second, which corresponds to a wavelength of 600,000 meters. This should be compared with the probable signal wavelengths used in transmission over a distance of say 1000 miles, which range from 600 to 6000 meters; (500,000 to 50,000 cycles per second, respectively). It is seen that, compared with the common signal frequencies, the average frequency of the atmospherics is very low. For this reason, the setting up of oscillating currents, due to atmospheric disturbances in a receiving circuit whose natural frequency is of the same magnitude as the signal frequency, is of the nature of impulse or forced excitation.

For example, consider an open antenna, Fig. 2, tuned to 6000 meters (50,000 cycles). An atmospheric of 500-cycle frequency will induce in the antenna a current of 500-cycle frequency, which will naturally be very small, since its frequency is so much

Fig. 2. Open Antenna

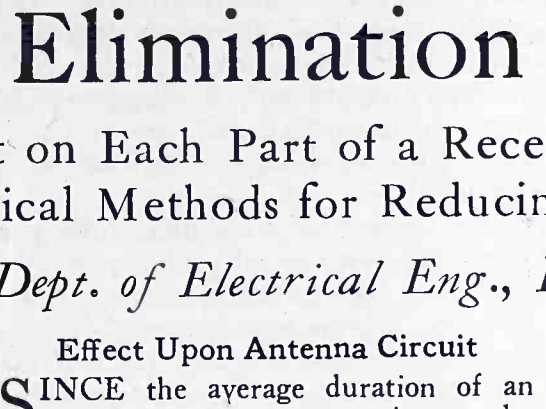


Fig. 3. Antenna with Coupled Tube

different than the natural frequency of the antenna. In addition to this effect, however, the antenna will be forced into oscillation at its natural frequency. It is this high-frequency component which is the source of interference. Obviously, selective tuning of the antenna will have little effect upon the magnitude of this component.

Now, let us assume that a three-electrode vacuum tube is coupled directly across the aerial tuning inductance, and that this vacuum tube may be either a detector or the the first tube of a chain of selective radio-frequency amplifiers operating a detector. (See Fig. 3). Let us also suppose that we can reduce the decrement of the antenna to any required degree, and, if necessary, that of all the selective amplifiers also.

The potential difference impressed upon the first tube is the potential difference developed across the ends of the aerial tuning inductance by the passage through it of the current set up by the atmospheric. It will obviously consist of a high frequency and low-frequency component.

It may be shown that the low-frequency potential difference is vastly smaller than the high-frequency potential difference, and is negligible in comparison. If the combined potential difference is applied to a selective amplifier, the high-frequency component will be amplified and the low-frequency component diminished, so that each successive stage of radio frequency amplification makes the low-frequency component less and less important.

It may be of interest to study probable numerical values for these two components. Consider an antenna tuned to a wavelength of 6000 meters and having an effective height equal to 30 meters. The maximum field strength of the atmospheric, as stated above, is 0.1 volt per meter, so that the maximum e.m.f. in the antenna is three volts. By substituting this value in theoretical formulas, it can be found that the initial value of the high-frequency component would be about 60 milli-volts and the maximum of the low-frequency component would be about 0.8 milli-volt.

It is, however, more important to consider the ratio of the signal potential difference to the atmospheric potential difference, rather than the absolute value of the latter. This ratio may be expressed as

$$\frac{\text{Signal Potential Difference}}{\text{Initial Max. P.D. of Atmospheric}} = \frac{Kf}{DF}$$

where K is a constant depending upon the magnitude of the signals, the effective height of the antenna and the prevailing atmospheric conditions, f is the signal frequency, F is the atmospheric frequency, and D the decrement of the antenna.

It is seen that, for fixed conditions of signal strength and wavelength, this ratio increases as the aerial decrement is reduced. Thus, to reduce the inter-

ference due to static, the aerial decrement should be reduced to the lowest value compatible with stability and speed of signaling.

To fix ideas, let us here consider a numerical case. Suppose that the signal wavelength is 6000 meters and let the decrement be reduced to a value equal to 0.002. For the signal potential difference to be just equal to the potential difference due to the atmospheric we have

$$\frac{Kf}{DF} = 1$$

$$\frac{K \times 50000}{0.002 \times 500} = 1$$

$$K = 0.00002$$

Usually K is very much larger, so that, by sufficient reduction of the antenna decrement, the signal strength may be reduced to a few microvolts per meter and yet be strong enough to hold its own against comparatively powerful static. This, after all, is not surprising, for, if any other conditions were true, it is hardly probable that radio communication would be as successful as it is today.

Returning to Fig. 3, let us now consider what happens in the tuned plate circuit. The potential difference developed across the terminals of the plate circuit impedance is handed on in the usual manner to the next tube, which may be another amplifier or a detector. We have seen that the potential difference applied to the input terminals of the first tube consists of a high-frequency and low-frequency component. This potential difference will produce a current in the plate circuit inductance which will consist of three components, one low frequency and two high frequency. One of the high-frequency components will have the decrement and the natural frequency of the aerial and the other the decrement and the natural frequency of the L. R. C. circuit of the amplifier, together with the mutual conductance of the tube. Since the amplifier is assumed to be tuned to the same wavelength as the aerial, the two high-frequency components will be of the same frequency.

The circuit of the amplifier may be replaced by the equivalent circuit shown in Fig. 4, where r is the apparent re-

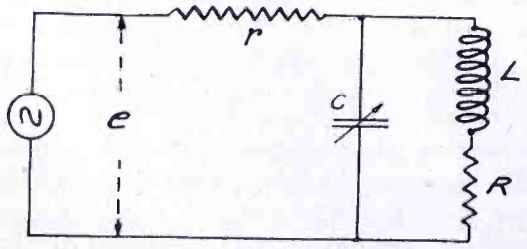


Fig. 4. Equivalent of Amplifying Tube Circuit

sistance of the tube and e is the voltage applied to the plate circuit, being equal to the voltage applied to the grid times the amplification factor of the tube. For the usual receiving tube, r varies from 30,000 to 40,000 ohms. To the low-frequency component of the applied e.m.f., the plate circuit therefore acts very nearly as a pure resistance. The resultant potential difference across the plate circuit inductance, due to the low-frequency component, is therefore very small, being approximately one-millionth part of the low-frequency component in the aerial.

The value of the potential difference across the plate circuit inductance, due to the two high-frequency currents, will, however, depend upon the amplification factor of the tube, the decrement of the antenna circuit and the decrement of the plate circuit. If the decrement of the plate circuit is reduced sufficiently, the amplitude of this potential difference may be reduced as much as 50%. However, if the decrement of the plate circuit becomes much less than the decrement of the aerial circuit, the interference becomes much more persistent, even though of small amplitude. The safest plan seems to be to keep the decrement of the plate circuit (*not* including the conductance of the tube) much greater than that of the aerial. The best procedure is to reduce the plate circuit decrement until further reduction increases the signal very little, and then to reduce the aerial decrement to the limit imposed by stability and speed of signaling.

Effect on Detector and Audio-Frequency Amplifiers

HAVING traced the course of static through the antenna and the successive stages of the radio-frequency amplifiers, let us now consider its effect on the detector and the audio-frequency amplifiers. The heterodyne method of reception is here assumed.

The potential difference applied to the detector consists of a small low-frequency component and a relatively large high-frequency component. If the signal wave length is 6000 meters, the actual value of the low-frequency potential difference will be less than a microvolt. The high-frequency potential difference will be, however, of the order of one or two volts. Consequently, even though the detector and its low-frequency transformer forms an amplifier suitable for the low-frequency component, the potential difference handed on to the first low-frequency transformer will be negligible as compared with that due to the rectified current produced by the high-frequency portion. The low-frequency component may therefore be finally dismissed from consideration.

Now, to discriminate between the high-frequency component of the atmospheric and the signal, it is highly beneficial to tune the second audio-frequency amplifier to the beat note between the signal and heterodyne and to make the natural frequency of the first audio-frequency amplifier very different from the beat note. In this manner, the ratio of signal to atmospheric in the phones will be considerably increased.

The above analysis shows then, that for audible reception with minimum atmospheric interference the aerial decrement should be reduced until the phenomenon of "ringing" becomes troublesome, the radio-frequency amplifiers should be tuned to the signal wave length, the second audio-frequency amplifier should be tuned to the beat note between the signal and the heterodyne and the first audio-frequency amplifier should have a natural frequency very different from the beat note. Under these conditions the receiving set is in the best form to battle with static.

In addition to the refinements described above, for use with a tuned open antenna, there are two other fairly simple methods for eliminating atmospheric interference. Both methods consist in modifying the aerial, one being the use of a tuned loop antenna, and the other the use of an aperiodic antenna.

Tuned Loop Antenna

SINCE static interference comes from all directions while the desired signal comes from one direction only, the ratio of signal to atmospheric may evidently be increased by using a directional receiving antenna. Furthermore, since the atmospherics are of very low frequencies (very long waves), the best antenna will be the one that absorbs but little energy from waves longer than that for which it is tuned.

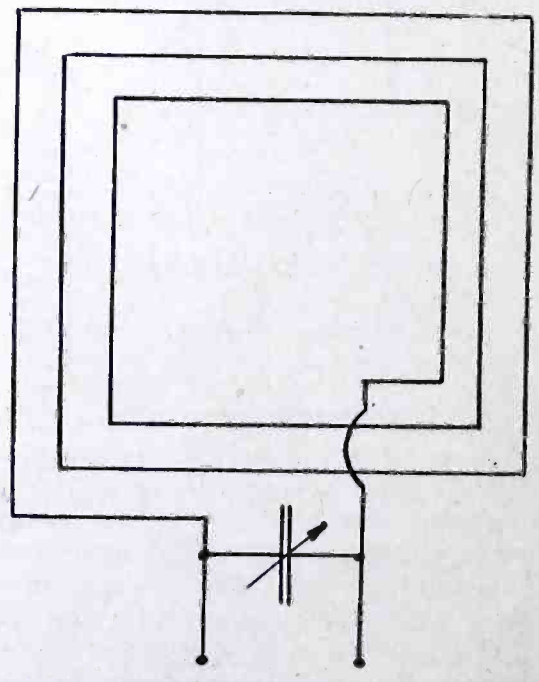


Fig. 5. Loop Antenna

A loop antenna (Fig. 5.) satisfies both of these requirements better than the ordinary open antenna, it being directional and having induced in it a voltage inversely proportional to the wavelength. (The induced voltage in an ordinary antenna is independent of the wavelength).

It is of course true that the intensity

Continued on page 72

How to Get Negative Grid Potentials

A Summary of Reasons for Using and of Methods Employed for Securing a Negative Grid

By Bernard Steinmetz

NUMEROUS articles have appeared recently to tell us how important it is to use a negative *C* battery potential for the grids of vacuum tube amplifiers. But, in covering the subject, they have omitted much meat. For example, they have limited their discussion to the vacuum tube amplifier, but how about the modulator tube used in radiophone transmitters, how about the oscillators used in transmitters? Also having decided that it is important to have a negative voltage on the grids of the tubes, what are the different ways of securing this negative voltage in practice?

The reasons for the necessity of negative voltage on the grids of vacuum tubes may best be illustrated by means of the well-known characteristic curve of Fig. 1. The curve *A* gives the plate current

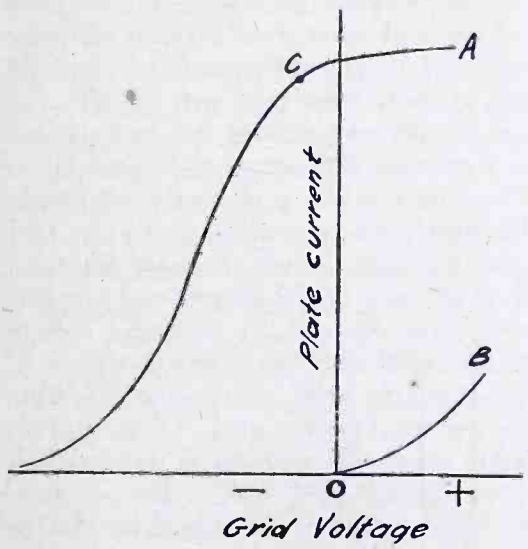


Fig. 1. Characteristic Curve of Vacuum Tube

which flows for different applied grid voltages, while the curve *B* shows the grid currents which flow for different applied grid voltages. It will be noticed that the grid current flows only when a positive potential is applied to the grid. When a grid current flows that is an absorption of energy in the grid circuit and this represents a loss of power. In order to avoid this loss of energy and thus keep the efficiency of the tube high, it is necessary to keep the grid at a negative potential, thus avoiding the flow of grid currents.

When no current flows in the grid circuit, the resistance of this circuit must be infinitely great, for it prevents any current from flowing in it. This resistance, from the grid to the filament inside the tube, becomes smaller, however, as soon as the grid becomes positive, for then grid currents flow. The more positive potential is applied to the grid the less the resistance becomes. This grid-filament resistance is in parallel with the circuit which is feeding the grid; for example, it is in parallel with the secondary of an audio-frequency amplifying transformer. It therefore has the effect of applying a low resistance across the secondary and short circuiting this secondary, or reducing the voltage which is applied to the grid by the transformer. Thus the effect of the grid currents produced by positive voltage on the grid is to reduce or destroy the amplification properties of the transformer and tube. To avoid this, it is essential to use negative potentials on the grids of tubes to keep the grid-filament resistance high.

The straight-line portion of the curve is over on the negative side of the grid voltage axis. It is most advantageous to work on the straight portion of the curve because the slope or grade is steepest, which results in maximum amplification. To work on this part of the curve, it is necessary to use a negative voltage on the grid. This applies both to amplifier operation and detector operation. Furthermore, unless the amplifier is used in this way, these will be considerable distortion of both speech and music.

When we consider the question from the point of view of the oscillator as used in radiophone or radio-telegraph transmitters, we must again work the tubes so that they operate on the straight part of the characteristic. If the oscillator tube were worked at an average grid potential given by point *C* of the characteristic curve (Fig. 1), equal grid voltage changes to the left and right would produce unequal plate current changes above and below the average plate current. This would result in the plate current curve being unsymmetrical; hence the radio-frequency oscillations would likewise be unsymmetrical, with the result that harmonics are generated. This is the reason that some stations may be tuned in at a few different points on the tuner. They generate harmonics and thus radiate on a number of different wavelengths. To avoid this, it is essential to operate the tube so that its average grid potential is at the center of the straight line part of the characteristic curve, and this requires that the grid be at a certain negative potential.

Finally, we have the case of the modulator tube, and here again it is essential to use a negative potential on the grid of the tube. Here the principal reason for using negative voltage on the grid of the tube is that it prevents distortion. Modulators are essentially high-power audio-frequency amplifiers, and it is just as important to bias the grid of the high-power amplifier as it is to bias the grid of the low-power receiving amplifier.

THIS desirable negative potential may be secured in a number of ways, depending upon the function of the tube. Thus the method of applying a negative voltage to the grid of the vacuum tube amplifier is entirely different from that used for the oscillator tube. We will take up the various methods in the following paragraphs.

The first and simplest method is to connect the grid return lead to the negative terminal of the filament; see Fig. 2.

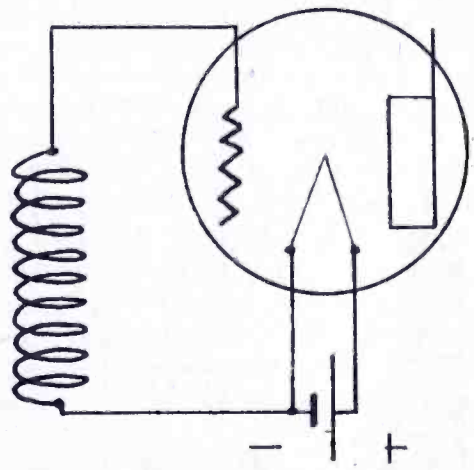


Fig. 2. Grid Return Connected to Negative Filament

In other words, we have simply placed the grid at the same negative potential as the negative end of the filament. The grid is thus no more negative than the most negative point of the filament. However, what we are after is to make the grid more negative than any point of the filament, for, when we talk of the potential of the grid, we mean its potential relative to the negative end of the filament anyhow. In order to secure this increased negative potential on the grid, we are led to the next method.

This method simply involves the use of an actual battery in the grid circuit, the negative terminal of the battery being connected to the grid, as in Fig. 3. By so doing, we make the grid more negative than the negative end of the filament by the amount of voltage the grid battery supplies. By varying the number of cells used, the grid negative potential may be varied. This method of biasing

is used in amplifiers, modulators, and sometimes detectors. In connecting such a *C* battery in circuit the following precaution should be observed. The battery should be connected in the filament leg of the grid circuit. Inasmuch as batteries have some capacity, they should be connected near earth potential (filament) and not near the grid, which is always at higher alternating potential and therefore more likely to result in high capacity losses if the battery is placed near it.

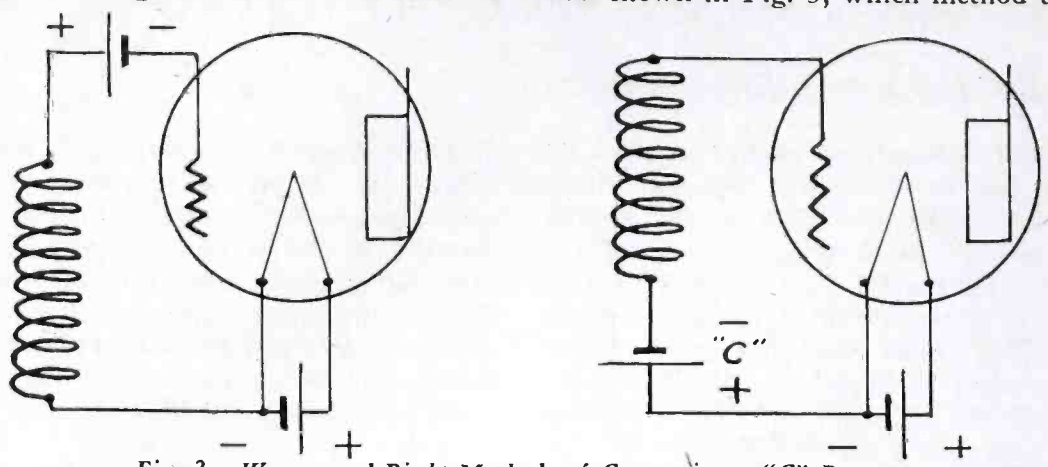


Fig. 3. Wrong and Right Methods of Connecting a "C" Battery

A third method, and very economical one at times, for securing negative voltage for the grids of amplifier and modulator tubes is to use a so-called biasing resistance. This will be evident from an inspection of Fig. 4. Consider the case of the rheostat in the filament circuit. The current flows from the plus terminal of the battery through the filament to point *A*, and from *A* through the rheostat to the negative terminal of the battery. Thus the negative terminal of the battery is at the lowest potential, and point *A*, which is the most negative point of the filament, is at a higher potential than point *B*, the negative terminal of the battery. Point *B* is more negative than point *A* by the voltage drop in the rheostat *R*. Therefore, if we connect the grid return to the negative end of the battery, the grid will be placed at a more negative potential than the negative end of the filament, and it will be more negative than the filament by the amount of voltage drop in the rheostat. This plan avoids the use of an extra bias battery, and is a method used in a good many receiving sets. It is limited in use by the fact that it sometimes is necessary to use a greater bias voltage on the grid than may be secured by this method.

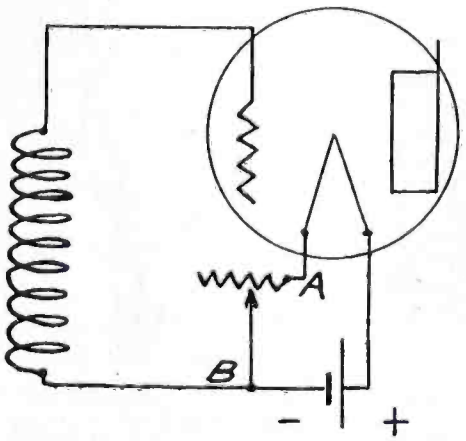


Fig. 4. Biasing Resistance Method

An adaptation of this last method is that shown in Fig. 5, which method the writer has used very effectively. A resistance is placed in the negative lead of the plate circuit generator or battery. The grid circuit is connected to the negative terminal of the plate battery or generator, while the filament is connected to the other end of the resistance *R* as shown. It will be evident that, since the plate current flows from point *B* to point *A* through the resistance, point *A* is at a more negative potential than point *B*, which is the filament. By varying the resistance *R*, the amount by which the grid is more negative than the filament, may likewise be varied. This system was adopted for securing negative potentials on modulators and proved highly successful. The resistance required costs some money; not more than a battery or bank of batteries, but it never has to be renewed as does the battery.

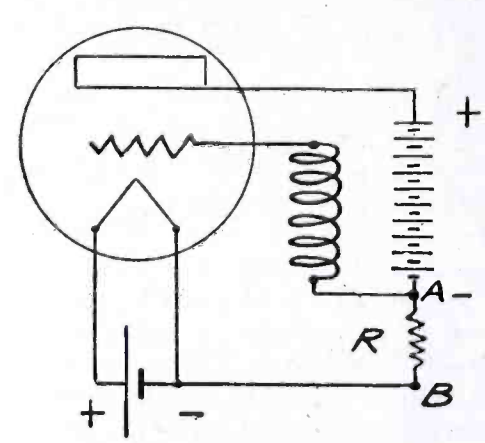


Fig. 5. Adoption of Biasing Resistance Method

The above methods apply generally to amplifier and modulator tubes. For oscillators and detectors, entirely different methods are used for properly biasing the grids. In this case use is made of the grid condenser and leak. In this method a small condenser and high resistance are connected in either of two ways as shown in Fig. 6. In this method use is made of the fact that electrons carry a negative charge, and, when they flow to the grid, they lodge on the grid and are prevented from leaking off it by the insulating condenser *C*. They do leak off very slowly by way of the very high resistance leak, but not fast enough to neutralize the negative charge which is imparted to the grid by the electrons. By varying the resistance of *R*, the grid leak, the rate at which these negative electrons leak off may be varied; in this way a variation of the negative charge on the grid may be secured. This is, therefore, the same as varying the negative potential on the grid. This is practically what the operator is doing when he varies his grid leak. He is automatically varying the negative charge on the grid and so securing best operation.

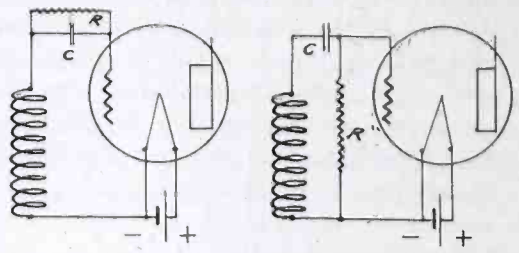


Fig. 6. Grid Leak and Condenser Method of Securing Negative Bias

The Simple Theory of Audio-Frequency Transformers

By Edward W. Smith

ONE of the most important and at the same time most neglected pieces of apparatus in the present day audio-frequency amplifiers is the transformer used to couple the plate circuit of one tube to the grid circuit of the next. It is the transformer which determines to a large degree the quality of the sound output and hence the usefulness of the amplifier. While the average transformer coupled amplifier does not give as good quality as a good resistance coupled amplifier, it has the advantage that much more amplification can be obtained per stage. The quality of output can be improved by properly designed transformers.

In order that the transformer coupled amplifier may compete with the resistance coupled type in quality, it should amplify all frequencies in the speech and musical ranges by approximately the same amount. Due to the inherent characteristics of this type of coupling, it is difficult to make the amplification exactly alike for all frequencies, but a close approximation can be obtained by careful design.

With regard to the correct ratio of transformation for an audio transformer much has been written. Ratios of from 3:1 to 10:1 I have tried with varying results, but present-day opinion seems to point toward the lower ratios as being the best.

The action of a transformer is briefly as follows. If an alternating voltage is applied across the terminals as at *A* in Fig. 1, a certain amount of magnetic

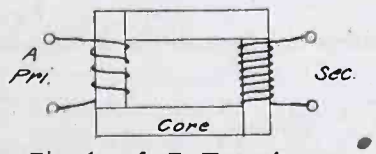


Fig. 1. A. F. Transformer

flux flows back and forth in the iron core, at a frequency determined by the frequency of the applied voltage. In its passage through the core some of this flux links the turns in the secondary winding and generates a secondary voltage of the same frequency as that of the applied voltage and nearly opposite in phase. This voltage is nearly equal to the primary voltage multiplied by the turns ratio of the transformer. Thus if the ratio is 5:1 the voltage in the secondary winding will be five times that impressed on the primary.

Fig. 2 shows the circuit of a transformer coupled amplifier. With the filament lighted and the *B* battery connected, a steady stream of electrons flows from the filament to the plate through the transformer primary and *B* battery

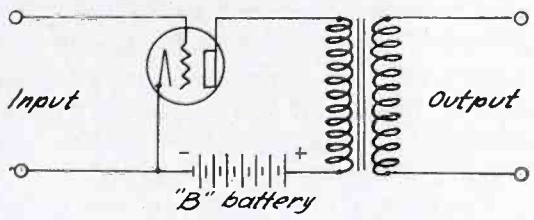


Fig. 2. Amplifier Tube and Transformer

back to the filament. If the tube is a detector, variations of the signal voltage on the grid cause radio-frequency variations in the plate current, the envelope of these fluctuations corresponding to wave shape of the sound wave striking the microphone, thus making the audio-frequency variations which may be resolved into a steady and an alternating component. Impedances, reactances, etc., referred to from now on will refer to the alternating audio-frequency component.

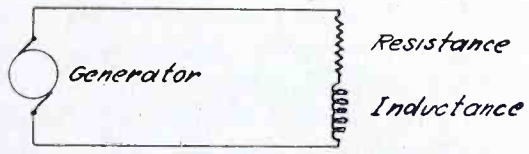


Fig. 3. Resistance and Inductance in Generator Circuit

In the simplified circuit of Fig. 3, the voltage of an a. c. generator forces current through a resistance, an inductance and the generator itself, the voltage depending on the resistance of impedance of the circuit. If most of the generated voltage is to be consumed in forcing the current through the inductance, its impedance should be be large compared to the resistance and to the impedance of the generator itself. Then almost all of the generated voltage would appear as a voltage drop across the terminals of the inductance.

We have a similar condition in Fig. 2. The plate resistance of the tube may be compared to the internal impedance of the generator, the resistance in Fig. 3 to the resistance of the *B* battery, and the inductance to the primary of the transformer. Since we want our amplification to be as efficient as possible, we want the audio-frequency current in the plate circuit to produce as large a drop as possible across the primary of the transformer, as it is only voltage drop across this point which is passed on to the next tube.

The impedance of a transformer is equal to $\sqrt{R^2 + (2\pi fL)^2}$ where R is the resistance of the winding, f the frequency of the applied voltage, and L the inductance of the winding. It was assumed in the beginning that we wished to have the amplification of all frequencies in the musical range approximately alike. From the equation for impedance it can be seen with a given inductance that the impedance increases with increasing frequency, so that if we make the impedance of the tranformer sufficiently high at 100 cycles so that its impedance forms the major impedance in the circuit it certainly will form the major impedance at any higher frequency. The plate impedance of the UV-201A tube at 100 volts plate with a 6-volt grid bias is approximately 13,000 ohms, so that, if we want to have 50% of the drop around the plate circuit at 100 cycles to be applied across the transformer, we must make its primary inductance approximately 20 henries.

It might seem that, knowing this, it would be comparatively easy to build a transformer which would work well, in an amplifier which might be called upon to amplify frequencies as low as 100 cycles efficiently. This is not the case, however, as the inductance of a transformer depends chiefly upon the number of turns in the primary and upon the permeability of the material composing the core.

The 20-henry inductance may be obtained either by using a core of comparatively low permeability and a large number of turns, or a core of high permeability and fewer turns. The disadvantage of a large number of turns is distributed capacity, which is equivalent to a condenser connected across the terminals of the primary winding. This shunts out most of the high frequencies in music, because they tend to go through capacity rather than through the inductance.

The required inductance may also be secured by using fewer turns with some such material as permalloy for the core. Permalloy allows a large magnetic flux to flow through it with a small magnetizing force. Too great a flux, however, saturates the core and introduces distortions in the transmitted voltage.

If we design a transformer to make the amplification of low frequencies fairly efficient, we begin to lose the high frequencies due to the distributed capacity of the windings, and, conversely, if we attempt to preserve the high fre-

Continued on page 67

Potomac Power Company Adopts Radio

By S. R. Winters

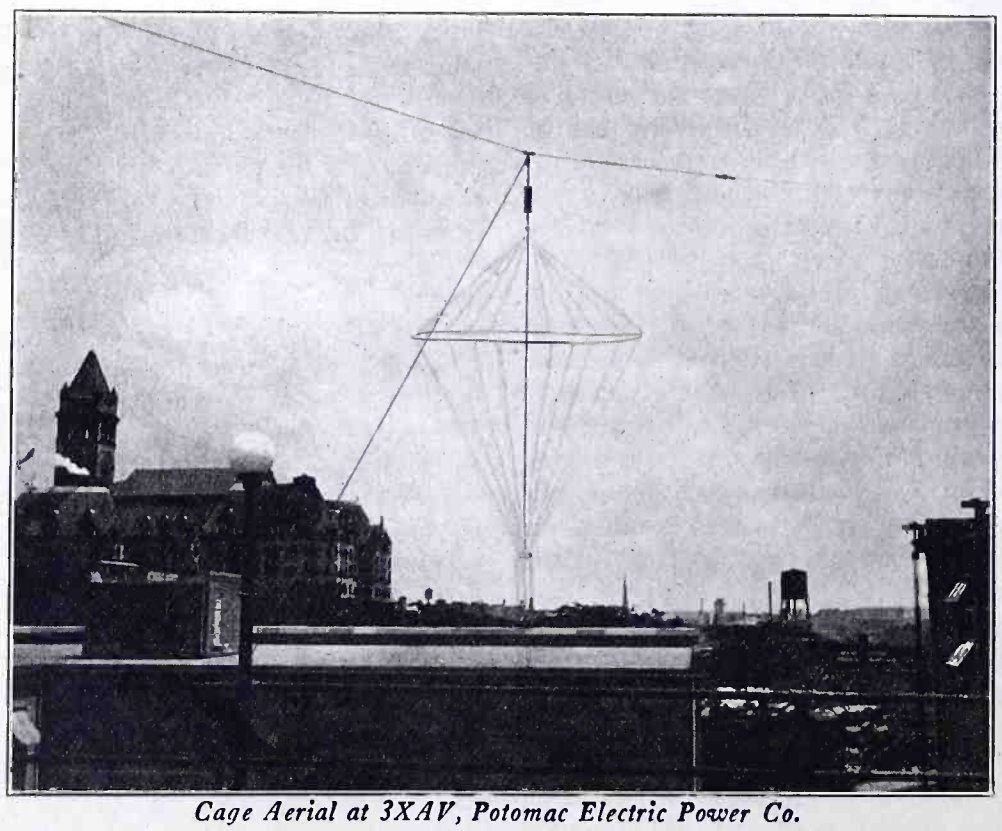
A HIGH-TENSION electric power line in the neighborhood of Hyattsville, Maryland, breaks down due to a faulty insulator. A motor truck in the District of Columbia, informed of the breakdown by means of radio telephone, hurries to the scene, and, without delay, makes the necessary repairs. The power-transmission service is thus interrupted for only a brief period and the potential danger from a leaking high-tension electric circuit is speedily removed.

This occurrence, once improbable, may happen frequently in view of the departure of the Potomac Electric Power Company of Washington in establishing radio communication facilities to meet such emergencies. The recent issuance of an amateur's license and the assigning of the call letters 3XAV signify that the radio telephone has invaded still another realm of service. Formerly, the repair trucks of electric power companies could not maintain constant communication with headquarters, once they had taken up the duties of the day in the field. The conventional telephone is not an attendant of the constantly-moving repair truck. Radio waves, however, are not circumscribed by the limitations of wires, but they spread in all directions speedily, and may instantly reach the repairman while he is in the act of climbing a pole supporting high-tension transmission lines, or while he is repairing an underground cable.

A radio transmitting and receiving station has been installed at the headquarters of the Potomac Electric Power Company, 14th and C Streets. The equipment, on the second floor of the building, includes a transmitter using a 50-watt modulating electron tube and a vacuum tube of equal capacity for the oscillator. The coupled Hartley circuit is employed, giving three amperes at 118 meters. The station also operates as low as 70 meters.

The antenna system of 3XAV is an 85-ft. vertical cage aerial and 8-wire fan counterpoise 15 ft. above the ground. The receiving equipment on the twelve repair trucks at first will be a two-vacuum-tube receiver, with the provision that repairmen listen for signals the first fifteen minutes of each hour. The aerial consists of 100 ft. of wire strung between poles wherever the repairmen happen to be working.

Provision is also made for the transmission of messages between headquarters and the power-generating plant at Bennings, District of Columbia, five miles away, where a duplicate of the transmitting and receiving equipment at Washington headquarters has been installed. This system is under the direction of J. H. Ferry, an electrical engineer. The radio operator at the Washington station is S. L. Seaton, and E. G. Speakman is in active charge of the radio facilities at Bennings.



Cage Aerial at 3XAV, Potomac Electric Power Co.

AN IDEAL CHEMICAL RECTIFIER

By William Jackson, 1CMP

One of the greatest needs of the amateur is a good inexpensive chemical rectifier. The chemical rectifier mentioned in this article is within reach of the amateur's pocketbook and requires but a moderate amount of skill to construct. It is composed of lead and aluminum sheets immersed in jars of sodium phosphate, but has the following advantages over other types: First, it rectifies perfectly; second, its resistance is low, enabling it to pass sufficient current; third, the solution does not evaporate; fourth, the solution does not crystallize and creep over the tops of the jars; fifth, the aluminum plates as well as the lead plates will last indefinitely and remain in perfect working order for years.

The rectifier must be designed for the particular use to which it is to be adapted. The number of jars to be used is determined by the terminal voltage of the transformer secondary. The terminal voltage divided by 25 will give the number of jars needed.

The size of plates is determined by the amount of current that is to be passed through them. A square inch of submerged metal will pass 50 milliamperes. The total milliamperes divided by 50 gives the submerged area in square inches of metal to be used per plate. An inch should be added to the length of the plates for joining.

The metals used are soft-rolled aluminum and sheet lead. The aluminum used should be 1/16 in. thick and may be obtained from the Aluminum Co. of America. Sheet lead 1/16 in. thick may be obtained from any local hardware store.

The solution consists of 5 pounds of sodium phosphate dissolved in 7 gallons of cold water. It should be allowed to settle before syphoning through a small rubber hose to the jars, this keeping the density of the solution in each jar nearly constant.

The larger the jars the less they are apt to heat. A test tube will only pass 30 milliamperes, while a pint jar will pass 300-400 milliamperes without excessive heating.

In order to overcome evaporation and creeping, high-grade transil oil should be poured on top of the solution in each jar, forming a layer about ¼ in. deep.

For example, suppose that we want to design a rectifier that will rectify 2000 volts and pass 250 milliamperes.

$$\text{Number of Jars} = \frac{\text{Terminal Voltage}}{25}$$

$$= \frac{2000}{25} = 80.$$

Area of Plates = Area of Joint + Submerged Area.

$$\text{Submerged Area} = \frac{\text{Total Milliamperes}}{50}$$

$$= \frac{250}{50} = 5 \text{ sq. in.}$$

Assume 1¼ in. for width of plates.

$$\text{Length of Submerged Area} = \frac{\text{Submerged Area}}{\text{Width Assumed}} = \frac{5}{1\frac{1}{4} \text{ in.}} = 4 \text{ in.}$$

Dimension of Submerged Area = 1¼ in. x 4 in.

Area of Joint = 1¼ in. x 1 in. = 1¼ sq. in.

Area of Plates = 1¼ sq. in. + 5 sq. in. = 6¼ sq. in.

Dimensions of Plates = 5x1¼ sq. in.

Getting Down to the Short Waves

Practical Suggestions Based on Experience with the Hartley and Meissner Circuits

By D. B. McGown

A NEW and interesting field for experimental work has been opened to the amateur under the authorization of the Department of Commerce, which permits amateur transmission on four bands of wavelengths under 100 meters. The wavelengths between 75 and 80 meters give a band of frequencies 250 kilocycles wide, as great as that between 175 and 200 meters. Between 40 and 43 meters, there is a 524-kilocycle band; between 20 and 22, a 1350-kilocycle band; and, between 4 and 5, a 15,000-kilocycle band; the last band being wider than those given to all the present amateur, commercial, broadcast and governmental wavelengths together. With all these available frequencies, the interference problem is solved for many years to come.

The new regulations provide that no direct coupling may be used between the oscillator and the antenna. This is done to prevent interference with nearby listeners. Probably 99% of the interference caused by amateur stations with B. C. L.'s is due, not to a poor filter or a.c. supply, but to the high potential surge set up in the antenna circuit when the radio-frequency current is suddenly cut off or turned on. With inductive, or capacitive coupling, these surges seldom get out of the transmitting set.

Furthermore, the use of a "chopper" or mechanical interrupter of any kind is forbidden, but the regulations allow the use of a modulated plate supply such as a.c. to tube plates.

Very little alteration is necessary to adapt a 200-meter set to 75-80-meter, or even the 40-43-meter band. But considerable research is yet to be done before amateur transmission will be practical on the 20-22-meter and 4-5-meter bands, which require extreme care in design for critical adjustment.

The simplest scheme for reducing wavelength is to reduce the effective length of your present antenna by "cut and try" until the proper wavelength is secured. A good series variable condenser with a maximum capacity of .00025 mfd. will cut the wavelength of the average 50-ft. flat-top aerial and counterpoise to 75 or 80 meters, assuming that it has a natural period of from 135 to 150 meters.

An ordinary low-loss receiving condenser may be used for this purpose if only a couple of 5-watt tubes are used. For power above 10 watts the condenser must have extra wide separation between plates. These may be either purchased or made up from a 43-plate condenser, using half the plates and double the spacing to get one-fourth the original capacity. A fixed-plate condenser may also be used.

A condenser may be considered good if it remains cool after a half hour's use. Otherwise it should be replaced. Another test is to substitute a trial condenser for one that is known to be good. If the radiation remains the same on the same wavelength, it can be assumed that the trial condenser is all right. Otherwise it should be discarded.

Better results should be secured by erecting a new and shorter aerial. A vertical antenna has a much lower natural wavelength for its height than the flat-top types. Local conditions vary so greatly that no direct measurements can be given.

The most careful consideration should be given to the insulation of a short-wave antenna, as poor insulation causes more losses than any other factor. Nothing but glass or porcelain insulators should be used, the thinner the better, until so long that they are weak mechanically. A mirror factory will generally supply strips of plate glass cut in convenient lengths and drilled at either end.

In short-wave transmission, with a series condenser, the ammeter readings are usually much lower than in using the longer waves when the antenna is worked above its fundamental. A radiation of from .2 to .5 ampere is good from two 5-watt tubes, for a single 50-watter from 0.5 to a possible 1.0 ampere, if you are very lucky, and, with a couple of 50's, about 1.25 amperes is exceptionally good radiation. A 250-watter will not give more than 1.5 or 1.7 amperes on 75 meters, and the latter tube will not give more than ½ ampere on 40 meters, while, on the smaller tubes, the radiation will only be readable in tenths of an ampere. Owing to the very high frequency and due to the very much greater resistance of the antenna when worked so far below its fundamental, such a large reading as is obtained on 200 meters with the ordinary equipment will be impossible. (Note, if you are an "ampere hound," don't try to work on the low waves, as you'll be disappointed.) The writer has seen a transmitter on just 100 meters, with a measured input of 1000 watts (plate supply), which only put out about 2.5 amperes, and, on this same set, when the antenna circuit was opened accidentally, the high frequency arc drew out to nearly an inch long, and burned the switch contacts to round copper balls before the power supply could be shut off, proving that the power is there.

Generally the common circuits, such as the "Hartley," "Meissner," etc., can be used as well on the short waves as on the longer ones. Certain details must be different, and the adjustments will be found to be very much more critical. But, if you are familiar with the operation of the various circuits on the longer waves, it will not take very long to get down to the shorter ones.

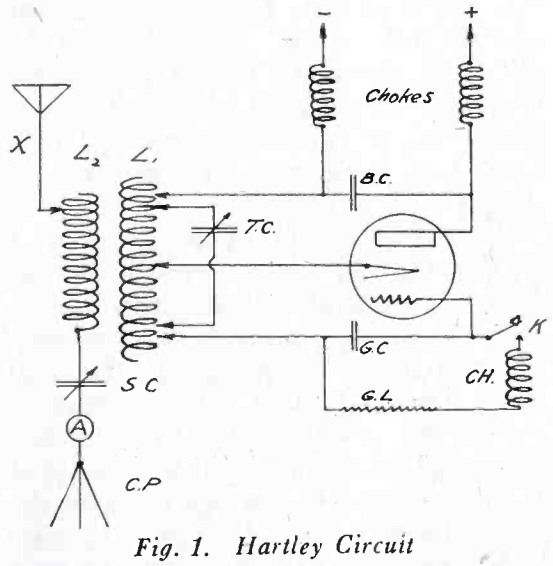


Fig. 1. Hartley Circuit

The Hartley Circuit shown in Fig. 1 is probably the best known and most widely used. The inductance L_1 can be made of any suitable material, either edgewise wound, such as the Radio Corporation inductor, or round wire wound in the form of a helix. The helical form usually is easier to handle than pancake wound, although the latter will also give good results. About 10 turns, tapped at least at every turn, is about right for 40 to 80 meters, with a diameter of 3 in., and a separation of about ¼ in. between turns. Coil L_2 may be either larger or smaller, and arranged so that it can be either loosely or closely coupled mechanically to L_1. The coupling is a matter of experiment.

The wavelength is determined by the settings of the series condenser in the antenna circuit and the tuning condenser shunted across some turns of the closed circuit inductor. The coupling is varied, and the condenser TC varied, until the highest antenna ammeter reading obtained. The positions of the grid and plate taps are not particularly critical,

but should be so adjusted that, when the grid leak *GL* circuit is opened by the key *K*, the plate current drops to zero. This point is usually quite critical, as compared with the plate tap adjustment, which simply controls the plate amperage, the latter being the least critical of the two. It is not desirable to make any adjustments of the antenna circuit for tuning, except when absolutely necessary, as this alters the emitted wavelength. All resonance adjustments should be made without touching *SC* unless it is found that the mutual inductive effect between the coils causes some slight displacement, which requires a slight resetting. It will usually be found that a large amount of inductance in L_2 and a small value of *SC* gives the best results. It may be also found that, if two series condensers are used, one in the counterpoise and the other in the antenna lead, at the point marked *X* in Fig. 1, that better results will follow, owing to the shifting of the nodal point.

It is sometimes a disadvantage to use inductive coupling with a Hartley circuit, as described, between the closed and antenna circuits. This is due to the fact that, owing to the interaction between coils, there will be a tendency for one circuit to cause the other to "hang over" and oscillate at the frequency of the other.

This is analogous to the action in a spark set when the coupling is set too close, but with the difference that, as two waves cannot be radiated, and, as there is nothing in the closed circuit that will stop the oscillations, the interaction causes very unstable operation. When this condition exists, it will be found that there is one particular wave where the radiation will gradually rise, and, suddenly, the wave will "flop" over to some other wave, quite a few kilocycles away sometimes, and where it will be impossible to get any radiation at intermediate points, the wavelength jumping up and down above and below these two points in an unaccountable manner. This can be remedied by loosening the coupling, although this cuts down the radiation. Another method is to increase the radio-frequency energy flowing in the closed circuit, but either of these are disadvantageous. Hence, although perfectly practicable, generally it is less desirable to use the Hartley circuit, when inductively coupled, than certain others.

In a Hartley circuit, the values of practically all instruments and parts remain the same for short waves as for operation on 200 meters, except the inductances. Coil L_1 as used by the author, consisted of 18 turns of No. 12 bare copper wire, wound on a 3-in. diameter form, separated ¼ in. between turns. The filament tap was taken off at the center, and the plate tap at the 7th turn from the filament, with the grid tap taken off at the 5th turn from the filament. With but three turns included in the "closed" circuit, it was found to be perfectly possible to get good, strong oscillations down as low as 30 meters, with *TC* having a minimum of about 0.0001 mfd. A maximum of 0.001 mfd. brought the wavelength up to about 70 meters. Additional turns can be easily cut into circuit, to get the wavelength up as high as is wanted. This will cover the band well up to 200 meters if 10 or 12 turns are used as an oscillator.

The inductance L_2 was coupled to L_1 by a small coil of two turns about 2 in. in diameter, arranged to telescope inside of L_1, with an additional loading coil to bring the wave up to what was desired. Fair radiation was obtained on 75 meters (about 0.8 amperes with a single 50-watt tube). Owing to the natural period of the antenna being rather large, and sufficient time not being available to build a new antenna system, no results were obtained on the 40-meter band. There is but little doubt, however, but that radiation could have been obtained on this wave, as well, using the same oscillator.

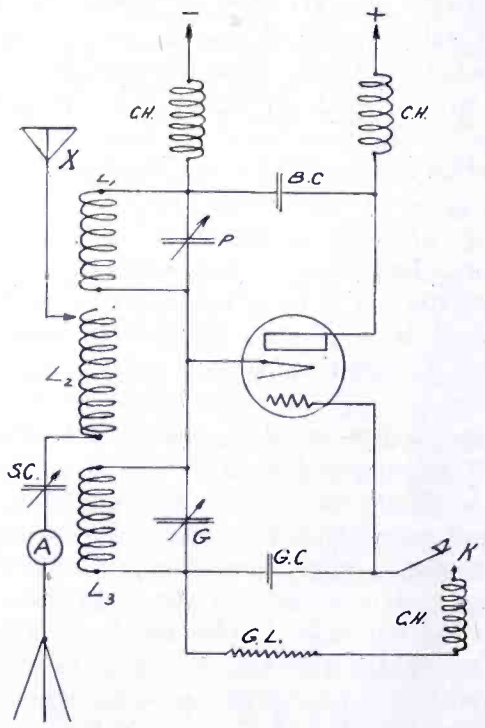


Fig. 2. Meissner Circuit

The Meissner circuit, as shown in Fig. 2, uses separate coils for the grid and plate circuits, with condensers shunted across them for tuning. The wavelength of the circuit depends entirely upon the wavelength of the open, or antenna circuit, composed of L_2, the series condenser *SC*, and the antenna and counterpoise. For L_2, the writer used the 18-turn bare wire wound inductor mentioned above, with a double-spaced air-condenser for *SC*, which had a maximum capacity of about .0003 mfd., on an antenna with a natural period of about 130 meters (to counterpoise). Coil L_1 was made of 5 turns of No. 18 bell wire wound on a thin cardboard tube 2 in. in diameter shunted by a .00025-mfd. receiving condenser, marked *P*, in Fig. 2. Identical coils and condensers were used for L_3 and the condenser *G*. Both coils were arranged so their coupling to L_2 could be varied, although this was not found to be critical.

The Meissner circuit was found to be better than the Hartley, owing to the fact that it did not possess the troublesome coupling elements. It may be argued that the Meissner circuit is not inductively coupled, but it is believed that it comes near enough to that condition to reduce all key clicks, and similar surges to a minimum, which is the desired condition.

The Meissner circuit had the disadvantage of changing entirely in frequency (as far as beat note reception was concerned) due to antenna swinging, a condition known to exist on the longer waves as well. As the coupled Hartley circuit has a fixed closed circuit, this condition is not so marked, but is known to exist in some cases with the Hartley circuit also.

In all cases, the fundamental instruments used were exactly the same, and the same lettering will be found in each of the diagrams. The writer used a single 50-watt tube, mounted in a regular socket. The chokes *CH* were small radio-frequency chokes, placed at various points to prevent the high-frequency currents from passing. These chokes were made up of about 100 turns of No. 28 DCC wire, wound on 3-in. bakelite tubing.

The bridging condenser *BC* is simply a by-pass for the radio-frequency currents; it is by no means critical, and any value above .002 mfd. It should be noted, however, that, as this condenser has the entire d.c. potential of the plate supply impressed upon it, it is absolutely essential that it be a good one, as a breakdown here would result in a completely short-circuited generator. The writer used a .002 mfd. condenser, which was built for a spark transmitter, being made of mica, and rated at 8,000 volts. This was rather large, but gave a very good factor of safety. Common transmitting condensers, such as are available for use for tube sets, would be suitable. The grid condensers were of the latter type (marked *GC*), and were of .002 mfd. capacity. The grid leak, which shunts these condensers, was a Radio Corporation leak, of 5,000 ohms resistance. Keying was accomplished by breaking this leak at the point *K*.

Experiments were made with various sources of filament supply, and it was found that direct current from storage batteries gave very much better radiation than when a.c. was used, stepped down with a filament transformer.

Once the transmitter is tuned, and correspondence with another station is in progress, the operator should never touch *any* adjustments of the equipment

Continued on page 67

Harmonic Transmission on Low Wavelengths

Some Suggestive Ideas for Amateur Experiments

By F. Dawson Bliley, 8XC-8GU

WITH certain precautions, the coupled reversed feed-back circuit may be used for transmitting from your present aerial on some of the new wavelengths allotted to amateur use. This method dispenses with the usual variable condensers, and their accompanying resistance losses, and gets down to some of the lower wavelengths by radiating on a frequency higher than the fundamental.

In this circuit the grid coil controls the frequency of the set. After choosing your band, say from 40 to 43 meters, pick the type of coil that you wish to use, employing the same type for grid, plate, and antenna coils. Then calibrate the grid coil so that it has a natural wave of 40 meters, or the lowest band of the wave that you are planning to use.

The plate coil should be calibrated for the same conditions, although it is not so important, as it has a greater range. Do not forget that the fundamental principle of the set is the reversed feed-back, so that the plate coil is wound opposite to the grid and in the same direction as the antenna or coupling coil.

Across both the grid and the plate coils connect a low-loss condenser of about eleven plates, widely spaced. A larger may be used if the occasion arises, but it is a better policy to use as little condenser as possible under such conditions. Very high frequencies are generated in the plate coil, as always happens on low waves, and there would be a great loss in the condenser due to sparking, jumping, and corona effects.

The antenna coil should be tuned to waves ranging from 120 to 129 meters (taking the example of 40 to 43 meters). A set oscillating on 120 meters would have harmonics on 60, 40, 30, etc. All odd harmonics are prominent, generally speaking. Of these harmonics the third is the strongest. This may be easily seen by measuring the harmonic strength and noting the values in more than one set. Another thing, the even harmonics often transmit on other waves than those desired.

If the antenna is tuned to 120 meters, there will be a harmonic on 40 meters, which will be the third and strongest. Therefore, the plate and grid coils should be tuned to 40 meters. This, then, would make the antenna oscillate on a 40 meters, or the third harmonic. That the set may be made to radiate on the third harmonic would also be true of other harmonics. However, it seems that anything greater than the fifth harmonic does not get out very well.

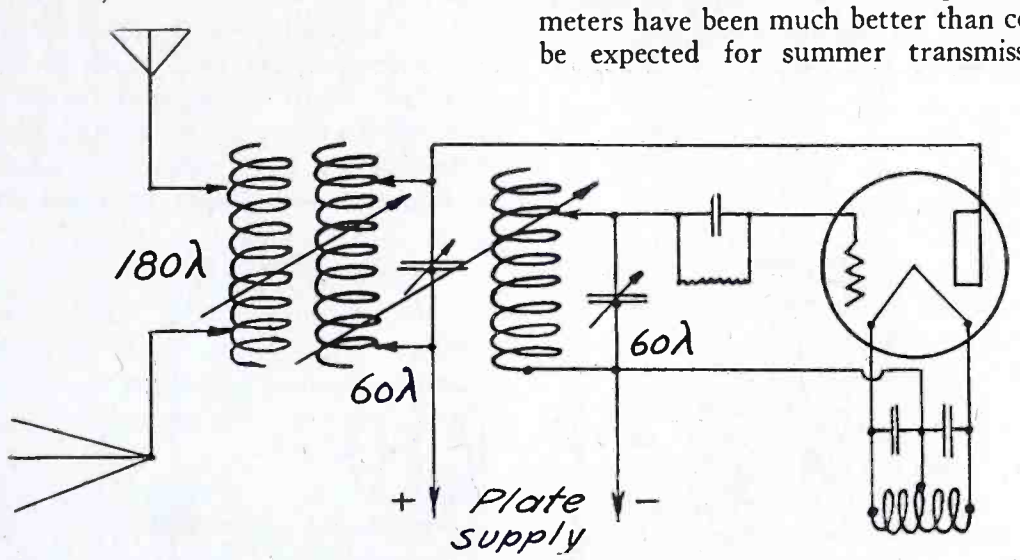
To tune the set, first isolate the antenna coil or disconnect all its connecting wires. Then tune the grid and plate coils so that both seem to be oscillating on the desired frequency. This having been done, reconnect the antenna and counterpoise to the coupling coil. If the set is tuned to 40 meters, then the antenna should be tuned to 120 meters. If you cannot tell exactly, tune the antenna clip around until radiation is at its maximum. This, unless you have the circuit mixed up, will be a multiple of the frequency that the oscillator is working at. However, you should have a general idea of the antenna fundamental and size of the antenna coil. If you have reached the maximum radiation, you will find that the set is oscillating on one of the harmonics of the antenna, and, if you are sure where the antenna is tuned, you will be able to tell the precise harmonic, which is the transmitted wave.

Remember the third and the fifth harmonics are the best for long distance transmission, and that you should never use any of the even harmonics, as they will also radiate on the fundamental.

It is best that this be coupled as shown, although the antenna may be made to oscillate on a harmonic by direct coupling, that is, connecting the antenna and counterpoise directly onto the plate coil. But, as slight swingings in the antenna are greatly noticed on the high frequencies (due to this type of transmission), it is almost necessary that it should be coupled.

The grid coil may be remote or coupled to the plate; the former is acceptable, while the latter is preferable. The plate coil should at all times be placed at a reasonable distance from the antenna coil, four inches being no great distance.

Results with this hook-up on 50 meters have been much better than could be expected for summer transmission.



Coupled Reversed Feed-back Transmitting Circuit

NKF, 1XAM have been worked with a 50-watt tube at noon with no trouble other than "local QRM" or QSS. Reports are continually coming in on the twelve noon and 7 P.M. transmissions. All of those within 400 miles report "vy QSA all over room" or "hr u on loud spkr om fb". Most of these reports are from stations employing nothing more than a one-step amplifier.

The 50-meter set at 8XC uses a grid coil of 8 turns wound on a 5-in. tube. Pancakes are used for antenna and plate coils, each containing about 10 turns of 1-in. brass ribbon.

Designing the Reversed Feedback Transmitter

Practical Suggestions to Precede the Construction of a C.W. Set Using One or Two 5-Watt Tubes

By L. W. Hatry, 5XV

THE design of the transmitter is a big worry to any amateur getting ready to build his first. He reads everything in sight, looks over fifty or two construction articles, and then builds something different. At least none of the article writers would claim or recognize it. I have come to believe, that for the majority of hams, a detailed description of the mechanics of a set is not necessary, and, perhaps, not desirable.

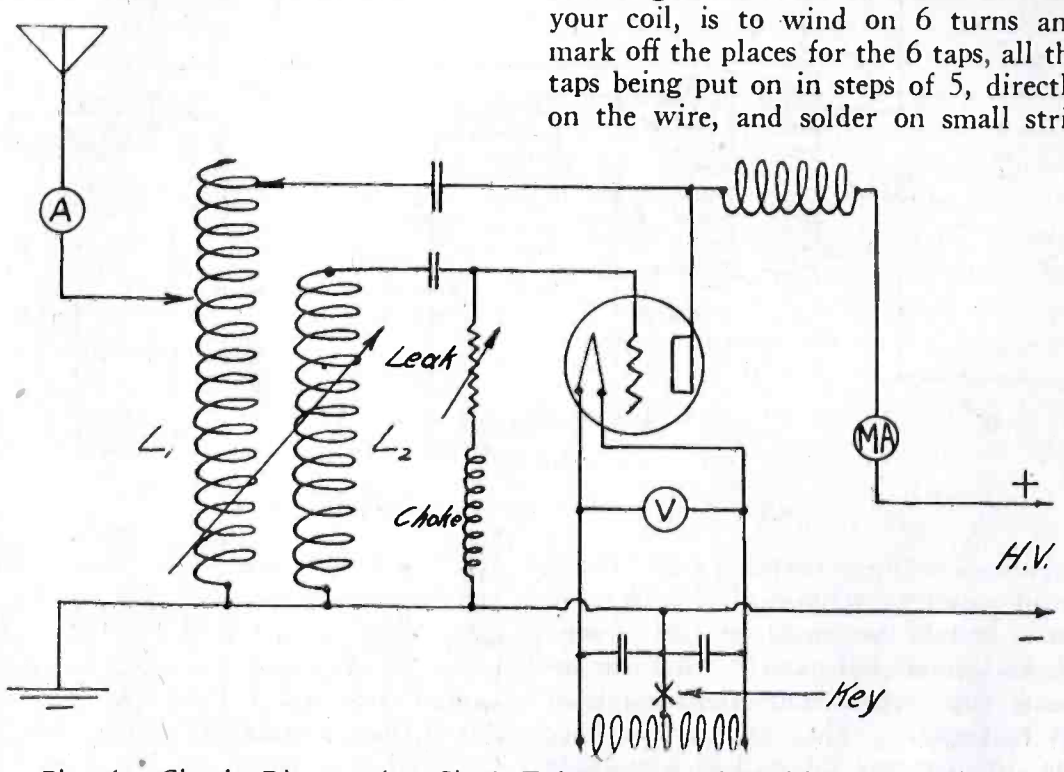


Fig. 1. Circuit Diagram for Single-Tube Reversed Feed-back Transmitter

For the single 5-watt tube set, or any single tube set using reversed feedback, the simplest and most efficient circuit is shown in Fig. 1. It doesn't matter whether you use a 50, 250, 5 or 1 watt transmitting tube, this circuit will work well and easily on all of them. (Having, of course, different constants for the different tubes.) The practical details of this article are confined to 5-watt tubes.

The only difficult adjustment is the number of turns in the grid coil L_2, and, as it is not critical to the turn or even the two turns, that difficulty is small. The coupling of the grid coil, however, is critical and must, therefore, be easily variable and permanent of location once the critical point is found. The grid coil, for the average 5-watt set, should be of 35 turns of No. 22 dcc wire to start. Then reduce two turns at a time to find the best value.

The antenna inductance, L_1, is of large wire, say No. 12 bare hard drawn copper for this low power, and should be tapped every turn. In tapping every turn you can simply make a hump in the wire as you wind it on the form, Fig. 2, and then finish up by tightening it with the pliers as in Fig. 2a, which makes a firm coil.

An even better construction, if you have a grooved form on which to wind your coil, is to wind on 6 turns and mark off the places for the 6 taps, all the taps being put on in steps of 5, directly on the wire, and solder on small strip brass lugs at the places marked. Then, after the first six are in place, you can measure off the proper places for the other taps on the wire itself without first winding it on the form, and you can have a finished job when you do wind it on. The wire can be spaced with heavy cord that has been soaked in hot paraffine in case you haven't a grooved form. The antenna inductance will need about 25 turns.

Don't write and ask me if a condenser in shunt to the grid coil will make the set work any better; it won't. In fact the average variable condenser will reduce the efficiency of the set by introducing extra losses.

The grid condenser for the single 5-watt tube set can be one of the receiving type of mica condensers such as the Freshman of .002 mfd. capacity and the grid leak should be a variable one up to 15,000 ohms. The grid leak can be

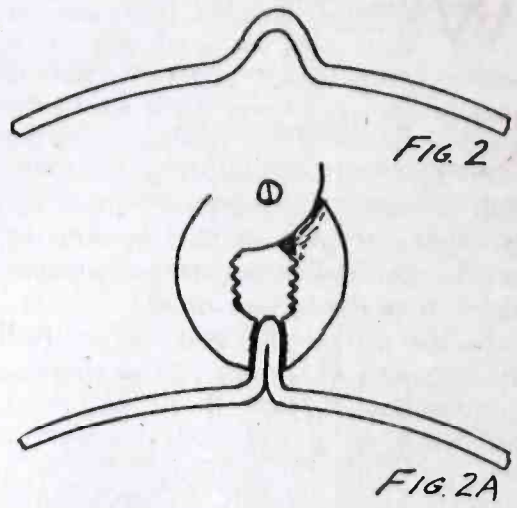


Fig. 2. Hump for Taps
Fig. 2A. Tightening Hump

made up of three of the standard 5000 ohm leaks which have the tap at 2500 or half resistance. You will most likely need above 10,000 ohms. The choke shown in series with the grid leak is optional; it increases the efficiency of your set, but the increase is not very much with the single tube set. For highest efficiency, the choke should be there; it is made single layer fashion of No. 36 wire on a 1 in. diameter form of 350 turns. Enameled wire will do.

The condenser in the plate circuit should be able to withstand at least double your full plate voltage and should be one of the standard mica type designed for the purpose, which are obtainable almost any place where transmitting supplies are sold. Its capacity should be .002 mfd.

The radio frequency choke in the high-voltage positive lead should be wound on a 4-in. diameter form with 260 turns of No. 30 scc wire. The wire can either be wound so tightly that it will stay in place of its own accord or it can be bound with paraffine. Use no shellac or varnish in any case, although an untreated cardboard form (you should use no other kind) must be paraffined to be moisture proof.

In preparing the cardboard tubes, the simplest method is to bake them to dry them out thoroughly; and then, having a hot pan of paraffine ready with a small varnish brush, you can apply the hot paraffine to both the inside and outside of the tube. The result will be an efficient water-proof coil form with a comparatively low loss.

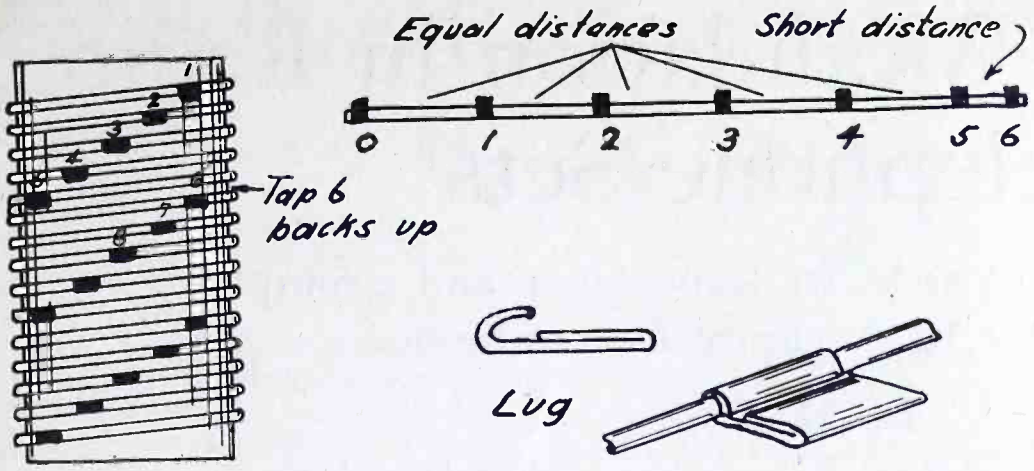


Fig. 3. Lug Method of Tapping Coil

THE multi-tube reversed feedback transmitter—two, three, or more tubes—requires a design different from the single tube set, as may be seen in Fig. 4, which differs principally from Fig. 1 in the addition of the variable condenser across the grid coil. The antenna and grid coil can be wound on the same form with a slight space between them, ¼ to ½ in. The grid coil is wound in the opposite direction to the antenna coil and consists of 25 turns of No. 18 dcc wire. It has fixed coupling to the antenna coil.

Where separate coils are used the grid coil should be wound spider-web fashion so as to reduce the relation between it and the antenna inductance by presenting only a small edge as an immediate capacity surface. The spiderweb can be wound on a paraffined cardboard form with 30 turns of No. 18 or No. 20 dcc wire. The form should be made of such size that it will just slip inside of the antenna inductance, if it is wound on a form, and fit with the edge of the cardboard rubbing the wall of the main coil form. Then a little heavy glue or shellac on three or four of the legs of the spiderweb will bind it in place firmly.

This design is based on the fact that the grid coil of the transmitter has two polarities and will work on either. With one polarity of the grid coil, the set will be working its best with a comparatively low value of the grid coil shunt condenser, while with the other polarity the set will be working better at a much higher and more critical value of the grid coil shunt condenser. It is to obtain this latter polarity that the grid coil is wound in the opposite direction to the antenna coil, although, by wrong connections, you can obtain the less efficient polarity in spite of that precaution. The grid coil shunt condenser should be a 43 plate, .001 mfd. maximum capacity. You should try your grid coil at both polarities, if you haven't already, merely to be familiar with the action in both instances.

The grid condenser, in this larger set, must be of .002 mfd. capacity and should be a regular transmitting condenser, as it will have to handle an appreciable amount of grid current and the losses must be low. The grid leak should be made up as before to be variable to 15,000 ohms, and the leak choke also is made the same but is not optional; it must be included to make your set really efficient as it keeps the tubes cooler.

The choke in the positive high-voltage lead is identical with the one described for the 5-watt set and must be carefully wired in. It should be connected to the plates of the tubes with as short a lead as possible and must be mounted at right angles to and well away from the antenna inductance to avoid any interaction.

The series plate condenser is .002 mfd. capacity to withstand at least double the plate voltage and of good current carrying capacity, and well insulated. As there are a number of such on the market it will be easy to obtain.

In using the counterpoise in conjunction with the ground (and the ground should be always connected to the set, if only for safety), the best method is shown by the dotted additional inductance and the attached counterpoise in Fig. 4. The counterpoise can also be tuned in on the same inductance as the antenna as shown in Fig. 5.

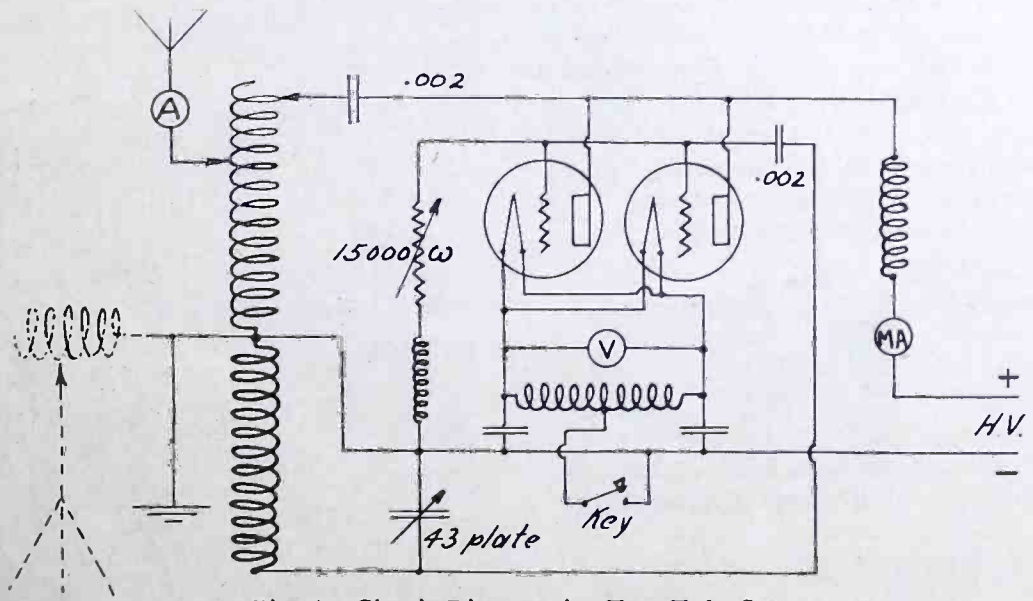


Fig. 4. Circuit Diagram for Two-Tube Set

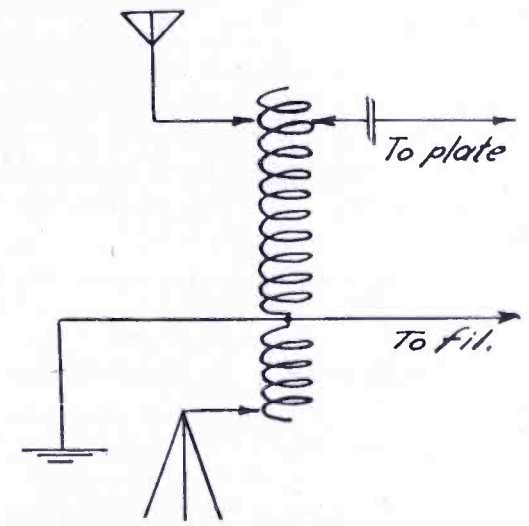


Fig. 5. Alternative Counterpoise Connection

Keying, in both the single tube and the multi-tube sets, is shown by the x in the centertap to the filament transformer. With this method the key and the transformer should be close to the transmitter so that the centertap can be as short as possible. It should not, under any except abnormal conditions (and then it will be inefficient), be more than about 2 ft. long at the most. Actually its length ought to be around 6 in., but something must be allowed for necessity.

An antenna ammeter and filament voltmeter are necessities and, in addition, if you expect to experiment to increase the efficiency of your set, you will need a plate milliammeter. The antenna meter tells you when your set is adjusted for maximum output; the filament voltmeter protects the life of your tubes; and the plate milliammeter tells you when your input is right as you can compare it to your antenna current as told by the antenna ammeter.

In constructing a reversed feedback transmitter for working on the short waves with an antenna series condenser (remember that the series condenser really belongs in the antenna); different

Continued on page 73

Percentage Modulation in Radio Telephone Sets

A Brief Statement as to Its Importance and a Simple Method for Its Accurate Determination

By M. Wolf

THE power radiated from a radio telephone transmitter depends upon the antenna current delivered by the r. f. oscillator, and upon the extent to which these oscillations are controlled by the modulator, or upon the percentage modulation. The greater these factors, the better will be the transmission. The amateur can tell what he gets out of the oscillator by means of a hot wire ammeter, but usually he is at a loss to know just how much he is modulating these oscillations. The object of this article is to describe a simple method for determining this factor without the use of expensive equipment.

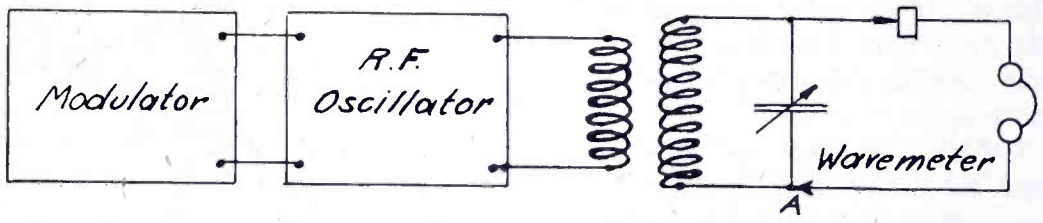


Fig. 1. Diagram of Connections for Approximate Determination of Percentage of Modulation

The best way to determine the percentage modulation of a radiophone set is to use an oscillograph. But this instrument costs several hundred dollars, and so is out of the question.

A quick, rough test may be made with a crystal detector wavemeter tuned to the transmitter wavelength. Whereas with no modulation a distinct click will be heard in the phones upon opening and closing the contact *A* of Fig. 1, the click will not be heard through the speech if the modulation is nearly complete.

The more accurate and reliable method is to chop up the received wave and measure its signal audibility with and without speech. The ratio of these audibilities is the percentage modulation, as may be readily proved for both absorption and non-absorption systems of modulation. This method gives the ratio of the actual variation of modulated antenna current to the maximum possible variation.

Either one of two methods may be employed for both systems of modulation. The first is based on the determination of the ratio of couplings for a given audibility. The second employs a fixed coupling and determines the actual ratio of audibility. But, as it calls for an audibility meter not possessed by the average amateur, it will not be discussed.

For the absorption system of modulation, a simple receiver consisting of a coil and a variable condenser with detector and telephones is connected and tuned to the wavelength of the transmitter., Fig. 2. With no speech applied, the coupling *M* is varied by moving the receiver coil to or from the transmitter coil along a straight line until a signal of known intensity or audibility is secured. A chopper or other interrupting device is used in the receiver for making audible the unmodulated continuous waves. The distance between transmitter coil and receiver coil is noted. Let us call it *OA*. The coupling between the two coils is proportional to the distance *OA*. Therefore, this distance *OA*, for the given audibility, is proportional to the maximum possible amplitude required for complete modulation in an absorption system.

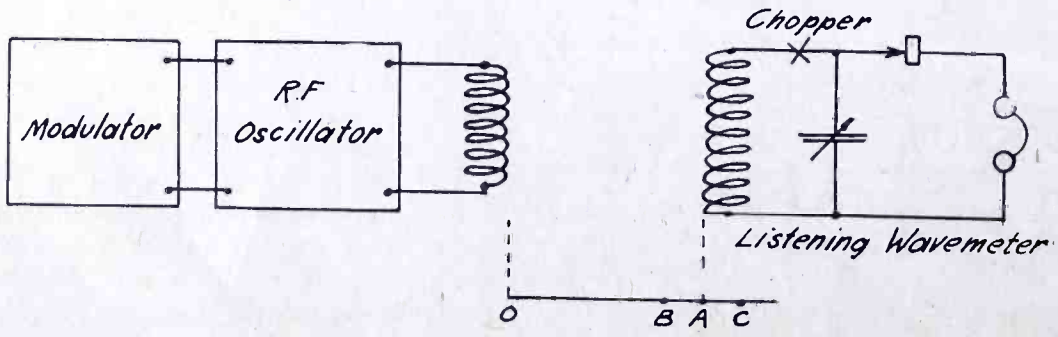


Fig. 2. Diagram of Connections for Accurate Determination of Percentage of Modulation

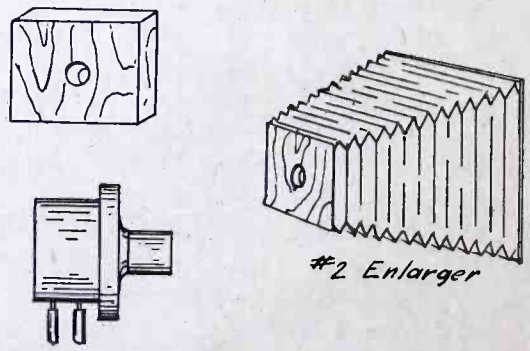
Now, let speech be applied to the set, and, without altering the tuning of anything, vary the coupling between receiver and transmitter until the speech is at the same audibility or intensity as the previous I. C. W. signal. (The chopper or interrupter is not used now.) Note the distance between receiver coil and the transmitter coil, and let it be *OB*. The distance *OB* is now proportional to the variation in amplitude of the modulated wave. Therefore, the ratio of distance *OB* to *OA* gives the actual percentage modulation of the set under test.

For the non-absorption system of modulation, the same circuit is used, and the coupling distance *OA* is noted for a given signal intensity when no speech is applied. Since in this system the amplitude is doubled for complete modulation, this coupling distance is really proportional to half the amplitude of a completely modulated wave, which fact will have to be considered in getting the percentage modulation. Now, apply speech to the set and vary the coupling until the given signal audibility is secured and note the distance, which we will say is *OC*, which is proportional to the actual modulated amplitude. Then the ratio of *OC* to *OA* is the percentage modulation of the set.

A PORTABLE LOUD SPEAKER

By HARRY MORTON

A portable loud-speaker for auto and camping use can be made from any one of several phonograph loud-speaking units, and a collapsible camera enlarger.



Merely fit the unit and adapter into a 1 in. block of wood cut to fit the small end of the enlarger, such as that used for a No. 2 Brownie Kodak. When not in use it may be folded into a flat package occupying but little space. The accompanying sketches show the method.

Improvements in the 45,000 Cycle Super-Heterodyne

By G. M. Best

THE most constructive suggestion for improving the 45,000 cycle super-heterodyne originally described in the May RADIO is a method of operating most of the tubes from alternating current, instead of dry cells or a storage battery, without introducing objectionable noise. Fig. 1 shows a complete circuit diagram using the a.c. feature.

The method consists in reducing the direct current filament consumption by substituting a.c. for all the tubes except the two detectors. The a.c. is supplied by a small step-down transformer of proper voltage, the design data for the transformer following the description of the circuit. C-301A tubes can be used in the audio-frequency stages in this case, permitting larger amplification, and the use of higher plate voltages if desired. Fig. 1 shows the use of the *A* tubes in the audio amplifiers, although such tubes may be omitted and the smaller tubes used throughout by connecting all the tubes to the 3-volt winding.

The circuit requires three additional condensers: C_{12}, .0025 mfd., serves to prevent the grid bias from being short-circuited, C_{13} and C_{14}, .1 mfd. each, provide low impedance paths to the filaments for the high and low-frequency currents.

The filament resistance volume control cannot be used on the intermediate frequency tube filaments, since it would disturb the alternating current balance. However, a good volume control consisting of a Bradleyohm of 10,000 to 50,000 ohms can be shunted across the primary of the first intermediate frequency transformer, or across the secondary of the first audio-frequency transformer. The latter is not so desirable, however, due to the fact that the radio-frequency amplifiers could very easily be overloaded due to an excessive input, which could not be controlled in the audio stages. The filament voltages of all the a.c. tubes are regulated by the 200-ohm rheostat or potentiometer in the 110-volt input leads. The windings of the filament transformer are proportional so that when the *A* tube filaments are 5 volts the 199 tube filaments are 3 volts.

SEPT. PRIZE WINNERS
In Contest for Improving Best's Super-Heterodyne

1st prize — $25.00 — Hugo Benioff, Lick Observatory, Mt. Hamilton, Calif.

2nd prize—$15.00—P. M. Cummins, 5515 Santa Monica Blvd,. Los Angeles, Calif.

3rd prize—$10.00—J. H. Bannerman, East Orange, N. J.

Similar prizes are to be awarded each month and additional final prizes for the best ideas submitted during a six-months' period.

To make the step-down transformer, a core should be made from silicon steel pieces 1 in. x 3 in. for the longer legs and 1 in. x 2 in. for the shorter legs. The core pieces should be piled up to form a rectangular window, 1 in. high, thus making a cross section of 1 sq. in. The primary coil, consisting of 1036 turns of No. 30 dcc wire, should be placed on one of the longer legs of the core, the proper insulating cloth or tape being placed over the core before the coil is mounted in place. The secondary coil, placed on the other leg of the core, is wound in two sections, 518 turns on each leg of the core. The secondary coils are wound over the primary coils, care being taken to insulate the two windings with empire cloth. The secondary sections should consist of 52 turns of No. 18 dcc wire, 26 turns per section. One secondary is tapped at the 10th turn, and the other at the 16th turn, so that from the mid-tap, 16 turns can be available each way, to provide a total of 3.3 volts, or the whole 26 turns each way can be used for 5 volts. Care must be taken to see that the windings on the two legs are in the right direction, such that, if the core were straightened out, one section would be the continuation of the other. Dry cells must be used to operate the two detector tubes, but the current consumption will be only ¼ that of the previous arrangement of supplying all eight tubes from batteries.

In trying out this suggestion, it will probably be discovered that the proposed volume control does not work low enough so that the set can be properly operated on local stations. It will probably be necessary to insert a small fixed resistance of 1000 ohms in parallel with the Bradleyohm, for local stations, or else provide a rather complicated jack arrangement for cutting out some of the intermediate stages.

THE second best suggestion takes care of that trouble as is shown in Fig. 2, by the addition of a four-contact jack, into which a plug having the tip and sleeve shorted together may be in-

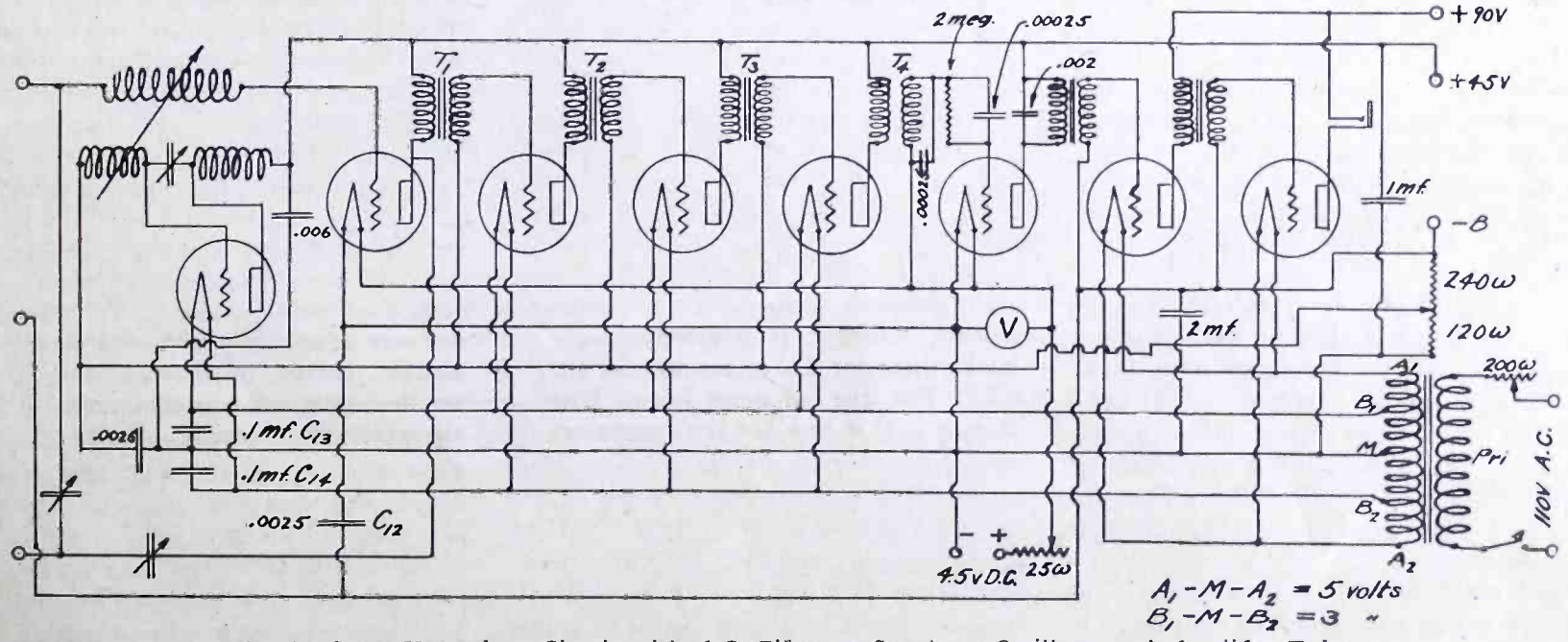


Fig. 1. Super-Heterodyne Circuit with A.C. Filament Supply to Oscillator and Amplifier Tubes

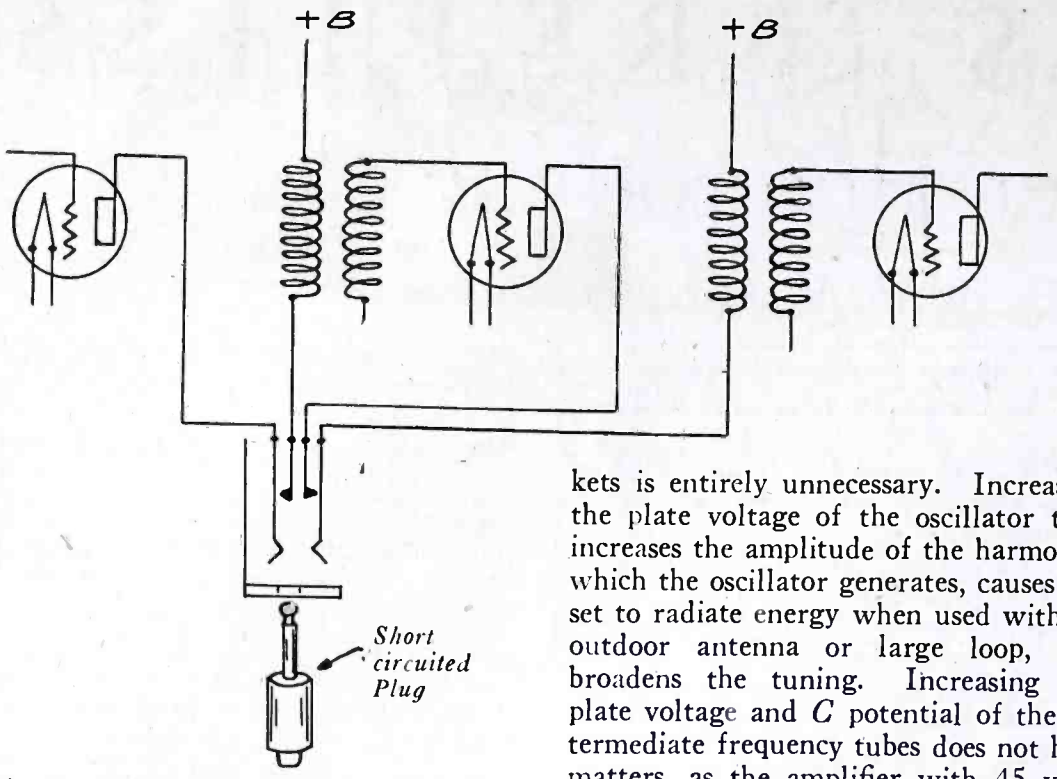


Fig. 2. Method to Cut Out One I. F. Stage

serted, thereby cutting out one stage of amplification. In using this jack, trouble might be experienced from coupling due to capacity between the jack springs, so a jack with springs spaced as widely as possible should be used.

The suggestion for eliminating the dry cell *C* batteries, made in August RADIO, has proved a very popular one, and an improvement in this connection has been suggested, in regard to the location of the two 2-mfd. condensers bridged across the resistances. The former arrangement, as shown in August RADIO, shows the two condensers in

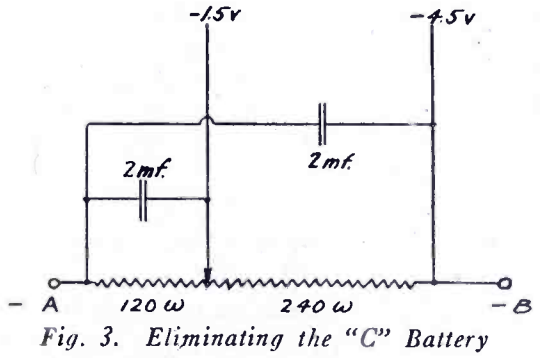


Fig. 3. Eliminating the "C" Battery

series, with the 1½-volt tap to the wire connecting the two condensers. If one of the 2 mfd. condensers is connected so that it is shunted across the entire 360-ohm resistance, it will present a lower resistance path to the alternating current than with the series arrangement, thereby eliminating any possible chance of singing due to resistance coupling.

It might be well at this time to explain to many readers who have sent in suggestions why their suggestions have not been awarded prizes. At least a dozen letters have been received suggesting the use of cushion rubber sockets for all eight tubes. As the intermediate frequency transformers do not transmit audio-frequency to any appreciable extent, noise due to tube vibration is not present, and the use of the cushion sockets is entirely unnecessary. Increasing the plate voltage of the oscillator tube increases the amplitude of the harmonics which the oscillator generates, causes the set to radiate energy when used with an outdoor antenna or large loop, and broadens the tuning. Increasing the plate voltage and *C* potential of the intermediate frequency tubes does not help matters, as the amplifier with 45 volts on the plate will overload the second detector on local stations unless the potentiometer is set to low volume, and the additional plate voltage will not increase the volume on distant stations. The addition of a push-pull stage in place of the last audio-frequency stage will enable the set to deliver a greater output, but adds another tube and transformer. A C-299 tube, with 90 volts plate and 4½ volts negative grid potential, will supply a good loud speaker with sufficient volume to fill an ordinary room, and, if it is necessary to add the push-pull stage to accomplish this, it means that there is something wrong in the set, either with the audio-frequency circuit or in the radio-frequency amplifiers. If large volume is desired, it would be better to use the large size tubes, with 120 volts plate and 9 volts negative grid potential, rather than increase the number of tubes and amount of apparatus.

THE HOT WIRE AMMETER

By JEROME SNYDER

THIS article is for the radio amateur who transmits. He generally uses as the indicator of the output of his set a radio-frequency ammeter in the antenna circuit. This ammeter is always of the hot wire type. But why? Why is not the ordinary type of measuring instrument as used in d.c. or commercial a.c. work suitable for r.f. measurements? Why is it so difficult to make a really accurate ammeter for r.f. measurements, while it is relatively simple to make them for d.c. or commercial a.c. work? For the amateur knows how seldom it is that two hot wire ammeters placed in series read alike in a radio-frequency circuit. These are some of the questions to be answered in this article, and although it may not help him transmit across the continent with a single 5-watt tube it will give him a desirable insight into the workings of this instrument.

Radio meters must be able to read accurately at all the radio frequencies used, say between 100 meters and 10,000 meters. If the mechanism of the meter has a part which is influenced by the frequency of the current measured it will be apparent that the meter can not be accurate at all frequencies. This fact immediately excludes from radio-frequency work all instruments based on electrodynamic or electromagnetic action. The behavior of iron varies markedly with frequency, especially at radio frequency. Hence the usual d.c. instruments with their permanent or electromagnets are unsuitable for radio work. Another reason precluding such instruments from radio work is that the moving coil in the instrument has inductance. The reactance of a coil varies with frequency, hence the indication of the ammeter would vary with the frequency, since the current flowing through the coil would be limited by its reactance. Finally the presence of any appreciable distributed capacity in these meters makes the meter unsuitable for radio work. A coil of wire always has some distributed capacity, and there is always the distributed capacity of the coil system to the ground. At very high frequencies there will be leakage of capacity currents flowing through this stray capacity, hence the total current to be measured will not flow through the coil system, but part will flow through the stray capacity and will therefore not be recorded. Furthermore the proportion flowing through the coil and through the distributed capacity varies with the frequency, since the reactance of coil and capacity vary with frequency. Thus it is impossible to make the ordinary commercial meter which almost always has coils, iron and stray capacity in it, suitable for radio-frequency work.

What then are the requirements for a good radio-frequency ammeter? Its inductance must be reduced to a negligible minimum, so that its inductive reactance will be negligible and not dependent upon frequency. Its capacity must likewise be reduced to a negligible minimum for the same reason. In this way frequency will have but little influence upon its indication. If it has no inductance and capacity its shape will have to be of the very simplest sort, such as a short, thin strip of wire without inductance and with negligible capacity. When such a piece of wire is heated by the passage of an electric current, it expands, the greater the current and consequent heating, the greater the expansion. This expansion is used to actuate a pointer over a scale and then register the value of the high-frequency current.

The resistance of the hot wire is made very great as compared with its self in-

Continued on page 54

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.

What is the best method of measuring an unknown resistance, where a resistance bridge is not handy?—H. W. P., Wenatchee, Wash.

If a voltmeter and milliammeter are available, fairly accurate resistances can be measured by the use of Ohm's law, where $E = IR$, E being the voltage of a battery used in making the measurements, I the current flowing through the resistance, milliammeter and battery, and R the unknown resistance. For example, if the resistance to be measured is 100 ohms, and the battery voltage is 3 volts, when measured with a good volt-meter, then the current reading of the milliammeter will be 30 milliamperes. If the resistance is very great, the battery voltage will have to be greater, in order to obtain a reading on the milliammeter scale, and, in case the resistance is very low, a voltage lower than 3 will be required, to avoid burning out the milliammeter.

Please publish a hook-up similar to that shown in Fig. 4, Page 37, August RADIO, except with the addition of another stage of radio-frequency amplification, and with 6-volt tubes. Also please show where a potentiometer may be connected.—M. S., Valley City, N. D.

The circuit you request is shown in Fig. 3.

What manufacturing company makes power transformers such as are described by Paul Oard in August RADIO?

—W. W. L., Unionville, N. C.

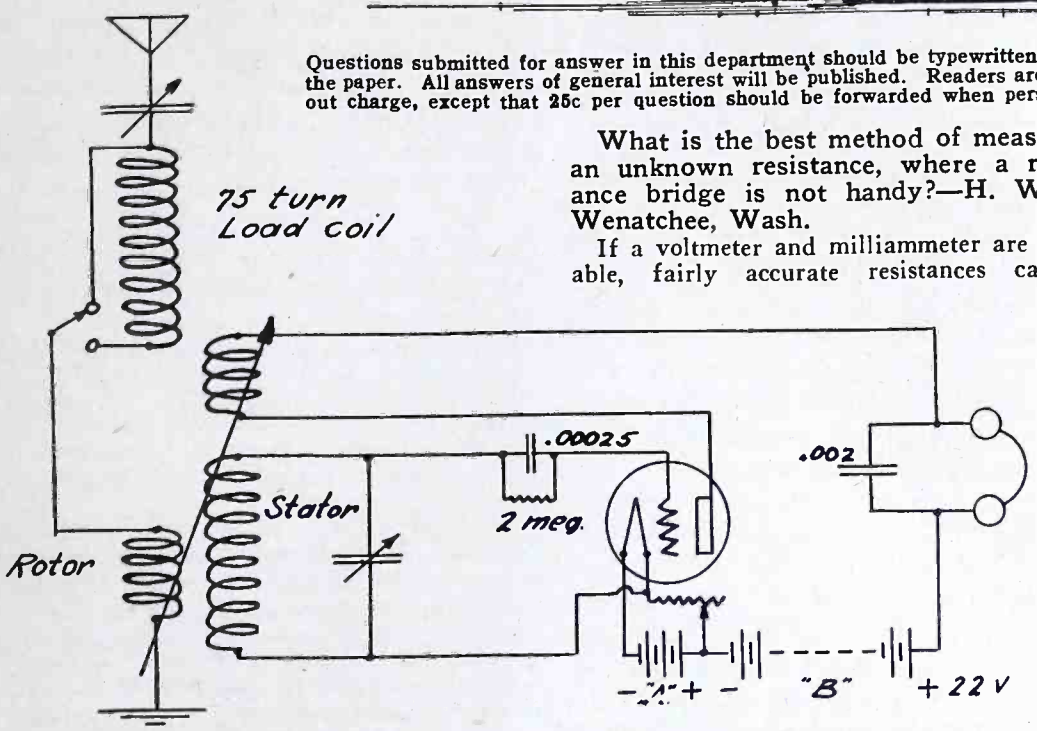


Fig. 1. All-Wave Receiver

Kindly publish a circuit for a tuner and detector to receive amateur C. W. and broadcast stations, using two variable condensers, coupler, tube, and batteries.—A. C., Lankershim, Calif.

A circuit diagram for such a receiver is shown in Fig. 1. For the short waves, it will be necessary to use only a few turns on the secondary, and to cut out the load coil in the primary circuit.

Please tell me what circuit is very efficient on 600 meters. Also what is the best one-tube circuit for 400 meters.

—Y. Y. S. J., Japan.

A good three-circuit tuner for 600 meters is shown in Fig. 2. In order to build the set cheaply, it would be advisable to use honeycomb coils, which are conveniently wound in 75 and 100-turn sizes. For 400 meters, the same circuit could be used, with a 50-turn primary, 75-turn secondary, and 50-turn feed-back coil.

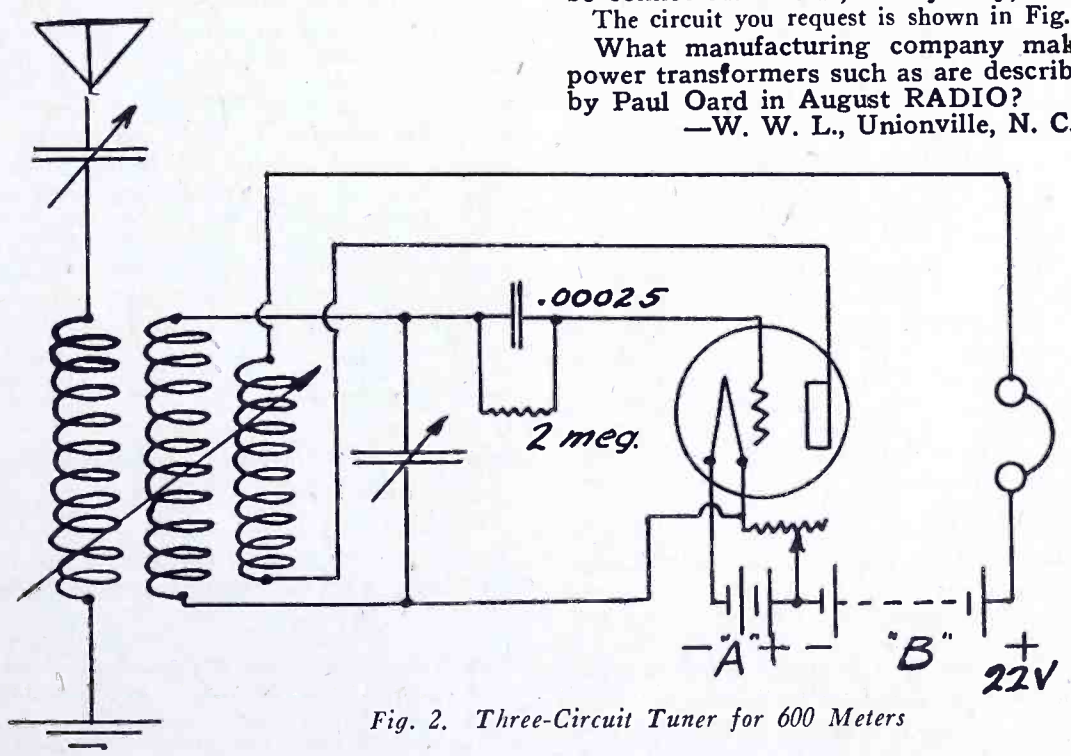


Fig. 2. Three-Circuit Tuner for 600 Meters

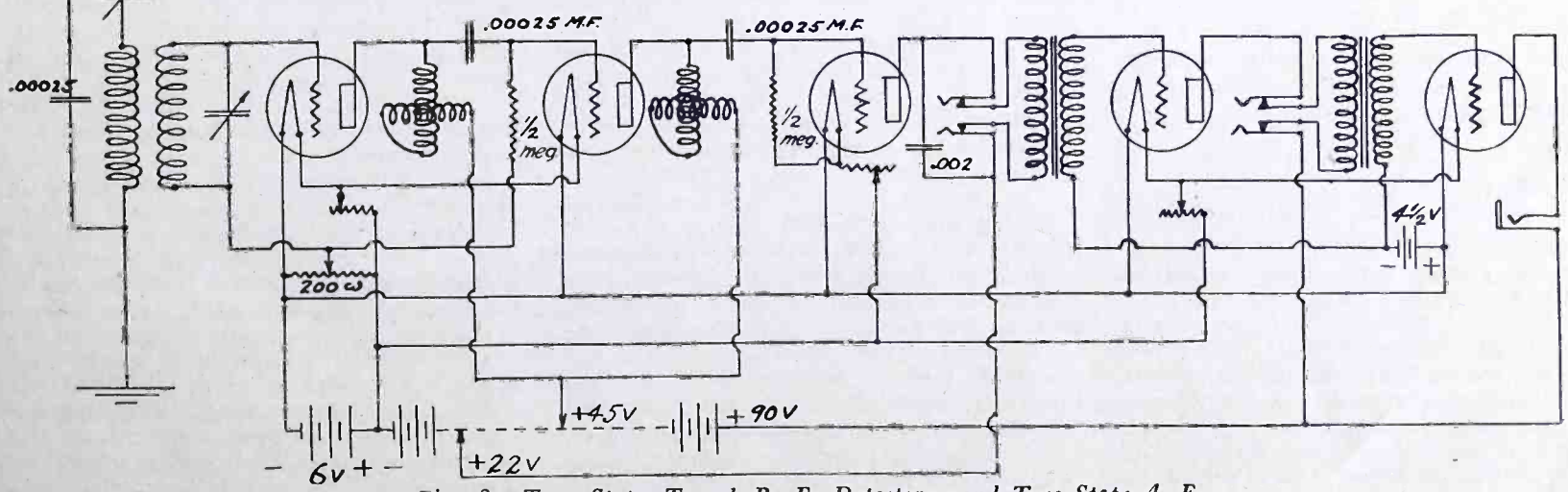


Fig. 3. Two Steps Tuned R. F. Detector, and Two Steps A. F.

The transformers Mr. Oard mentioned are those used by the Magnavox Company in their power amplifiers. The transformers are not generally sold separately, although no doubt the Magnavox Company would be glad to inform you as to where they might be obtained.

Please publish the "Bridge System" of rectifying a.c. for high plate voltage. My transformer has no center tap on it, to use the other systems. Please tell me how many plates are necessary to make .002-mfd. and 1-mfd. condensers. The mica used is .010 inch thick and 5 in. x 2 in. wide. Foil is of .003-in. thickness. Will the mica stand 2000 volts?—J. W. C., Calistoga, Calif.

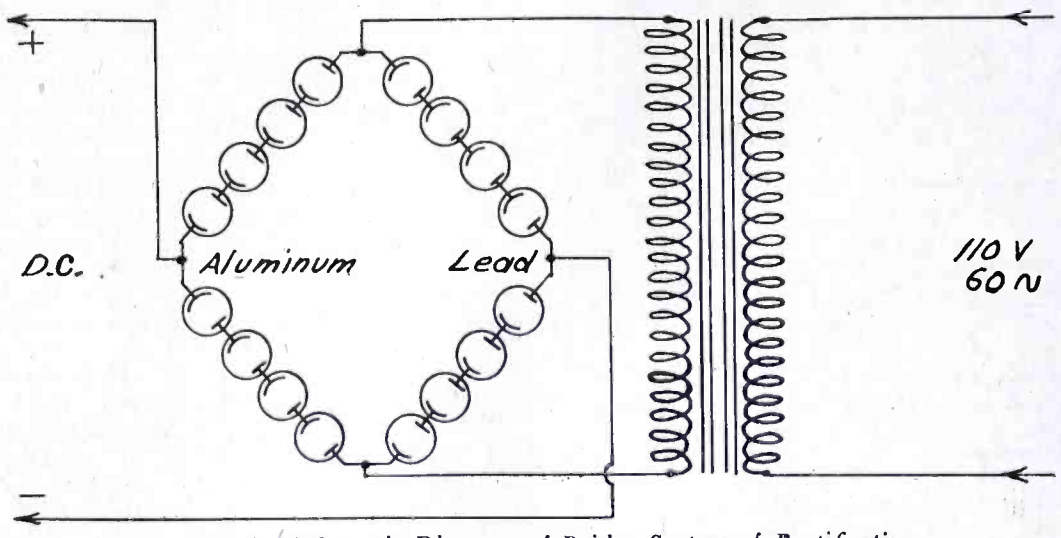


Fig. 4. Schematic Diagram of Bridge System of Rectification

Fig. 4 is a schematic hook-up of the bridge system. It is assumed that an electrolytic rectifier is to be used for converting the a.c. into d.c. Your .002 condenser will require three sheets of foil, so that approximately 1500 sheets will be necessary for 1 microfarad. Such a condenser would be very bulky unless some means of very tightly compressing the sheets of foil and mica were available.

I built a one-tube Super-Regenerator described in November, 1923, issue of RADIO, and it works O.K. except for a whistling sound. Can you tell me how to get this trouble out of the set?
—C. W. M., Pryor, Okla.

The whistling you hear is the oscillation caused by the .012 mfd. condenser. It can probably be cured by reducing the capacity of the condenser slightly until the frequency of the oscillator has risen above audibility. Try a condenser of .006 and one of .004 mfd. in parallel, instead of two .006 mfd. condensers. If raising the frequency does not help, the only recourse is to install a filter in the output, which will greatly complicate the circuit and cut down the efficiency.

How may a 32-volt farm lighting circuit be used for operating a radio receiver without the use of large resistances to cut down the voltage. I have tried connecting the filaments in series, but cannot cut out the noise of the generator.—N. E. J., Ukiah, Calif.

Shunting a 2-mfd. condenser across the 32-volt line where it enters the radio set will probably eliminate most of the trouble. Series operation of the filaments is about the only method possible with economy.

Lately there have been numerous claims of people having received long distance on crystal sets of the most common design. Most people familiar with radio are aware that from 50 to 75 miles is the limit of reception on crystal sets. Is it not possible that these crystal sets, instead of picking up long distance, are really getting it from a tube set in the near vicinity, the tube set receiving long distance at the same time and radiating energy on the same wave?—T. M. L., Alameda, Calif.

This is a subject on which there has been a great deal of discussion. There is no doubt that the average distance at night, with an ordinary crystal receiver, receiving from a 500-watt broadcasting station is 100 miles, but instances occur constantly where stations have been received over many times that distance. It would appear that, given a good crystal, an efficient tuner, sensitive headphones, and a listener having sharp ears and an infinite abundance of patience, reception over distances up to 1000 miles are quite common, and the writer is of the opinion that this is not due to radiating receivers.

In a Neutrodyne circuit, why is the "C" battery omitted from the radio-frequency amplifiers? Would not the addition of the "C" battery be more economical on the "B" battery, without affecting the operation of the set?—B. C. H., Troy, N. Y.

Yes, the addition of a *C* battery in the grid circuits of the two radio-frequency tubes would greatly increase the life of both the tubes and the batteries. The principal reason why most commercial Neutrodynes do not employ a *C* battery is that they are not licensed under the patents covering the use of a *C* battery in a vacuum tube circuit. For 90 volts on the plate, in the Neutrodyne circuit, the *C* battery should be 4½ volts.

NEW RADIO REGULATIONS IN AUSTRALIA

By L. S. LANE

Owing to the failure of the "sealed set" to satisfy the public, the Australian government revised the regulations under which experimental and broadcasting licenses are issued. The new regulations are as follows:

(1) Licenses will be issued to class "1" stations, which will obtain revenue from receiving license fees, and class "2" stations which will not receive revenue from license fees.

(2) Advertisements will be permitted on both classes of stations, but in each case a tariff of advertising charges must be published, and no advertisement may be refused excepting with the approval of the postmaster-general.

(3) On class "1" broadcasting stations advertising shall be confined to periods not exceeding five minutes and aggregating more than 30 minutes in a regular program, or 60 minutes in 12 consecutive hours. Advertising will be preceded by a suitable announcement.

(4) Both classes of stations will be permitted to relay or broadcast programs from other stations by agreement with, and with the approval of the postmaster-general.

(5) Minimum powers on which the stations shall operate will be specified in the station license.

(6) The existing licensees shall be permitted to operate class "1" stations, and in Queensland and Tasmania, where no license has yet been issued, one class "1" station will be authorized in each case.

(7) The two existing licensees in New South Wales will receive 70% and 30% respectively of the allotted revenue collected within the state, and the same allocation will be made in respect to the two Victorian licensees—the higher percentage being paid to the company operating the higher power station. It is intended that one company in each state shall operate on a power of not less than 5000 watts and the other not less than 1500 watts.

(8) If the apportionments are objected to, a settlement by arbitration will be accepted by the government.

(9) In other states the allotted revenue collected within the state will be paid to the licensee within that state.

(10) All license fees will be collected by the government.

(11) Where a reasonable public demand exists licenses will be expected to establish additional broadcasting (including relay) stations. In the case of failure to meet reasonable demands, rights will be reserved to license other broadcasters, and to allot a proportion of the revenue.

(12) Subject to a satisfactory service being rendered, the regulations, so far as they relate to the number of class "1" station licensees, and to the amount in respect of each class of receiving license fees apportioned to the broadcasting licensees, shall not be altered within a period of two years from the date of issue. At the end of that period rights are reserved to revise the position and make such alterations as may be deemed necessary.

(13) In default of satisfactory service, reservations are provided to cancel the license or any portion of the rights secured thereunder.

(14) For the purpose of fixing receiving license fees, the territory will be divided into three zones, giving roughly a 250-mile radius in the first zone, 150 miles extending beyond the first in the second, and the balance of the state in the third.

(15) The proposed fees per annum for the three zones are respectively, ordinary license, 1924-25, thirty-five shillings, thirty shillings, and twenty-five shillings; 1925-26, thirty shillings, twenty-five shillings, and twenty shillings; special licenses for hotels, entertainments, etc., where profit is to result, £10, £9, and £7-10-0. (£1 equals about $4.50, and one shilling about $0.22½.)

(16) Dealers will be licensed, and will be charged per annum as follows: Zone 1, £5; zone 2, £3; zone 3, £2. There will be no restrictions on the design of equipment or the sale of apparatus by registered dealers.

(17) Experimental licenses will be issued in cases where the department is satisfied that the applicant possesses sufficient knowledge to undertake scientific research and investigations. The charges will be: Zone 1, twenty shillings; zone 2, seventeen shillings and six pence; and zone 3, fifteen shillings. There will be no stipulation prohibiting the reception of broadcasting programs or the design of receiver equipment.

(18) The revenue to be collected will be apportioned between the government and the broadcasting licensees. From the ordinary licensee the government will retain five shillings, and the balance will go to the broadcasting companies. The latter amount is variable, depending upon the zone.

(19) Penalties are provided for breaches of the regulations.

The administration of the regulations is entrusted to the postoffice. Owing to the fact that some people will not bother to take out licenses, it will be necessary to "police" the regulations.

LETTERS TO THE EDITOR

Improving the Tone of Spark Coil C. W.

Sir: In regard to the article written by Mr. F. S. Huddy in August RADIO, I have come across some items that may interest some of the readers. Most amateurs, when using spark coil C. W., overlook a good tone. Any amateur will tell you that the clearer and sharper the tone, the better it will go out. Not that the poor tone does not, but it is more pleasant to read a sharp, clear tone.

At this station a Ford coil was used, but, as storage battery was the only available source of power, the vibrator would get off tone when the battery voltage dropped a little, and the vibrator had to be readjusted. After trying several types of vibrators, I got a R. C. A. chopper wheel and mounted it on a 6-volt toy motor. Then the wheel contacts were connected to the coil where the vibrator formerly was. This gave a clear tone at all times.

The pitch can be adjusted by inserting a rheostat in series with the motor wiring as in

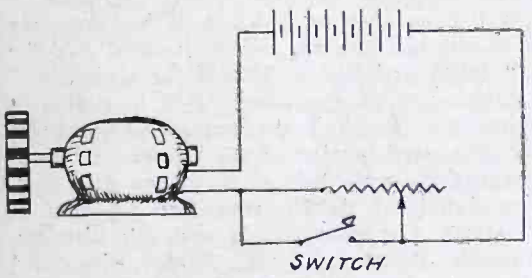


Fig. 1. Pitch Adjustment

Fig. 1. On starting the chopper, it will be noticed that at a certain speed the antenna current will increase. This is the best point. After passing this, the tone will still be good, but it will not be as strong. This is a better method than the vibrator, in that it will stay the same. The wheel should be cleaned about once a month with fine sandpaper.

The circuit used at 3ADI was the familiar 1-DH. The antenna current was about 0.5, using an 8-volt battery on the coil.

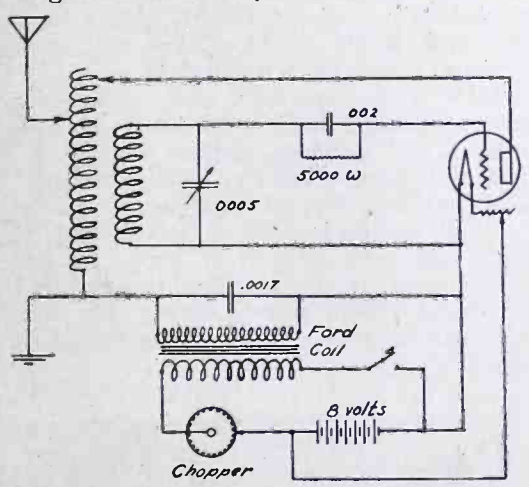


Fig. 2. Circuit Diagram for Spark Coil C. W. with Chopper

This method is used by another amateur in Philadelphia—3ABQ—excepting that he built his chopper wheel. Considering the cost of the R. C. A. wheel, it hardly seems worth while, unless the amateur happens to be a first-class machinist.

Practically any circuit will work with spark coil C. W., provided the amateur has patience to tinker with the circuit.

Mr. Huddy wrote that a "mike" can be inserted in the circuit. It can be used very nicely with the chopper. This can be done by connecting the "mike" across the key terminals and letting the chopper stop with the brush on a segment.

I have worked the "fone" about 10 miles. Although the spark coil here was not very consistent in getting DX, every once in a while I could get 400 or 500 miles.

West Philadelphia, Pa. ALLAN R. MUNCEY.

An Apology is Due and Freely Given for An Unaimed Barb

Sir: Do you not care for the business of the Jew? I mean both radio bug and manufacturer-dealer. Have you ever heard of the Anti-Defamation League? Is it not a fact that a wise editor keeps out of his paper anything which might be offensive to any class?

The picture on the cover of your September issue is offensive to every self-respecting Jew in the United States. If you had come out editorially and said that you did not care to have any Jews buy your paper or advertise in its pages you could hardly do your organization more harm than by the use of the picture mentioned above.

Do you honestly believe that all Jews would try to make such a bargain as your picture suggests? Do you mean to insinuate that none but a Jew would try to drive such a bargain?

Some of the foremost radio engineers of the world are Jews. What will they think of you?

Columbus, Ohio. RADIO JEW.

Even the Draft Eligibles Volunteered

Sir: Re Mr. Laizure's letter in your August issue and Mr. Sacker's letter in September issue.

Mr. Sacker quotes Mr. Laizure as saying that no quiet hours are *observed* in Canada, whereas Mr. Laizure actually states that there are *no* quiet hours here. I have an amateur license and there is nothing in it prohibiting me from using transmitter at any time. The fact that most Canadian amateurs observe quiet hours voluntarily in no way makes them compulsory.

Duncan, B. C. W. F. REEVES, Canadian 5CT.

But One of A Million

Sir: Never again!

Never again will I write to any of the broadcast stations nor will I send applause cards. I have listened night after night to different announcers asking for cards, letters and telegrams, and have sent in the cards asked for, especially to the distant stations that I have heard and have received the little printed acknowledgements of those cards and have felt good about it.

Now, listen to this. Last month—I believe it was the second Tuesday evening—I made a record. I received one of the big eastern broadcasters on a loop with good loud speaker volume. I logged the reception, and, of course, told some of my friends, as you know any good "fan" would do, and met with the usual disbelief. I wrote to the station giving the names of two of the selections played and descriptions of two others and the exact time the diffent selections were rendered and the time that the station signed off after the usual session of begging for letters commenting on their efforts, and I received in return the usual printed card with the usual half-tone of the usual orchestra on one side, and on the other something like this:

> "Dear Sir: The selections you mentioned were broadcasted from this station on a wavelength of 326 meters at the time you state. Thank you."

I am still a liar.

I know the fans and listeners owe something to the broadcast stations; in fact, they owe them an awful lot; but I do believe also that the listeners-in who have been fortunate enough to make a 3,000-mile record or better through the summer static is entitled to a little more consideration than this.

Seattle, Wash. L. F. CROFT

An Ounce of Education Is Worth A Pound of Legislation

Sir: September issue of RADIO received today. Mentions the *single-circuit pest again.* Many nights during the summer I have been compelled to close down my supers and amuse myself elsewhere, due to regenerative bloopers so completely jamming the air that not one single station could be received clear. Out here in the country, where it takes a real "HE" receiver to get anything decent on speaker during the summer time, it is indeed lovely to have a blooper riding the carrier for four hours continuously. Now that radio has been sufficiently advertised and that there are cheap hook-ups available which do not radiate, there certainly is little left to excuse the use of bloopers. Congress will probably fiddle around revising the tariff, etc., through the coming session and not pass a law to prohibit such sets. Therefore, it is up to the radio publications to condemn and DAMN such nuisances until the public is educated. Reprinting these circuits will cause many beginners to think it is the latest and hook them up.

Redding, Calif. E. L. STEPHENS

A Converted Charger

Sir: Not long ago I purchased a sixty-cycle battery charger of the vibrator type and used it up to the time I moved to another city, where the voltage was the same, but at a frequency of fifty cycles. Of course the charger would not work at this frequency, so I set about to remedy this trouble. I decided that the transformer was all right, so directed my energy toward the vibrator. This swung from a heavy piece of springy steel, for which I substituted a piece of fairly stiff tin (the stiffness to be determined by experiment). The charger worked as well as it did on the higher frequency.

Long Beach, Calif. ARTHUR H. CRUMP.

Is It Banana Oil?

Sir: In September RADIO Mr. Oliver W. Jones tells about his experience with a crystal detector. I have had a similar experience about two years ago, while experimenting with crystal detectors. I was using a Great Lakes detector stand with a galena crystal, and I found that, by placing the cat whisker on the outside of the cup, that the sigs were coming through QSA. My theory on the phenomena is: As galena has a small quantity of oil, the cat whisker obtains a thin coating of oil; then you have an imperfect contact detector; when, by placing the cat whisker on outside of cup, you observe the above phenomena; so there is no such thing as a thread detector. I suppose Mr. Oliver W. Jones was using a galena crystal in his experiments; so that was the phenomena he was observing. A good experiment is to place a few crystals in some thin oil for a few days and then try the crystals out. The increase in sensitiveness is surprising, especially if the above experiment is tried out on old crystals that have lost their sensitiveness through usage.

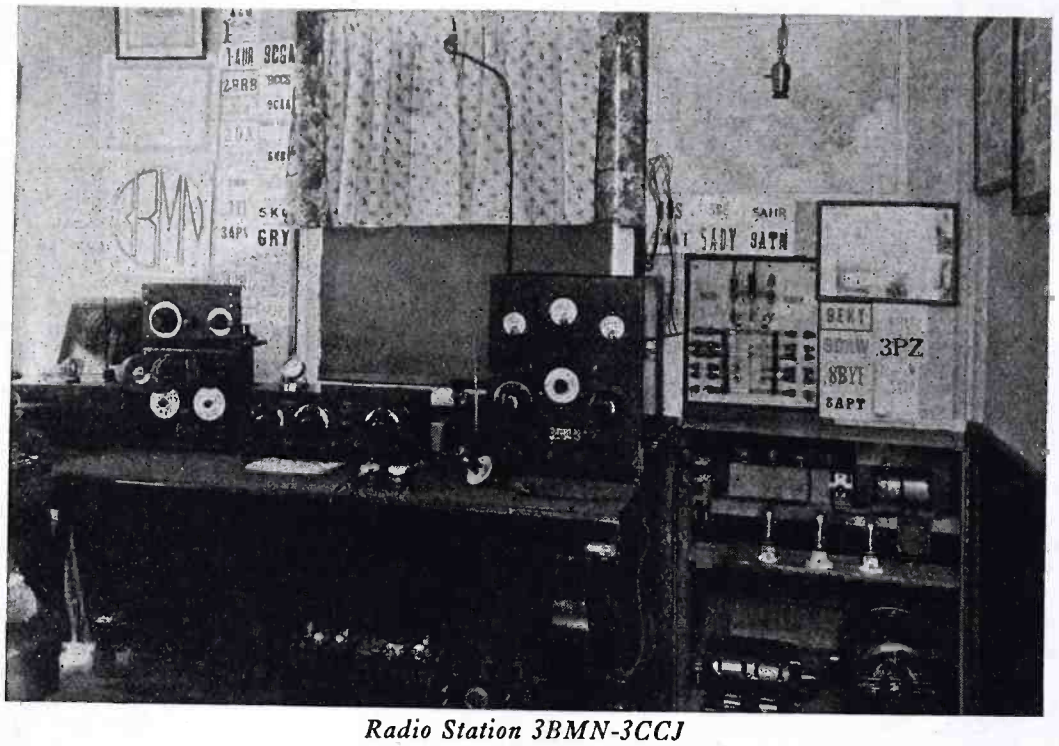
Oak Harbor, Wash. STANLEY WAITKUS

WITH THE AMATEUR OPERATORS

RADIO STATION 3BMN-3CCJ

By RAYMOND J. CARR

'Twas in the Pre-war days when 3BMN took an inevitable tumble from the absorbing of radio literature to the realization of a "cat's whisker" and loose coupler. The larger the coupler, the better it would work thought the owner. The straight gap 4D coil, with its romantic piercing screech, from no meters at all to a point above 25,000, rapidly injected the fangs of the Ham Bug, so deep that only a few months found a 10-watt tube set doing everything but work, together with the trials and tribulations of an audiotron and honeycombs functioning only a fraction of a per cent. The ammeter wiggled on a memorial day back in July, 1922, from said 10-watt set, with motor-generator, using the 1DH circuit. Just one year of unsuccessful hook-ups and patient juggling of connections.



Radio Station 3BMN-3CCJ

Now listen! A 10x10 shack located 25 ft. from the house, accommodates the whole gear. The location at Petersburg, Va., is very good, being on a level tract of land. No dielectrics, which is unusual for a station in the city.

The antenna formerly consisted of four wires, flat top; 60 ft. long on 12 ft. brass spreaders insulated with 20 in. glazed porcelain insulators with 8 in. caged lead-in supported between an iron pole 50 ft. high and a wooden 2x4, 41 ft. high near the shack. Just recently the antenna has been changed to a 6-wire cage, 81 ft. long, on 3.5 ft. brass hoops. The wires are of No. 12 solid copper enameled. The counterpoise consists of same kind of wire on 12 ft. brass spreaders, 18 ft. high and 100 ft. long. The height of the counterpoise is due to four one-lung peach trees dotted as if by measurement, along its effective line. Both leads are brought through glass tube insulators. The ground is very good for receiving, but tests used with it on transmitter revealed no better results, so it was junked.

Entering the shack, you will hardly see a wire. The owner has tried to combine neat appearance with efficiency throughout the station. So many different power sets have been used at 3BMN that it is hard to summarize, in a general way, the set that was responsible for the consistency with which 3BMN covers the country. Arranging from 5 watts to 50, but never over. (The actual output was way over the way hi.) When 50 watts was first used, with 750 volts on the plate, radiating 3.5 amps., the set worked below normal rating, and kicked to Hawaii, 6000 miles. A Western Electric 50-watter was overloaded considerably when 1250 volts were put on the plate at 175 mills, rad. 5 amps. on 185 meters.

The one standby and consistent transmitter employs a single 5-watt tube in the reversed feed-back circuit with series feed; incidentally the circuit has never been changed since radiation was first obtained (not superstitious hi). The chemical rectifier, 24 pint fruit jars, with lead and aluminum electrodes, 1 in. wide and 5 in. long, immersed in a saturated solution of borax, has been the old standby source of rectification for the past two and a half years. Chemical or Amrad "S" tubes can be used at present, either with but an instants throw of two switches, and the pull of another. The so-called 5-watter thrives from 600 volts at 75 mills, radiating 2.5 amps., an input of 45 watts and an approximate output of 30 watts on 155 meters, using a .001 General Radio condenser in series with antenna. The 165 meters is used most, but the wave is changed often, 165 being the best operating wavelength. The apparatus is so arranged and designed that the leads are very short and showing very original designing with a very neat appearance. The complete transmitter is home-built as far as practical. The genuine mahogany panel that graces the front of the transmitter on the table is sugar ham-cured and bears a handsome old English engraving of the call letters and the operator's private trade mark, showing he takes pride in his handiwork. The high voltage and filament transformer inductance and grid coil, RF choke, 10,000-turn iron core choke and rheostat are all home-made, this putting more kick into the sensation of working DX.

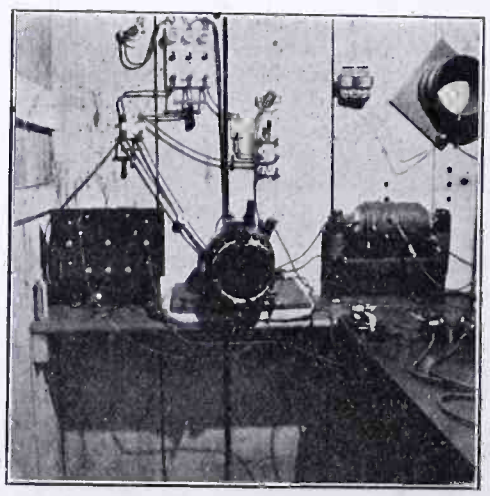
We are just bound to tell you what's hooked to the ear muffs. 1BGF low loss, described in the latest radio periodicals, which functions to the limit of the claims made of them. A Grebe CR-13 is also used, which works FB. The DX reception is Mexican "GX," G2SZ, N-PA9, F8AB, and every state U.S. and all private Canada. Incidentally all districts of the U.S. have been copied in two hours. The long wave tuner is double circuit—two condensers and shunt-series switch. This affords the necessary romance of deciphering POZ when the jazz from KDKA fails to amuse the operator.

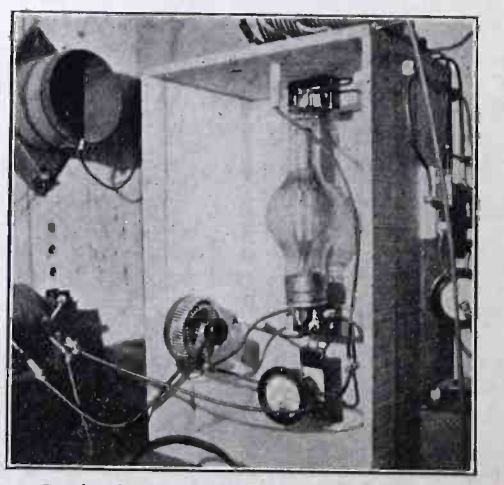
On the table at the extreme left can be seen the portable set, 5 watts with dynamotor from storage battery. This is used for the call 3CCJ assigned to 3BMN for such use.

Like most of the hams, DX is the most sought-for phase of the game; incidentally, unlike a good portion of the fellows, all communications and cards received are answered. The signals of 3BMN have been reported in 40 states, Canadian 1-2-3, and 9th districts, Hawaii, Panama, Cuba, Porto Rico and England. 34 states have been worked using 5 watts, together with Porto Rican 4JE—1600 miles, and Canadian 9BL—1200 miles. Best daylight DX worked is 1000 miles. Fone is used occasionally, though having been heard 300 miles. The consistent working range that is maintained throughout the year is 1200 miles. QSO Florida,—900 miles—nightly.

During the past two years there has been only four months of inactivity. With possible exception of tube-less, antenna-less, or otherwise, so to speak, the old brass is pounded daily, and not, maybe, from 5:30 to 7:00, and 10:30 to 11 P.M., and three mornings a week from 4 to 8 A.M.

3BMN is an important traffic center for southern messages, having schedules with both northern and southern stations nightly for quick and prompt delivery, which the new O.R.S. requires. Over 50 messages have been mailed since appointment as O.R.S. and 48 hours is an exceptional delay here. Of late 100 messages is an average, though 1336 were handled one month during the race, with 3ZO for first place in Brass Pounder's League.





The Latest Arrangement at 6EB, Operated by L. F. Seefred, an Old-Timer at Los Angeles, Calif. He was recently reported as heard by New Zealand IAX. The picture on the left shows the 1066-3000-volt transformers, synchronous rectifier and filament transformer. That on the right shows the 250-watt tube.

NEWS OF THE AMATEUR OPERATORS

8ALI has been re-issued to Max Bauer, 11407 Scottwood Ave., Cleveland, Ohio; reports apptd. on 5-watt C. W. and phone.

H. Compton, late of 6AUB, is now operator on KDLK, S.S. *Cuba,* care R. C. A., 50 Fremont St., San Francisco.

QRA of 3RS-3CKC is 817 14th St., N. W., Washington, D. C. All cards QSL'd.

9AIF is now licensed to Louis Milstein, and Hyman H. Milstein, 1115 So. St. Louis Ave., Chicago, Ill., 50 watts C. W., I. C. W. and phone. All cards QSL'd.

6DF and 6RK, two old-timers, are operating the Radio Service Co. and KFQH, a 50-watt radiophone at Burlingame, Calif. They'll have nothing but talent—on 231 meters.

6BX has been re-assigned to A. Binneweg, Jr., 524 Fairbanks Ave., Oakland, Calif.

QRA of 6BVG is 6551 National Blvd., Culver City, Calif., operated by J. M. Letts.

Herman A. Fisher, ex-2AT, an old-time commercial op., and author of several articles in RADIO, stepped off August 2. We hope his wife will be second op. He is a charter member and past president of the Radio Club of Irvington, N. J.

2JL, Jos. L. Roemisch, 841 Lexington Ave., New York City, wants the co-operation of amateurs while he is doing research work on 5, 20, and 75-meter wavelengths in the radio laboratories of New York University. Special study is to be made of DX carrying power and fading.

CIVIL SERVICE EXAMINATION FOR JUNIOR ENGINEER

The examination will be held throughout the country on October 8 to fill vacancies in various branches of the government service at an entrance salary of $1,860 a year. Examination will be given in the optional subjects of electrical engineering and radio engineering. Applicants must have been graduated with a degree in engineering, preferably along the line of the optional subject selected, from a college of recognized standing, or must be senior students in such course, and furnish, within three months from the date of the examination, proof of actual graduation. Courses of study along scientific lines in a college of recognized standing will be accepted as equivalent to engineering courses, the amount of such credit, however, depending on the relation the courses of study pursued bear to those required in a regular engineering curriculum.

Applicants who have successfully completed at least two full years of engineering study may substitute a year of experience for each additional year of the college course. The duties of the position require that appointees perform such work as routine testing, preparing specifications for engineering material or apparatus, making computations, assisting in conduct of experimental research tests, compiling reports, handling technical correspondence, and other related work.

Competitors will be rated on general physics, pure and applied mathematics, practical questions on the optional subject selected, and education, training and experience.

Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. civil service examiners at the postoffice or customhouse in any city.

CALLS HEARD

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

By 4PV, 148 Avant St., Spartanburg, S. C.

(1aap), 1abf, 1ajx, 1azr, 1bcu, 1bdx, (1bgq), 1boa, 1bq, 1bvr, 1bwj, (1cak), 1cmx, 1cpj, 1gv, (1mm), (1pl), 1py, (1rh), (1zd), (2abt), (2aey), 2al, 2ana, 2ayp, (2bgo), (2bmr), (2bqb), (2brb), 2cg, 2cjj, 2cka, (2cqz), (2crq), (2crw), 2cvj, 2cvu, 2cwj, 2gk, (2jc), (2kf), (2mo), 2my, 2rb, 2rk, 2wz, 2xbf, (3abw), (3adv), 3aec, 3ahp, 3aky, (3apv), 3auv, 3bco, 3bei, (3bkl), (3bnu), (3buv), 3buy, 3bva, (3bvl), (3bvu), 3bwt, 3bz, (3cbx), (3cdk), 3cel, (3chh), 3doo, 3fb, 3fr, 3jh, 3jv, (3lg), 3mf, 3ph, 3pi, (3qt), (3sf), (3tf), (3zm), 3zo, (4aa), 4af, 4ai, 4bg, (4bk), 4bw, 4dt, (4du), 4dv, (4dx), 4ea, 4eq, 4fg, 4fs, 4ft, 4gx, (4gw), (4hr), (4hw), (4hz), (4it), 4jd, (4jr), 4ll, (4ls), (4mi), 4pb, (4pd), 4pk, 4rh, (4rr), (4si), (4sy), 4tj, (4un), 5agn, 5aiy, (5akw), (5alz), (5amh), (5aom), (5apc), 5ck, 5es, 5fm, 5gi, (5gp), 5iq, (5ka), 5kc, (5nj), 5pa, 5pk, 5ua, (5uk), 5vv, (5wi), 6avj, (8acm), 8aey, 8agp, 8aig, 8aip, 8ajh, (8alw), 8anb, 8app, 8apr, (8aq), (8atp), 8avd, (8avx), 8awn, 8aws, (8axf), 8ayw, (8bit), 8bjt, (8bkh), 8bkm, 8blp, 8bma, 8bmb, (8bni), (8boe), 8bos, 8boy, 8bqi, 8bqr, (8brc), 8brm, 8btl, 8bvd, 8bvj, (8bvr), 8bvu, 8byk, 8cab, 8cci, 8cee, (8cei), 8chk, 8cia, (8cjp), (8cmh), 8cnl, 8con, (8crw), (8cud), 8cwp, (8cwr), 8cxm, (8cyi), 8cys, (8dae), 8dfm, 8dgt, (8dhs), 8dki, 8dla, 8dmx, 8dnf, 8do, 8doc, 8doi, (8doq), (8dph), (8dqi), (8dsn), 8fj, (8fm), 8hc, 8hn, 8lr, 8md, 8ry, 8vq, 8vt, 8wy, 8xs, 8zab, 8zg, (9aa), (9aal), 9aau, 9aps, (9arp), 9aud, (9aus), (9auy), (9azx), (9baz), 9bce, 9bcx, 9bdp, (9be), (9biw), 9bjz, (9bk), 9bkj, (9bkk), 9blr, 9bmk, (9btk), 9bwf, 9bwu, 9cah, 9cco, 9cfi, 9cfs, 9cii, 9cmr, (9cwp), 9cyq, (9czb), 9cze, 9dfq, 9dge, (9dgv), 9djn, 9dlm, 9dlw, (9mi), 9dmj, 9dpx, (9drc), 9dsa, 9dtk, 9ead, (9ebq), 9efz, 9elb, 9eld, 9eli, 9em, 9kd, 9tf, 9uc, 9vc, 9xw.

Canadian—5mb.

Fones—2rb, 4rr, 4it, 4hw, 4ll, 4si, 8cab, 8brc.

Will QSL on request. Repts on 4PV'S sigs greatly appreciated and always promptly QSL'D.

By 8RY, Sullivan, Ohio

1gv, 1ow, 1py, 1rv, 1se, 1aac, 1abf, 1acs, 1aeg, 1ajt, 1alj, 1all, 1axz, 1bbp, 1bdx, 1cue, 1cmx, 1cpc, 2by, 2cv, 2dq, 2kf, 2le, 2adk, 2agd, 2ana, 2aww, 2azy, 2bck, 2bmr, 2cvj, 3bj, 3uu, 3aha, 3bco, 3bta, 3cgs, 4dv, 4hw, 4kl, 4oa, 4rr, 4sa, 4sh, 4tu, 5ez, 5fs, 5kq, 5oq, 5wi, 5akw, 5anl, 5aqw, 6cfz, 6cic?, 7fd, 7no, 7gr, 9es, 9kb, 9nq, 9oi, 9uc, 9aad, 9alb, 9amb, 9and, 9aps, 9ash, 9baz, 9bcb, 9bcx, 9bhd, 9bmu, 9bzi, 9cee, 9cei, 9cgr, 9cii, 9cnb, 9cqz, 9czq, 9dct, 9ddp, 9del, 9dhl, 9djz, 9dlj, 9dmj, 9dng, 9dpx, 9dqe, 9dsl, 9dsn, 9elz, 9efy—qra pse?

Specials—1xw, 1xaq, 1xay, 1ze, 1zab, 3xav, 3zp, 4xz, 5zb, 5zas, 8xab, 8xba, 8zg, 9xbd, 9zk, 9zt. Can.—Czaa, Czhe, Czxx, Czyk, Czvh, C5go.

By Le Roy Moffett, Jr., 5ZAV, at Sea

Low loss tuner. Tampico, June, July, August: 1ei, 4eq, 4fs, 4iz, 5ame, 5aex, 5agl, 5agn, 5ank, 5acj, 5acf, 5amw, 5ajh, 5ail, 5agf, 5aen, 5aa, 5bo, 5ck, 5es, 5ew, 5gi, 5iq, 5ii, 5lm, 5nh, 5nn, 5nj (most qsa and consistant), 5ns, 5oc, 5ox, 5oq, 5pk, 5qx, 5rg, 5to, 5uw, 5uk, 5ux, 5vo, 5vu, 5wy, 5xaw, 5xab, 5xbf, 5zas, 6bbh, 9aau, 9ahn, 9amb, 9aim, 9avx, 9bkk, 9cym, 9cee, 9elb, 9eky, 9vm, 9mc, 9zt. Mex.—bx, 1k. Cuban—2by, kdka and wgy on 100 meters.

Puerto, Mexico, July 23rd, 1924: 5alz, 5cc, 5hp, 5rg, 5nk, 5nj, 5ns, 5zb, 5zd, 9dqu, kdka.

Frontera, Mexico, July 25th, 1924: 1xae, 4pk, 5akn, 5agn, 5fm, 5ft, 5hg, 5nj, 5oq, 5ua, 5uk, 5vq, 8xao, 9amb, 9dgm, kdka.

By 5GE, 418 Twohig Ave., San Angelo, Texas

1xae, 1xam, 2cjn, 3mo, 4ai, 4io, 4jz, 4kl, 4kx, 4pb, 4ql, 6aib, 6ajd, 6alw, 6ama, 6atf, 6avj, 6awt, 6bbh, 6bcf, (6bcp), 6bcl, (6bdi), 6bfw, 6bgh, 6bip, 6bjl, 6brf, 6bra, 6bwl, 6cae, (6cbb), 6cdg, 6cdn, 6cek, 6cfe, 6cfz, 6cgc, 6cge, 6cgo, 6cgw, 6cih, 6cmu, 6cng, 6cqe, 6cto, 6dno, (6ih), 6jd, 6ji, 6ka, 6nk, 6pl, 6qj, 6ti, 6rb, 6xad, 6zba, 7ahw, 7co, (7no), 7ok, 7td, 7sr, 7zu, 8abm, 8ajz, 8axf, 8btl, 8cd, 8cmu, 8cr, 8cud, 8cwp, 8dfm, 8dgp, 8ge, 8gz, 8xc, 8zg.

Can.—3ni. 4cr, 4io Special—whu, nkf. Mex.—(ik). Wl qsl on request. Pse mention if 5GE hrd by u.

By 6BBV, J. Barsby, 518 W. 50th St., Los Angeles.

5ado, 5amo, 5ao, 5cn, 5go, 5lr, 400 6's, 7aak, 7acf, 7acu, 7adg, 7adp, 7aek, 7af, 7ahs, 7aif, 7aiv, 7aj, 7ajq, 7akk, 7ald, 7av, 7bj, 7em, 7go, 7gr, 7ha, 7ju, 7jw, 7ke, 7ls, 7mf, 7mi, 7no, 7ok, 7pz, 7rk, 7ry, 7to, 7wm, 7xa, 9bm, 9bqf, 9caa, 9cfy, 9cju, 9cpu, 9dkv, 9dte, 9eam, 9eky, C5go. Low loss tuner 1 tube used. Pse qsl my 20-watter.

By 8CUD, George Brown, 5506 Edgewater Drive, Toledo, Ohio

1aei, 1arf, 1bbo, 1bbc, 1bmj, 1bwj, 1ccz, 1cmp, 1om, 1py, 1qm, 1rv, (1vk), 2ah, 2abt, 2aco, (2aey), 2ajc, 2alr, 2aoy, 2bbx, 2bco, 2bkl, 2bta, 2bmr, (2bqb), 2brb, 2byu, 2cgd, 2chg, 2ctq, 2cwj, (2cpa), 2fb, 2gc, 2kr, 2ky, 2pd, 2rb, 2ry, 2zm, 3apv, 3avn, 3bay, 3bj, 3bnc, 3ccv, 3ckl, 3cdk, (3cjn), 3cu, 3hz, 3lg, 3oh, 3tf, 3tt, 3uu, 3vh, 3qt, 4af, 4bx, (4dx), 4cy, 4it, (4ft), 4nd, (4oa), 4og, 4py, (4pv), 4rr, 4sb, 4si, 4uf, 4xz, 5aek, (5agn), 5agv, 5akn, 5ali, (5apc), 5cn, 5fc, 5ft, 5kr, 5mi, 5nj, (5ru), 5sh, 5ua, 5uy, 5zb, 6awt, 6bwl, (6cgo), 6cgw, 6pl, 7zu, 9dgbr, 9cfi, 9dei, 9aea. North Pole—vdm. Mex.?—ij.

By 5AQW, 223 So. 3rd St., Enid, Okla.

1aaw, 1aer, 1boa, 1fp, 1gv, 1xam, 2brb, 2cjn, 2mo, 2mo, 3bwj, 3bco, (3cdk), 3he, 3jj, 4ai, 4bq, 4dp, 4fg, (4gw)?, 4jk, 4jr, 4io, 4pk, 4pv, 4tj, 4tf, 4xe, (more 5's), (6agk), 6alw, (6amw), 6apt, (6bcp), 6cgw, 6zcd, 7co, 7fd, 7aby, 7afw, 8aaj, 8abm, (8cun), (8cwp), (8cyi), 8ij, (8jq), 8xt, 8yu, (mni nines).

Can.—3gg, (3ni). Mex.—(bx)?.

Fones: 5abe, 5anl, 5apz, 5gj.

By 2AEY, R. E. Groebe, 338 El Mora Ave., Elizabeth, N. J.

1abs, 1aco, (1aeo), (1ajo), 1ajt, 1ajx, (1all), (1bbx), 1bym, 1cmx, (1gh), (1zt), 1rq, 1se, (3acc), 3api, 3avg, (3bez), 3bkl, 3bmn, 3bta, 3buv, (3cdk), 3cdn, 3cfc, 3cgc, 3chc, (3cka), 3ckl, (3xan), (3bm), (3bu), 3dk, 3lg, (3mk), 3tf, (3qt), (4ft), 4hw, 4io, 4it, 4jr, 4pv, 4ll, 5apc, 5fv, 5mi, 5nj, 5sg, 5vv, 5wl, 5zb, 6cgw, 6lv, 8aat, (8acm), 8aii, 8ams, 8avd, 8bbf, 8bcb, 8bhy, 8bjt, 8bkh, 8boa, 8brc, 8bzf, 8cci, (8cmh), 8cnq, 8cpq, (8cud), 8cuv, (8cxm), 8daa, 8dgo, 8dgw, 8dhs, 8dhu, 8djf, 8dmv, (8doo), 8doq, 8dsn, 8dtw, 8bp, 8cb, 8gz, 8hv, 8ku, (8uf), 8wo, 8wz, 8rh, 8rj, 8sf, 8tt, 8zg, (9aau), 9afk, 9arp, 9biu, 9bmu, 9bsf, 9cfk, 9djz, 9dyy, 9hk, 9hw, 9vm.

Can.—2bn, (3oh). Will gladly send printed card to any of above stations. Pse qsl if u ever hr me.

By 6CAN, J. W. Clark, Calistoga, Calif.

5aac, 5ajj, 5akz, 5bx, 5ane, 5gg, 5lm, 5mo, 5ob, 5oq, 5ph, 5rg, 5sk, 5ux, 7abb, 7acf, 7ahs, 7akk, 7akt, 7ald, 7alk, 7av, 7aek, 7bk, 7ca, 7fv, 7gj, 7ga, 7gv, 7ij, 7io, 7ln, 7ma, 7mf, 7no, 7pj, 7pz, 7rd, 7rw, 7ry, 7td, 7tn, 7tq, 7sf, 7zn, 7zz, 7zm, 8xs, 9agz, 9ahv, 9ahz, 9aii, 9bcx, 9caa, 9cee, 9cfy, 9cja, 9cpu, 9cvo, 9dkv, 9dng, 9doe, 9dte. 9ss.

Can.—4er, 4gt, 5bf, 5ct, 5gg. Anyone hearing my 10-watt C. W. or fone pse qsl crd. Tnx.

At 6CJQ, 650 California St., Venice, California

4ft, 4pv, 5aex, 5ajh, 5amw, 5dw, 5em, 5ga, 5ge, 5in, 5lg, 5ls, 5ns, 5oq, 5uk, 5ux, 5uy, 5xaz, 6bbh, 6crs, 6rm, 7aek, 7afm, 7agz, 7ahs, 7aiu, 7ajq, 7akk, 7alk, 7av, 7co, 7dm, 7do, 7dz, 7fa, 7fr, 7if, 7it, 7jw, 7ln, 7ls, 7mf, 7mi, 7no, 7ok, 7ot, 7pz, 7ry, 7td, 7vn, 7zm, 7zo, 8bic, 8hrc, 8dtc, 9aw, 9agl, 9amb, 9awx, 9bcb, 9bjk, 9bkf, 9btx, 9bun, 9caa, 9cfy, 9cpu, 9dkv, 9dpx, 9eae, 9eam, 9eli, 9ss, 9ua, 9zt.

Can.—4cb, 4gt, 5cn, 5gg, 5go. !!! Cx-1, npl, nqw.

By 6CTE, Brookdale, Calif.

4pb, 5agn, 5ajh, 5akn, 5amo, 5bu, 5ef, 5gf, 5lg, 5mi, 5ux, 5xv, (7agz), (7ahq), (7akk), (7alk), (7av), (7cm), (7dd), (7dz), (7gr), (7gv), (7kb), (7kv), (7ls), (7mf), (7no), (7nw), (7pj), (7pz), (7qy), (7tq), (7un), (7vn), 8apn, 8brt, 8brc, 9ado, 9agl, 9ahs, 9bm, 9bng, 9bxe, 9caa, 9ccs, 9cfi, 9cju, 9cpu, 9dbf, 9dkv, 9dng, 9dpx, 9eae, 9eam, 9efy, 9ss, 9zt. Can.—4gt, (5ch), (5gg), (5go). So. Amer.—Venezuela c9g.

By 6CFE, 938 No. Genesee St., Hollywood, Calif.

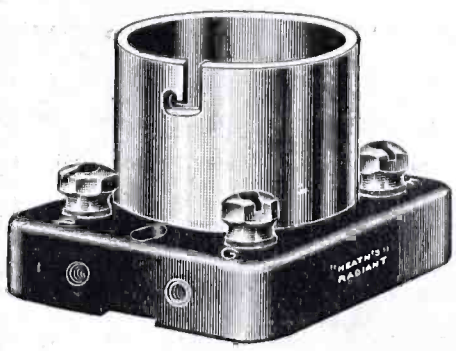
4fs, 5lg, 5fm, (5ak), 5ux, 5in, 5ez, 5go, 5vo, 5gn, 5ns, 5qh, 5bo, 5rg, 5oq, (5amd), (5ajh), (6cka), (6bcl), (6adb), (6atf), (6cie), (6atz), (6aoi), (6alw), (6bcf), (6pu), 7ju, 7ly, 7adi, 7af, 7tq, 7ry, 7ij, 7od, 7id, 7bj, 7io, 7no, 7qc, 7nx, 7mf), 7td, 7wm, 7gr, 7ls, 7pz, 7if, 7it, 7rw, 7ahs, (7akk), 8vn, 8brc, 8cpp, 9aau, 9ado, 9agl, 9amb, (9caa), 9dhy, 9dxy, 9dkv, 9dqe, 9eam, 9eae, 9elb, 9egz, 9zt, 9xbb.

Mex.—bx. Can.—4gt, 4cb, 5cn, 5go, 9bx. Anyone hring my 10-watt C. W. pse qsl. All cards answered.

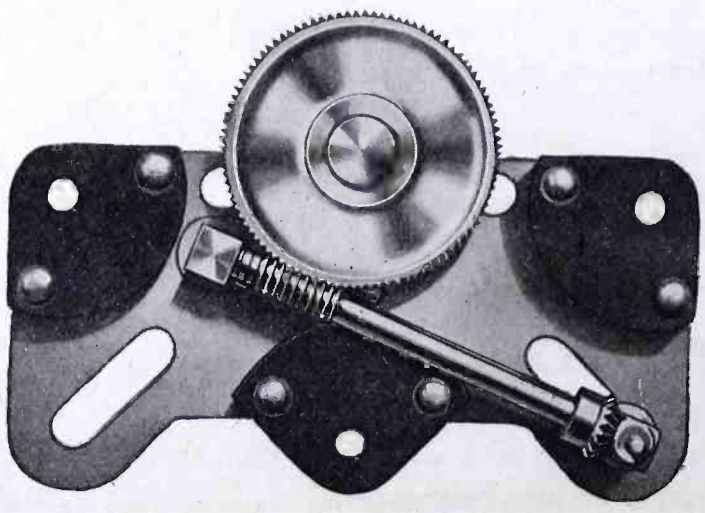
FROM THE RADIO MANUFACTURERS

The Exide Chemical Rectifier is a simple outfit designed for charging storage "B" batteries and low voltage "A" batteries from alternating current supply. It will safely deliver a current of 0.3 ampere continuously for 1500 hours without overheating. As it is free from noise, it can be used while the set is in operation. It consists of a lead and an aluminum electrode suspended in an electrolyte contained in a heavy glass jar with a hard-rubber top.

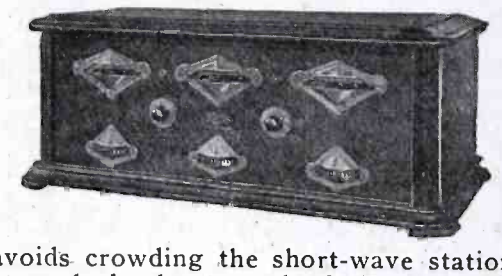
The new Heath Socket is equipped with a rubber cushion to absorb vibrations and prevent microphonic effects. It has self-cleaning contacts made of reinforced phosphor bronze set into grooves molded in the base so as not to become loose. It is suitable for either panel or table mounting.



The American Brand variable condenser with worm drive vernier combines rugged construction with low resistance. Micrometer adjustment of the entire set of movable plates is secured by a 100-1 geared vernier. Low resistance losses are insured by pig-tail connection and plate supports without washers. These condensers are made with or without worm drive vernier in 13, 17, 23 and 44 plate sizes corresponding to .00024, .00035, .0005 and .001 mfd. capacity respectively. It is especially well adapted for use in a super-heterodyne circuit.

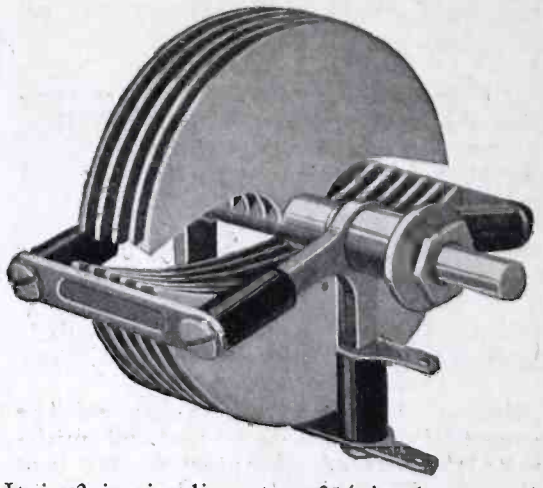


The Grebe Synchroscope is a new broadcast receiver using two stages of tuned radio-frequency secured by a new type of fieldless inductance (the "binocular coil") in combination with a variable condenser whose scale gives equal spacings for various wavelengths and thus avoids crowding the short-wave stations toward the lower end of the scale. It employs tangent verniers and horizontally-mounted dials projecting through escutcheon plates on the panel. Plug and jack control has been supplanted by a new input method which gives six gradual variations of volume. It is made in two types, one using 5 "A" tubes, the other 6 "99" tubes.

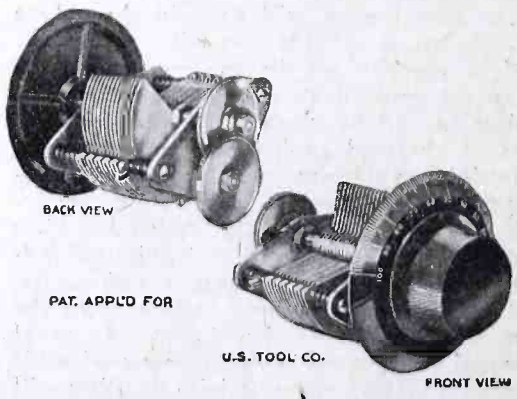


The Pacific Quintet Super-Het Kit consists of an oscillator coupler, three intermediate frequency transformers (iron core) and a tuned transformer (air core) intended for use in building a 45,000-cycle super-heterodyne. They are furnished with instructions for assembling a complete set.

The Premier "Crofoot" Condenser has a minimum capacity of .000007 mfd. and a maximum of .000516, a tuning ratio of 1 to 74. The rotor and stator plates are of brass in a semi-straight line plate design. It is 3 in. in diameter, 3⅝ in. long, and weighs 11 oz. One hole is required for mounting. The soldered connection of the plates are covered with red varnish as a means of identification. It has a high insulation resistance and a low phase angle loss.

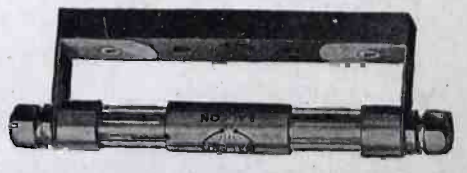


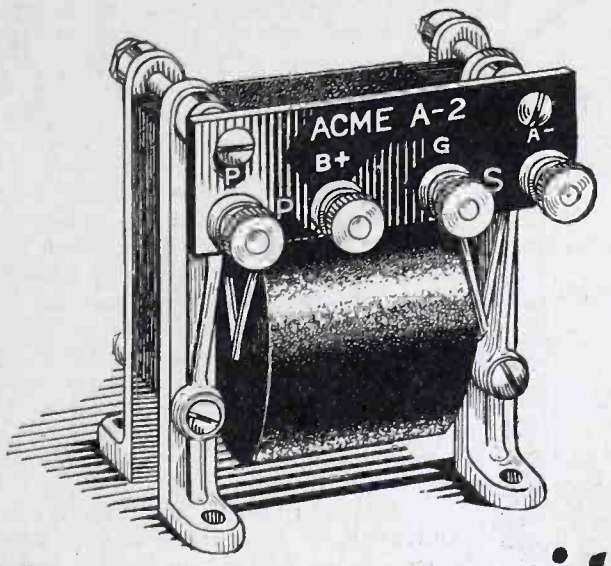
Type No. 6 U. S. Tool Co. Condenser is typical of a number of new models of their low loss variable condensers. It is made with a one-piece stator being stamped and folded from one piece of brass, thus minimizing resistance losses.



The rotor plates are held in position by a hexagonal shaft. It has a protected pig-tail connection and a friction drive vernier giving a 9-to-1 ratio. It has a tested equivalent series resistance of less than .08 ohms at 200 meters and .2 ohm at 500 meters. It is made with capacities of .00025, .0003, .00035, .0005, or .001 mfd.

The Pacent Balcon is a new balanced condenser designed for tuned radio-frequency circuits, or wherever a small balanced condenser is desired. It consists of two nickel-plated electrodes with 3/16 in. space between ends and inclosed in a ¼-in. glass tube along which a ¾-in. brass tube slides. Maximum capacity is obtained when the center of the brass tube coincides with the center of the space between electrodes.





After distance, what do you want?

Amplification without distortion,

OF COURSE, you want to hear the distant stations but you want these loud and clear so a whole room full of people can understand.

And when you listen to a fine musical program from your local station it certainly is fascinating to get all the notes, all the words, and to be able to close your eyes and just be content.

If you use Acme Transformers in the set you build and insist on their use in the set you buy, you are giving your loudspeaker a chance to reproduce the singer's voice, the violin's notes, the orchestra or lecture, loud and clear, without distortion.

Send 10 cents today for 36-page book "Amplification without Distortion," containing many practical wiring diagrams and many hints for getting the best out of your set.

ACME APPARATUS COMPANY

Transformer and Radio Engineers and Manufacturers

Cambridge, Mass.

ACME

~ for amplification

ACME APPARATUS COMPANY,
Dept. 82, Cambridge, Mass.

Gentlemen: Enclosed find 10 cents for copy of "Amplification without Distortion."

Name .....

Street .....

City .....

State .....

PACIFIC RADIO EXPOSITION A GREAT SUCCESS

The Pacific Radio Exposition at San Francisco closed August 23rd with an attendance of nearly 60,000 people during a six-day period. A profit of over $10,000 is to be divided equally between the exhibitors and the Pacific Radio Trade Association, under whose auspices it was held.

The greatest interest naturally centered around the 1925 models of complete sets, a dozen or more of which were given their first public showing. These were mostly five-tube tuned radio-frequency sets and eight or more tube super-heterodynes.

The most marked advance was in the high grade cabinets for housing the equipment. They gave evidence of the fact that radio has passed from the experimental to the musical instrument stage as far as broadcast reception is concerned.

There were many indications of standardization in appearance and in component parts. Many of the sets show a marked improvement in design and workmanship. Most manufacturers are stressing selectivity, non-radiation, simplicity of operation and clarity of tone. This latter quality is largely dependent upon the loud speaker, whereof there were a number of excellent models.

The parts for home-made sets were of far better quality than was available a year ago. There is an increasing tendency toward definite test and specification as to electrical characteristics and also toward compactness in design. Resistance losses are being minimized and operating efficiency increased.

The show gave the general impression that there is nothing radically new or revolutionary impending in radio equipment for some time to come. Changes are due mostly to refinements in construction. Prices are about equal for models of equal merit and it becomes largely a matter of personal preference or of salesmanship as to which make is deemed best for a desired purpose.

NEW RADIO CATALOGS

Publication 3131, from the Cutler-Hammer Mfg. Co. of Milwaukee, while devoted primarily to House Wiring Devices, devotes two pages to C-H radio products, including rheostats, potentiometers, variable grid leaks, switches, sockets, and resistance units.

The Electric Storage Battery Co. has issued several booklets describing the new Exide storage batteries. The *A* batteries are made in 2, 4 or 6-volt sizes, the *B* in either 24 or 48-volt units.

"The How and Why of Resistance-Coupled Amplification" is the subject of a valuable bulletin from the Daven Radio Corporation of Newark, N. J. It gives the answers to a large number of questions asked Zeh Bouck.

R. Mitchell & Co. of Boston have issued a complete catalog of SE-AR-DE radio products which comprise most of the parts used in home-built sets. A number of good tables and diagrams are included.

Make the World of Music Yours

WHEN a famous soprano sings the Gypsy Song from Carmen, hear it in your home exactly as she sings it.

Through MUSIC MASTER, the musical instrument of radio, let her voice be crystal clear. MUSIC MASTER gives to radio life and beauty, lending a wholly new charm to the wonders of the air.

MUSIC MASTER is not just a loud speaker—it is a *true* speaker, a *clear* speaker, a pleasing musical instrument.

Radio impulses entering the sensitive precision instrument in the base are translated into sound waves, undistorted and faithful to the original voice or instrument. In the tapered tone chamber of cast aluminum these sound waves grow clear and bell-like and, finally, the full, mature tones pour forth in rich resonance through the MUSIC MASTER amplifying bell of natural wood.

Your dealer knows. Have him send you a MUSIC MASTER to be proved with your own set.

Dealers Everywhere

Music Master Corporation

Makers and Distributors of High-Grade Radio Apparatus

10th and Cherry Streets

Chicago PHILADELPHIA *Pittsburgh*

Music Master
RADIO REPRODUCER

Connect MUSIC MASTER in place of headphones. No batteries required. No adjustments.

14-inch Model, for the Home $30

21-inch Model, for Concerts and Dancing $35

BROADCASTING PROBLEMS

Continued from page 10

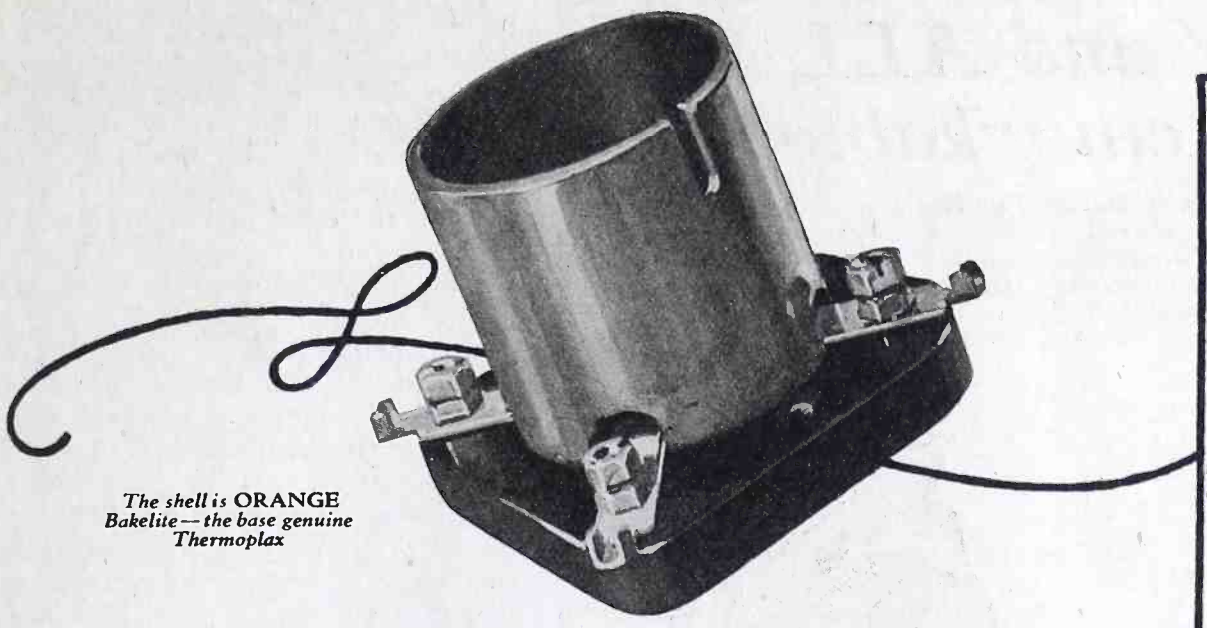
other difference between telegraph and telephone use. It is perfectly possible to send a telegram from London addressed to John Jones in New York by radio which will be picked up by one of our radio stations and dispatched to John Jones by messenger. That is we can send communications from one individual to another by wireless telegraph parallel to the ordinary telegraphic system.

This can not, however, apply to the radio telephone in the use of wave lengths suitable for broadcasting. Here we can not allow any personal communications. If we wanted to apply the telephone to personal communications such as we have in the normal telephone service, only seven people could call up at once in any one neighborhood, and therefore it has no practical application for service in personal communications. Thus we have a further step in regulation. We do not allow any personal communication by telephone within the lower range of wave lengths but reserve it entirely for broadcasting purposes where millions of persons can be served instead of only a few. If we allowed private communication by radio telephone, we would have the air filled with invitations to dinner or comments on Lillie's bobbed hair with a possible exclusion of a speech by the President of the United States. And in any event only seven or eight people could communicate at once in the whole United States.

That brings me to another step of regulation. As I have said, we have at present a maximum of only ten or twelve practical wave lengths in any one vicinity for general broadcasting. We have about 600 broadcasting stations and in order that each one of them may have some right to start things in the ether we have to divide them in different categories as to quality of station, to group them in zones and to divide the time among them. We can for practical purposes use the same wave lengths upon the Atlantic Zone as the Pacific Zone for the distance of transmission is such that they do not interfere. Thus by a sort of staggering of wave lengths we accommodate more stations. And when there are more than two or three stations located in one town in any given zone we have to arrange for them to divide the time during the day. The art is always improving and with the perfection of instruments we should be able to put the wave lengths closer together and then have more for use as time goes on.

THE next problem in Governmental relations is monopoly. If anybody could get a wave length perpetually to himself, he would have a monopoly and

Continued on page 48



The shell is ORANGE
Bakelite—the base genuine Thermoplax

At Last—A Radio Socket Worthy of This Famous Trade Mark

After months of experiment and research the Cutler-Hammer engineers announce this masterpiece of radio socket design. With features never before found in any socket, it brings to your set a degree of efficiency that means added miles of range and hours of clearer, more enjoyable reception.

Capacity has been absolutely minimized—without sacrifice of mechanical strength, and its base of ebony black Thermoplax in beautiful color contrast with the thin shell of orange Bakelite adds as much to the appearance of any set as this socket's construction does to its efficiency.

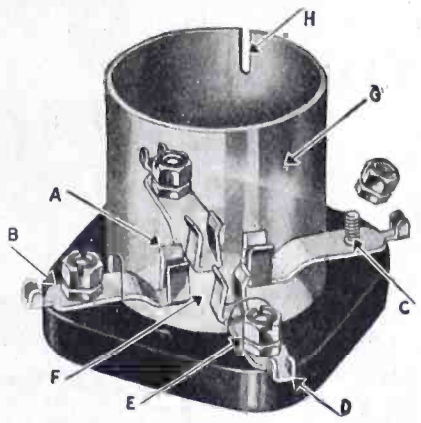
You'll like all of its many exclusive features—the silvered bronze contacts that afford *permanently* perfect contact; the slotted binding nuts; the handy terminals for soldering; the wide spacing of current carrying parts.

You'll like its appearance—neatness—small size. You'll like the way the tube is inserted and removed without twisting. And best of all, you'll like the price, 90c. *This socket that meets the specifications of the most exacting radio engineer costs no more than most of those on the market today.* Until all dealers have been stocked, you can be supplied direct from the factory at the retail price plus 10 cents for packing and postage. Be sure you have the genuine—it will pay you in every way to refuse all substitutes.

THE CUTLER-HAMMER MFG. CO.
Member Radio Section, Associated Manufacturers of Electrical Supplies
MILWAUKEE, WISCONSIN

C-H

These Exclusive Features Assure Better Reception



A
Perfect contact. Both sides of tube prong cleaned when inserted—no contact or wear on soldered end.

B
All metal parts *silver* plated—perfect contact for the life of the set. Silver may tarnish but its contact resistance does not change.

C
One piece contact construction. The binding post is NOT a part of the circuit—the wire to the socket always touches the contact strip which carries the current direct to the tube prong—no joints to cause losses.

D
Convenient terminals for soldering—full length to allow bending down for under-wiring. Ears hold wire in place for soldering.

E
Extra handy binding posts—tight connections with either wrench or screw-driver. Lock washers hold terminals rigid.

F
Wide spacing of current carrying parts both in air and insulation—true low-loss construction.

G
A minimum of both metal and insulation for low capacity. Shell of thin Bakelite—the base of genuine Thermoplax.

H
The tube is held in place by merely a vertical motion—no twisting to separate bulb from base.

The attractive orange shell helps identify this better socket, but the famous C-H *trade mark both on the socket and on the orange and blue box is your genuine protection*

C-H **RADIO SOCKET**

Continued from page 46

eventually a property worth millions of dollars. We have to safeguard that there should become no vested right to a wave length on the part of any broadcasting station. This would be creating a monopoly of a certain road through the ether just as important as if we gave an exclusive right to one person for the navigation of the Sacramento river. Therefore we must limit the use of the ether to a definite period of years or months so that we can under any reasonable conditions at any time return the use of this particular wave length to the Government. At the same time, we must be careful to give a reasonable continuity of service to a broadcasting station so as to warrant its erection and support. We hear a great deal about attempts to monopolize radio communication. There can be no real monopoly if the policies I have laid down are held to. As a result of these policies, the Government controls the ether today.

Some of the patents on instruments give temporary control of the doors in and out of the ether, but they expire in time, and I have no doubt that the great companies who control and manufacture the apparatus have so fundamental an interest in the expansion of the art and in the development of this method of communication that they will show great vision in the handling of patent rights.

And in any event, through the policies of the Department as adopted for retaining fundamental control of all the routes through the ether by the Government, there is no danger that any vested right is established which will run counter to public interest.

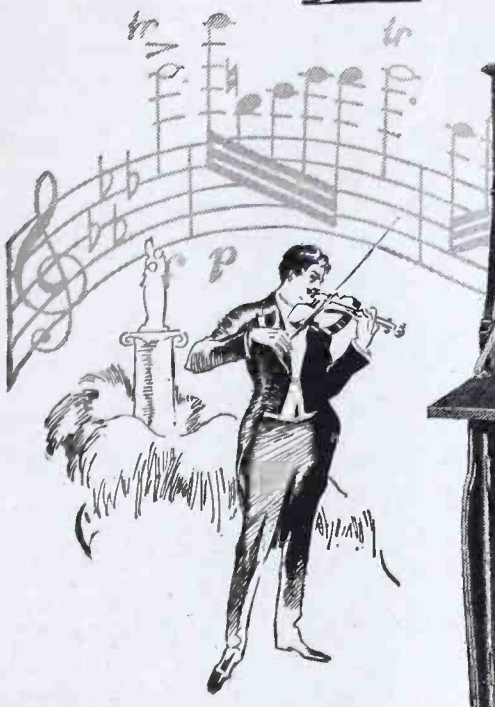
THE third great question in radio is in the improvement of the programs so that radio fans may receive constantly better programs of entertainment, larger participation in the discussion of public questions, in vital events and important news. Every radio fan knows that regular and positive service can only be received over his local stations. Some fans have instruments that are fine enough to listen in on distant stations, but static and other conditions make any but local service irregular, and of no importance as a question of national communication.

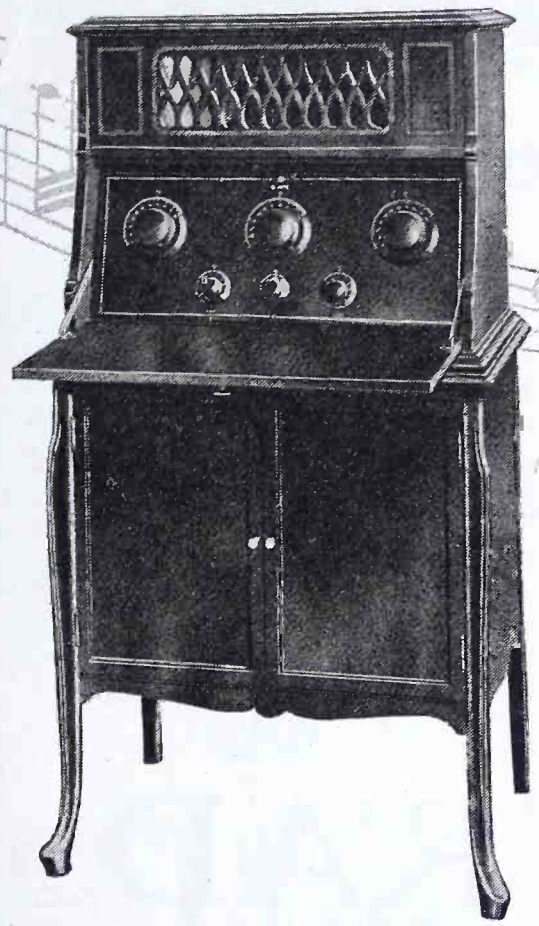
Therefore, from a national point of view, we must rely upon the local station, and, in order that we should have a service of national events, we must have interconnection of these different broadcasting stations in important occasions by the ordinary telephone.

Great musical performances, great sermons, the greater events in the United States generally occur only in one spot at a time, and therefore if radio is to become a great source of serious distribution of such public events, interconnection must be our first concern.

Continued on page 50

FADA Radio





FADA Neutrola Grand
No. 185/90-A
This is the five-tube Neutrola 185-A, mounted on FADA Cabinet Table 190-A. Price (less tubes, batteries, etc.) $295.

The high sweet notes of the violin — the low rolling bass of the organ

TONE quality—true reproduction of voice and music without distortion—is one of the outstanding features of the new FADA Neutrodynes. You hear the music just as it is played or sung.

FADA Neutrodynes can be depended upon at any time, anywhere, to give you the utmost in radio. They operate on a simple indoor or outdoor aerial and use the types of powerful tubes which give maximum results. Each bears the stamp of FADA engineering skill plus the artistry of master cabinet designers.

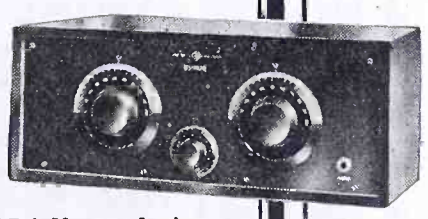
You who have deferred buying a radio set—waiting for someone to produce just your combination of price, performance, cabinet design and finish—need wait no longer. In the new complete line of FADA Neutrodyne receivers you can find exactly what you want.

See your dealer. He will show you a FADA Neutrodyne that will delight you—in appearance, performance and price.

You have a range from $75 to $295 from which to select—six models, each a remarkable value.

F. A. D. ANDREA, INC., 1581 JEROME AVE., NEW YORK

FADA Neutroceiver
No. 175-A
Mahogany cabinet. Inclined panel and roomy battery shelf. Five tubes. Price (less tubes, batteries, etc.) $160.



FADA Neutro Junior
No. 195
Three-tube Neutrodyne. A wonderful performer. Price (less tubes, batteries, etc.) $75.

F.A.D. ANDREA INC. LICENSED BY INDEPENDENT RADIO MANUFACTURERS INC. NEUTRODYNE UNDER HAZELTINE PATENTS NOS 1450080 AND 1450329 OTHER PATENTS PENDING TRADE MARK REG. U.S. PAT. OFF.

Continued from page 48

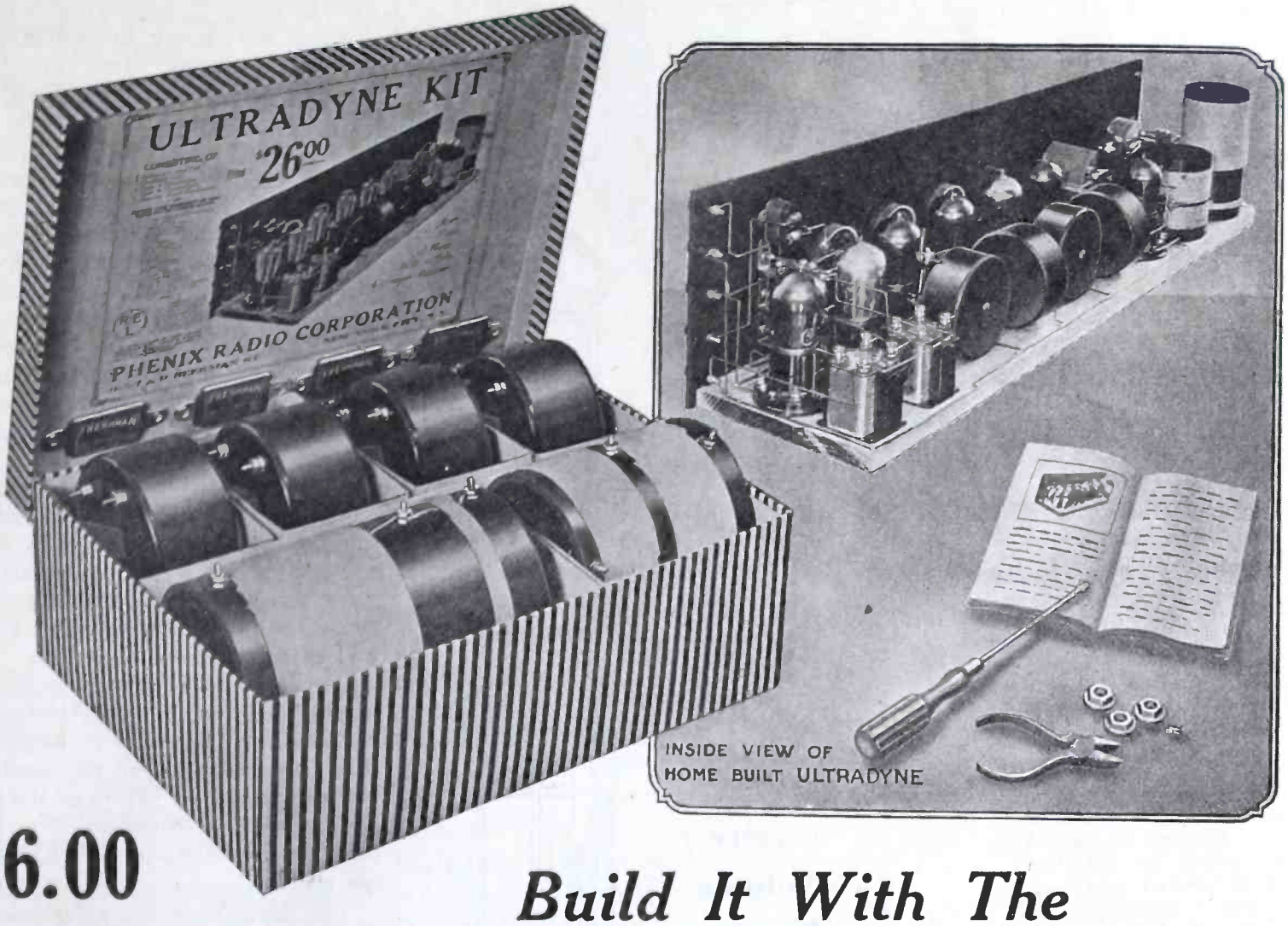
This has been accomplished east of the Rocky Mountains, where often enough twenty local stations are connected up to broadcast an important event. This interconnection has not yet been extended west of the Rocky Mountains, and is the most important matter for us to develop for service of Western radio listeners. President Coolidge's acceptance speech was delivered to 20,000,000 people east of the Rocky Mountains as plainly as you can hear me from this local station. It was accomplished by connecting up many different broadcasting stations by telephone. The Eastern public listened to every incident and every speech of the recent political conventions; even more clearly than if they had been in the conventions themselves.

ANOTHER great question is how we are going to pay for the service to make it self-supporting? The actual operation of broadcasting service of the country is costing today at the rate of $5,000,000 a year. There are, except for a few trivial amounts, no direct revenues to the stations. Up to date they are supported through their advertising value to owners or through the desire of manufacturers to maintain a service for purposes of developing the art and stimulating the sale of instruments. It is as yet impossible to say whether these interests will be sufficient to maintain an acceptable service to the public. It can be said at once if radio broadcasting shall be overwhelmed with advertising the radio audience will disappear in disgust. It is as yet too early to foresee the solution of this problem of support, but I am confident that a system will be worked out.

There are some problems in the world which must be given time for development in order that we may have the most advantageous solution. This is one of them. In the meantime I am opposed to any scheme of imposing a charge on radio listeners by law.

ANOTHER question that is beginning to arise is that of determining priority of material to be broadcasted. When stations are interconnected there will be more material than time. This implies indirect censorship, or the organization of some method of expression of the wishes on the part of radio listeners as to the material which is broadcasted. At the present time most of our receiving instruments when not blanketed by the local broadcasting station can receive programs from three or four alternative stations. The art and perfection in instruments are so developing as to render it possible even now, with certain kinds of receiving sets, to receive from several times this number of stations. This will, I believe,

Continued on page 52



$26.00

Build It With The

ULTRADYNE KIT

To protect the public, all genuine Ultraformers bear Mr. Lacault's personal monogram seal (R. E. L.) and are guaranteed so long as this seal remains unbroken.

Now, the famous Ultradyne Receiver has been so simplified that anyone can successfully build it with the Ultradyne Kit.

This Kit includes all the special parts required to build the Ultradyne, designed by R. E. Lacault, the inventor—1 Type "A" Ultraformer, 3 Type "B" Ultraformers, 1 tuning coil, 1 oscillator coil, 4 matched fixed condensers.

The Ultradyne incorporates the new "Modulation System"—a decided departure from the detector arrangement of radio reception used in all other Super-Heterodynes. This "Modulation System" is the latest development of R. E. Lacault, A. M. I. R. E. Consulting Engineer of this company and formerly Radio Research Engineer with the French Radio Research Laboratories.

Even Super-Heterodyne Engineers marvel at Ultradyne performance—its unusual selectivity and great range on the loud speaker.

There is no greater receiver! Now you can build it yourself!

Write for descriptive folder.

Send for 32-page illustrated book, giving latest authentic instructions on drilling, wiring, assembling and tuning 6 and 8 tube Ultradyne receivers.

50c

PHENIX RADIO CORPORATION

9 Beekman Street, New York City

ULTRADYNE
The Improved
SUPER-HETERODYNE

Continued from page 50

solve the problem by competitive programs.

With the present limited number of stations questions often arise as to whether political speeches should be delivered at a certain hour of the day or whether that hour is to be given over to music, religious service, baseball scores or whatnot. I certainly am opposed to the Government undertaking any censorship even with the present limited number of stations. It is better that these questions should be determined by the 600 different broadcasting stations than by any Government official. These stations naturally are endeavoring to please their listeners and thus there is an indirect censorship by the public. This is the place where it belongs. What we must safeguard is that there shall be no interference with free speech, that no monopoly of broadcasting stations should grow up under which any person or group could determine what material will be delivered to the public.

Legislation is before Congress that would safeguard all of these questions and maintain Government control of the ether, would hold open the questions of free speech and yet permit of the normal and proper development of the art through the initiative and ingenuity of our people.

The department has a fatherly interest in the development of the amateur, and in helping him along as a matter of fine stimulative education and recreation for our boys and for real contributions in invention that have been made.

We have a vast number of complaints about one thing or another, which radio listeners seem to think I might settle for them. A gentleman in Cuba complains bitterly that he can get nothing but Protestant sermons over his radio on Sunday. Some complain about too much jazz music; some complain the music is too highbrow. Some object to instructional speeches; some protest at the speeches of the opposition party. Some complain about the static, and everybody complains of interference. No one who could go over this correspondence would ever want to undertake the censorship of the material of broadcasting stations. You may object to the program sent out by your station; but then you generally conclude that he is probably doing his best. But, if the government were to send out this program for you, you would demand its immediate alteration.

But, when all is said and done, there has dawned upon us a great system of communication. It has enormous implications. Twenty million people today may listen to an address by the President of the United States. The day will come when the whole of our people may listen to great public pronouncements, to the programs of great

Continued on page 54

Ware NEUTRODYNE Receivers

The dominating idea of the Ware Radio Corporation is to build the best receivers that can be made. The tone quality is the outstanding characteristic of Ware Neutrodyne Receivers; the ability to receive the broadcast programs with absolute naturalness, free from distortion, and to render musical programs in all their original perfection.

Type T

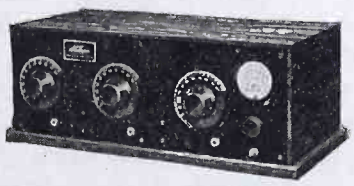
Mahogany cabinet, 10¾" high, 14" wide, 13½" deep. Dry cell "A" and "B" batteries enclosed in cabinet. Reflex neutrodyne circuit. Three dry cell tubes, one reflexed; equivalent to four tube circuit; one stage tuned radio frequency amplification, detector, two stages audio. Operates loud speaker. Outside antenna.

$65.00 without accessories

Type X

Walnut cabinet, 8½" high, 21½" wide, 10¾" deep. Dry cell "A" and "B" batteries enclosed in cabinet. Reflex neutrodyne circuit. Four dry cell tubes, one reflexed; two stages tuned radio frequency amplification, detector, two stages audio, equivalent to five tube circuit. Double-scaled voltmeter indicates voltages of "A" and "B" batteries. Indoor or outdoor antenna.

$150.00 without accessories



Type W

Walnut cabinet, 8½" high, 21½" wide, 10¾" deep. Neutrodyne, not reflexed, using five vacuum tubes—two radio, detector, two audio—and storage battery. "B" batteries enclosed in cabinet. Double-scaled voltmeter indicates voltages of "A" and "B" batteries. Indoor or outdoor antenna.

$175.00 without accessories

Send for catalog

THE sensitivity and selectivity of the Ware Neutrodyne Receivers are remarkable. Nearby broadcasting stations are tuned out, and the desired station brought in at the will of the operator.

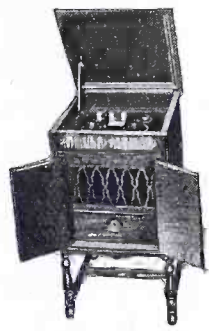
The different instruments are illustrated and described on each side of this page, from the moderate priced but highly efficient Type T to the beautiful cabinet model Type WU, with its powerful equipment and great range of reception. But every one of them has the same wonderful Ware tone quality.

Types T and X are our new reflex Neutrodyne circuits, giving the equivalent of one additional tube in each case; and they are the first neutrodynes to be operated successfully with dry cell tubes.

There is a sense of pride in the ownership of a Ware Neutrodyne Receiver that is fully justified by its performance.

To obtain the utmost satisfaction, investigate the various receivers on the market, but be sure to hear the Ware before reaching a decision.

Ware RADIO CORPORATION
529-549 WEST 42nd STREET
NEW YORK



Type TU

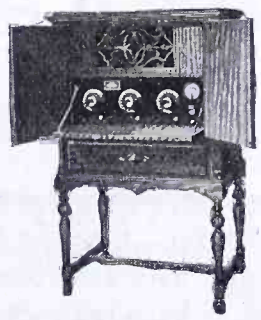
Brown mahogany or walnut cabinet, housing Type T circuit. Panel exposed by raising lid. Loud speaker concealed behind grille. Dry cell "A" and "B" batteries enclosed in cabinet. Dimensions: 34½" high, 18¼" wide, 18¼" deep. **$150.00 without accessories**

Type XU

(See WU for cabinet open)

Brown mahogany or walnut cabinet, with panels of contrasting shades. Embodies Type X Circuit. Loud Speaker concealed behind grille at top, below which a desk leaf turns down, exposing the panel. Dry cell "A" and "B" batteries enclosed in cabinet. Dimensions: 44" high, 27¾" wide, 18⅞" deep.

$275.00 without accessories



Type WU

(See XU for cabinet closed)

Brown mahogany or walnut cabinet, with panels of contrasting shades. Embodies Type W circuit. Loud speaker concealed behind grille at top, below which a desk leaf turns down, exposing the panel. Storage and dry cell batteries enclosed in cabinet. Dimensions: 44" high, 27¾" wide, 18⅞" deep.

$300.00 without accessories

DISTRIBUTORS

Progressive Musical Instrument Corp., New York, N. Y.
Dalrymple-Whitney Radio Corp., New York, N. Y.
Cohen & Hughes, Inc., Baltimore, Md.
A. R. Rodway, Chicago, Ill.
Estey Company, Philadelphia, Pa.
Lucker Sales Co., Minneapolis, Minn.
Commercial Associates, Inc., Los Angeles, Calif.
C. A. Richards, Inc., (Foreign Distributor), New York, N. Y.

Continued from page 52

artists. They may participate in great events. They may do so at their own fireside. They may combine in it the enjoyment of the whole family. The present possibilities of extension of good understanding, of high stimulation to thought and learning of which we have had no parallel since the invention of printing—if it be applied with truth, if its use be free from malice, if it be the vehicle of moral stimulation, it will become the handmaiden of the print in its influence in our national progress. It is of tremendous import,—and it is my business as Secretary of Commerce to see that nothing happens in the ether that disturbs its orderliness and its rapid development,—and that we shall preserve the ingenuity of our people for its perfection.

[Editor's Note: This article is the text of a talk given by Secretary Hoover at the opening of the Pacific Radio Exposition at San Francisco on August 16.]

CHOKE COIL AMPLIFIER

Continued from page 15

3/16 in. being sufficient to accommodate the two amplifier tubes, voltmeter, rheostat, and shelf with associated apparatus. The amplifier will operate a small loud speaker with good volume, but, in case it is desired to furnish great volume for a large room, it would be well to add a power stage using a larger tube, such as theUV-201A or C-301A, with 130 volts on the plate and 9 volts negative grid potential. An additional 1-mfd. condenser will also be necessary, between the negative and positive 130-volt battery terminals, to prevent howling.

THE HOT WIRE AMMETER

Continued from page 36

ductance to eliminate the latter. For that reason it is always made of high-resistance wire such as nichrome, manganin, or german silver. Skin effect, with its variation of resistance for variation in frequency, is overcome by using wire with a diameter not to exceed ½ millimeter.

In order that such small wires or strips may handle larger currents several of them are connected in parallel. being equally spaced around the circumference of a cylinder so as to balance out inductance effects. In this way ammeters may be made to accurately cover a wide range of frequencies and currents.

The Agricultural College at Manhattan, Kansas, is giving a complete series of radio extension courses covering agriculture, engineering, home economics and general science subjects. The lectures are given by the university professors. The course started September 15, 1924, and will close April 15, 1925. The lectures will be broadcast by KFKB on 286 meters until KSAC is ready for operation.

THIS BATTERY WILL MATERIALLY REDUCE YOUR OPERATING COSTS ON HEAVY CURRENT SETS

NEW!

Eveready Heavy Duty "B" Battery. 45 volts. Three Fahnestock Clips. Length, 8 5/16 inches; width, 4 5/16 inches; height, 7 5/16 inches; weight, 13 3/4 pounds.

New low price, $4.75

New Heavy Duty 45-volt "B" Battery No. 770
Extra Large Cells—
Extra Long Service

For maximum "B" Battery economy, use this *New Eveready Heavy Duty* 45-volt "B" Battery, in the following general cases:

1—On all receiving sets operating at 90 volts or more, having four tubes without a "C" Battery, and all sets having five or more tubes, with or without a "C" Battery.

2—On all power amplifiers.

3—On all sets that pull heavy currents from the "B" Battery.

Under the above conditions, the *New Eveready Heavy Duty* 45-volt "B" Battery will give much longer service than the 45-volt "B" Battery of usual size.

If your receiving equipment falls under any of the above classifications, you can make a big saving in "B" Battery costs by using this *New Eveready Heavy Duty* 45-volt "B" Battery No. 770. Buy it and you get the biggest battery value on the market to-day!

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, Inc.
Headquarters for Radio Battery Information
New York—San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY
Radio Batteries
—they last longer

No. 7111
Eveready Radio "A" Dry Cell
Specially manufactured for use with dry cell tubes

Eveready 6-volt Storage "A" Battery

No. 772
Vertical 45-volt, large size "B" Battery

No. 766
Eveready "B"
22 1/2 volts. Six Fahnestock Spring Clip Connectors

No. 771
Eveready "C" Battery
Clarifies tone and prolongs "B" Battery life

No. 764
Vertical 22 1/2-volt "B" Battery

A ROYAL HIATUS

Continued from page 22

And always his booties gave him pain.

It was at a reception at the palace, that the King noted his suffering.

"Take them things off that dog's feet," he had ordered.

He had patted Fido the Terrible on the head and the dog looked up at him gratefully.

"Any time you can return this favor, don't overlook it," the King had said.

The dog had never forgotten. For twelve years, six weeks, five days and three hours he had waited for a chance to show that he had not forgotten. Now, with the precious scroll three inches away from his nose, he kept faith with his King, and his promise to himself.

IT was late that afternoon that a dust-stained, haggard dog, staggered up the front steps of the palace and thrust his way into the royal ante-chamber. His chest was white with lather, and in his mouth he carried the precious scroll. When a page approached him, he jerked a significant paw toward the royal suite.

"Haben!" he barked. "Haben! Haben! Ich haben!"

The page departed on a run. He panted into his Majesty's presence.

"A dog waits without, sire," he announced.

"Without what?"

"A collar, sire."

"Well—what about it? If he needs a collar, give him one. Give him mine—the stand-up collars. They saw my neck anyhow."

The page shifted uneasily.

"He is a German stag-hound, sire. At least he speaks in that tongue."

"German?"

"Aye, sire. He said: 'I have * * *' something, in German. I came at once."

The King laid down his screwdriver and the broken tube socket he was mending.

"Bring him in," he said.

The page stepped to the door and the next instant the great stag-hound, Fido, the dog who had not forgotten, crouched at the feet of his master. Into the King's hand he dropped the program of the impending revolution, the precious scroll on which, hour by hour, was mapped out the plans of the dastardly plot against the peace of the nation.

"Ich haben * * *" barked the hound, softly, and tears dripped from his eyes.

The King laid a kindly hand on his head.

"I understand," he said. "So have I. We both have. You are a brave dog. For that, you shall head the dog-watch at the palace gates."

He unrolled the scroll and read what was written there, and his eyes blazed. After a bit he put on his dark glasses to

Continued on page 58

Amazingly Different!

Music lovers from coast to coast have learned to divide all Radio Reproduction into two broad classes.

One class is the reproduction supplied by the Superspeaker.

The other is the wide variety that comes from all the rest of the so-called loud-speaking devices.

Between these two classes yawns a veritable Grand Canyon of Acoustics—the difference between real music and mere noise. Such is the verdict Jewett owners everywhere proclaim.

We can easily understand this verdict, for we know the reasons which cause this amazing difference.

These reasons have their beginnings in such fundamentals as dimensions, materials, workmanship and the application of acoustical engineering, available only to experienced musical-instrument men.

Not in even one of these fundamentals does the market include a duplication of The Superspeaker. Until the advent of some other instrument which can duplicate our product not in one but in every fundamental, the present chasm cannot be bridged.

JEWETT Quality Products

No extra batteries—nothing to get out of order—Each Superspeaker shipped in individual carton—

Vemco Reproducing Unit also furnished separately for Phonograph Adaptation.

Get our dealer proposition in time to cash in with Fall Demand.

THE JEWETT RADIO & PHONOGRAPH CO.

5680 Twelfth Street - - - - Detroit, Michigan

The Dealers Supply Company

323 South Western Ave., Los Angeles, Calif.

Superspeaker

Continued from page 56

hide the glare, and read on. He was not a fast reader and it took some time. When he had finished, he rang for his cabinet.

"Jake," he said, when the cabinet answered, "read this!"

The Secretary of State, Foreign Relations, Education, Exports and Imports, Productions, Legal Affairs, and Detrimental Increments took the scroll and read it through. Then he yanked his nose in and out several times with a lean thumb and finger.

"It appeareth to me that the annual outing of the Raspberry boys is about to take place," he said.

"Aye," said the King. "Once a year they try to get me away from this cinch I hold by divine right of clampage. So they thought I slept, did they? They would raus me from my own palace, butcher up the guard, and * * *"

He paused, struck by a sudden thought. His eye fell on the dog.

"You work for Peruna, don't you?" he asked.

The tired hound yawned an answer at him.

"J-Ja!" he said.

"Hum," said the King. "Was he in on this—he and Veronal?"

"J-Ja!" said the dog.

The King held up grateful hands.

"God bless the German language," he said. "We owe that much to the Kaiser, at least. It is a tongue a dog can talk."

He swung suddenly on his cabinet, every inch a King, except where he was slightly bald on top.

"I see the whole thing," he exclaimed. "Peruna has been in love with the Princess Nervana for some time. It is a plot to steal her, bend her to his will, leave me in the lurch, crack the kingdom wide open, and make himself monarch in my place."

"Phew!" said the cabinet. "If he thought of all that, the old boy is mighty smart."

"J-Ja!" said Fido the Terror, scratching his nose with a tired paw.

"I told you," shouted the King. "All right. It's to be war is it? Fine! We'll have war. But we'll have our kind of war—not Peruna's. Get me my sword!"

"But sire * * * your safety, the safety of your family," protested the cabinet, paling.

"Gwan!" snapped the King. "Get that sword so I can be official!"

Ten minutes later, with the famous sword, "Excelsior," which had never yet beheaded a woman, or carved a possum, tied around him with a red tassel, and flanked by the cabinet and six department heads, the King grabbed the telephone and called his chief operator at radio station YAWP.

"Hello—that you, Louie?" he called

Continued on page 60

HIGHEST EFFICIENCY
on All Circuits

THE Massachusetts Institute of Technology is one of the world's largest and most famous scientific schools. Its laboratories are fitted with the latest, most sensitive, most accurate instruments.

In a comparative test conducted there by experts, the SAMSON HW-A2 audio frequency Transformer showed the highest efficiency and the least distortion.

Whether building or buying a receiving set, insist on Samson Helical Wound Transformers—most efficient because of the exclusive Helical Wound Coils. Write for Bulletin C6 proving SAMSON Transformer superiority.

now $5 *was* $7

TWO RATIOS 3:1 *and* 6:1

Made by

Samson Electric Co.

Manufacturers Since 1882

Factory Canton, Mass.

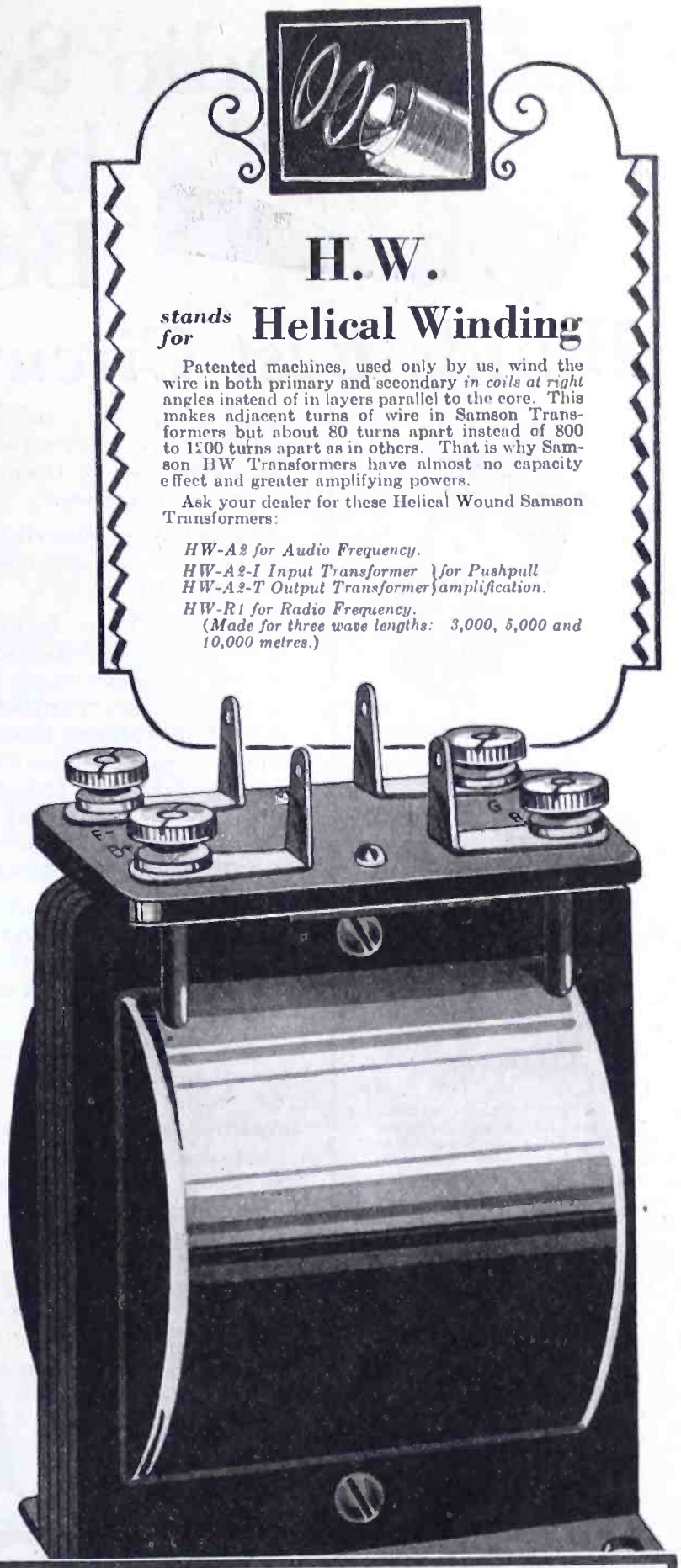
REPRESENTATIVES:

SAN FRANCISCO
A. S. Lindstrom
111 New Montgomery St.

LOS ANGELES
Lombard J. Smith
451 East Third St.

PORTLAND
H. A. Killam
312 McKay Bldg.

SEATTLE
G. H. Maire
95 Connecticut St.



H.W.
stands for Helical Winding

Patented machines, used only by us, wind the wire in both primary and secondary *in coils at right* angles instead of in layers parallel to the core. This makes adjacent turns of wire in Samson Transformers but about 80 turns apart instead of 800 to 1200 turns apart as in others. That is why Samson HW Transformers have almost no capacity effect and greater amplifying powers.

Ask your dealer for these Helical Wound Samson Transformers:

HW-A2 for Audio Frequency.
HW-A2-I Input Transformer } *for Pushpull*
HW-A2-T Output Transformer } *amplification.*
HW-R1 for Radio Frequency.
(Made for three wave lengths: 3,000, 5,000 and 10,000 metres.)

Samson
HELICAL WOUND
Transformer

Continued from page 58

into the transmitter. "Well this is M. H. I said this is M. H. MOST HIGH, you ass! Yes—His Majesty—sure * * * Who the hell did you think this was? * * * Hello * * * aw get off this line. Hello—say, I don't have to drop a nickel * * * this is the palace line. Hello—that you, Louie—All right. Say, Louie—Listen * * *"

For ten minutes he talked. When he had finished, the chief operator hung up the telephone with a dazed look.

"Well, for the love of Mike!" he said.

In the palace the King sat back in his great carved chair, and chucked a water cracker up to the pet crow that perched on the top.

"We'll show 'em trumps, eh Borah?" he said.

"We have an hour to wait, sire?" asked the Secretary of War, respectfully.

"An hour," said the King. "I'll take you on for a round of mah jong! I feel just like the east wind right now! Let's blow into the library where it's cool."

AT sundown, daylight losing time, with the sun already an hour below the horizon, the Princess Nervana strolled into the King's council chamber—to come face to face with a strange sight. There, in a tense little group about a radio instrument on the table, was the King and his entire entourage of officials. The King, himself, was in full uniform with the Order of the Cravat blazing on his chest.

"Hello, popsy," cheered the Princess. "Why all peacocked up in the joy togs?"

"Chut, girl," said his Majesty. "The fate of the kingdom swings on the tick of the pendulum!"

"You don't say? What's busted loose now?"

In a few words he told her, those around him confirming him. The princess paled.

"Atta boy, dad," she said, when he had finished. "You and me both!" Her face was brave.

The King nodded.

"Spoken like a Princess!" he said. The officials bowed—all except the Quartermaster, who was too fat to bow, and squatted respectfully instead. In the silence that followed, the deep-toned chimes of the palace clock boomed in the great council chamber.

"Five o'clock!" intoned the chamberlain.

The King ran his eyes around the circle. Suddenly his sword rang in its scabbard, and every man snapped to attention.

"For our country!" exclaimed His Majesty!

"For our country!" chorused the officials, saluting.

The King reached out a steady hand and jerked the switch on the radio set—the set that was tuned to the great na-

Continued on page 62

New complete line of radio batteries

AN even better battery and at a much lower cost! That is what you will say when you examine the new Exide "A" Battery.

The composition case including handles is moulded in one piece, beautifully stippled and finished in glossy black—an ornament to any room.

Notice the refinements that have been made—broad inter-cell connectors that fit close to the top of the battery and add to its sturdiness. Off-set terminal binding posts that facilitate hooking the battery to the set; the same wonderful Exide plates, the same separators and the same electrical efficiency as the old battery—yet lower in cost!

There are, of course, the Exide two-volt and four-volt "A" batteries for low voltage tubes. These are midgets in size but giants in power.

New "B" Battery in glass jars

With the increase in popularity of the many-tube sets has come the need for a "B" battery of greater capacity than the twenty-four volt, 4000 milliampere hour, rubber cell Exide used with smaller sets.

To meet this need the new Exide "B" batteries in glass jars were designed. They are made in two sizes—twenty-four and forty-eight volts but with larger plates and greater space for electrolyte, they have a capacity of 6000 milliampere hours.

The new Exide rectifier

With this attractive and compact rectifier, your "B" battery can be recharged from your regular alternating house current, at a cost that is insignificant because of its unusually efficient characteristics.

Whatever the size of your set, all of your battery needs can be filled from the complete Exide line. These batteries accepted everywhere as the standard of quality, are made by the world's largest manufacturer of storage batteries for every purpose.

Exide Radio Batteries are sold by Exide Service Stations and Radio Dealers. Ask to see them.

THE ELECTRIC STORAGE BATTERY COMPANY, PHILADELPHIA
In Canada, Exide Batteries of Canada, Limited, 133-157 Dufferin Street, Toronto

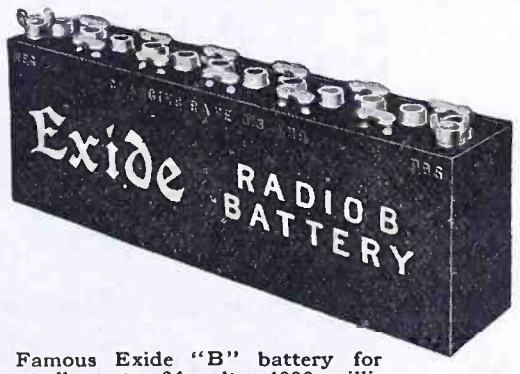
The beautiful new Exide 6-volt "A" battery in one-piece case. Many new refinements but the same old rugged power. $14.60 up f.o.b. Philadelphia.

Exide
RADIO BATTERIES

2-volt "A" battery for low-voltage tubes. Also made in 4-volt size. Prices $5.40 and $7.30 respectively f.o.b. Philadelphia.

New 24-volt Exide "B" battery in glass jars, 6000 milliampere hours capacity. Also made in 48-volt size. Prices $12.00 and $23.30 respectively f. o. b. Philadelphia.

New Exide Rectifier. The economical device for recharging your "B" battery from your house current. $2.00 f. o. b. Philadelphia.



Famous Exide "B" battery for smaller sets. 24 volts, 4000 milliampere hours capacity. $10.00 f.o.b. Philadelphia.

For better radio reception use storage batteries

Continued from page 60

tional station YAWP—mightiest of the three—the station that reached into every home in the land. As the carrier wave struck upon their ears, they strained forward.

"Special announcement preceeding the regular evening news bulletins!" came the voice of the announcer.

The King stiffened suddenly. It was as he had ordered.

"There will be no concert tonight at any of the three national stations," the announcer continued. His Majesty, the King, late today announced that owing to the fact that power lines leading to the royal sub-stations have been cut by agents of the Duke of Peruna and the Duke of Veronal for political reasons, the regular programs will have to be discontinued temporarily. We are operating on storage batteries now * * *"

The rest was drowned in the scream of berserk rake that rose from the city beyond the palace—from the throats of men, women and children, cheated of their evening's entertainment, as they poured from houses, offices and shops in a tidal wave of blood-thirsty frenzy.

"Down with the Duke of Peruna!" they shouted. "Down with Veronal!"

East, west, north and south they came, from urb and suburb, from village, hamlet and farm. They grabbed weapons wherever they found them—the cobblestones upon the streets, the aged gun from behind the door. Many wrenched the bars from jail windows. Others carried the tools of their trade in their hands. Men paused to kiss their wives or some other woman, a child or a family pet, and joined the throng.

Here and there men cursed under their breath or openly quoted whole sections from the Bible. Now and then someone broke into song—a fragment of a martial air, or a battle song, such as "The Angel's Serenade," which always drives men to deeds of violence. The highways grew black with them. The roads congested. Farmers en route to the free markets, threw their produce overboard, loaded their lizzies with cheering madmen, and turned back—back toward the drab embattlements of Joblots castle, where the two Dukes, unconscious of the miscarriage of their plans, chortled over their mint juleps.

It was the King that saved their wretched lives—the King, whose kind heart and open face, known to every smoker of a five-cent cigar, stepped between them the two conspirators and certain death. In the palace foyer, into which the drone of the hurrying mob came fainter and fainter, he stepped into a telephone booth and called Useless 456—the number of Peruna's private telephone.

"The King speaking," said His Majesty, when the Duke of Peruna answered

Continued on page 64

19 IMITATIONS!

A RECORD COMPLIMENT

We have counted 19 imitations of our products. But the imitator cheats by offering the exterior likeness only. *Scientific achievements defy imitation.* General Instrument Corporation eliminates and reduces losses in its condensers by scientific means available only to manufacturers with laboratory facilities equal to those of General Instrument Corporation.

Air, Isolantite, Pyrex, Corantum and Quartz are the only recognized zero or minimum loss insulations in existence.

General Instrument Corporation insulates with Air, Isolantite, Pyrex, Corantum and Quartz.

The embodiment of this scientific principle in General Instrument Condensers makes a certainty of *greater distance, increased selectivity and clearer reception.* By eliminating energy waste these genuine condensers overcome losses.

IMPORTANT: Pigtails introduce variable inductance and variable resistance, defeating accuracy and creating losses. The Bureau of Standards does not use pigtails on their standard variable air condensers. Neither does the General Instrument Corporation.

THE GENUINE COST A LITTLE MORE

BUT ARE

WORTH INFINITELY MORE

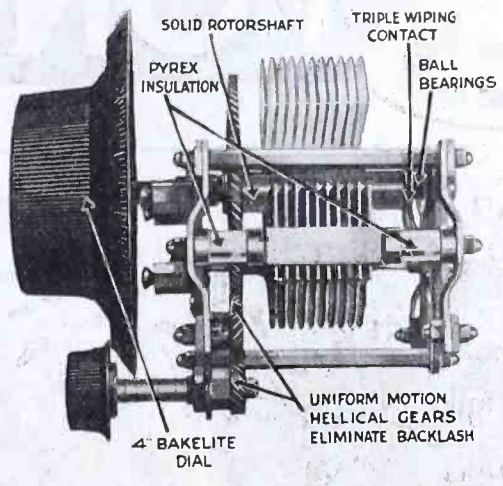
NOLOSS

Type 51 Type 52

Insulated with

PYREX

Type 52



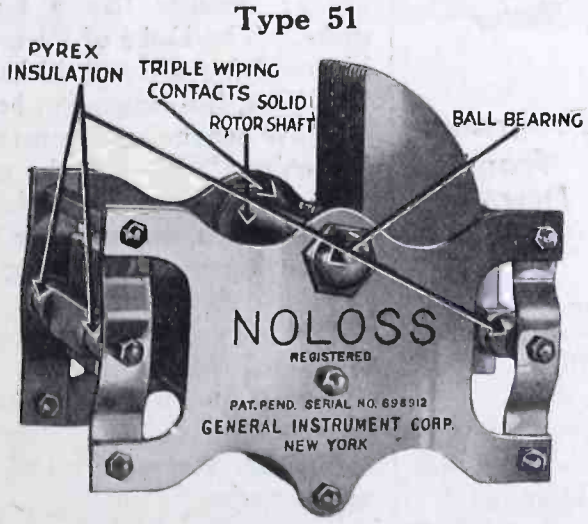
LOW LOSS

Type 46 Type 47

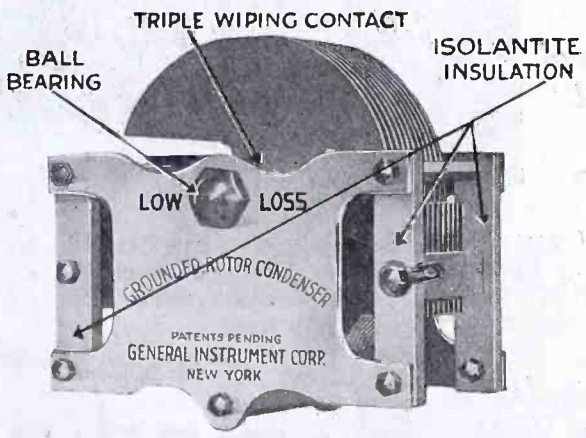
Insulated with

ISOLANTITE

Type 51



Type 46



GENERAL INSTRUMENT CORPORATION

MANUFACTURERS OF LABORATORY EQUIPMENT

423 Broome Street, New York

Continued from page 62

in person. "Stick your head out of the window and listen!"

There was a wait. Presently * * *

"What is it?" The Duke's voice was nervous. "It sounds like a number of voices."

"It is," said the King, placidly. "It's several thousand voices. It's a mob, Peruna, headed your way and they're going to stretch your skin along the top of the castle until you can play tunes on it like a violin string."

"Oh, say not so, sire," cried the Duke, changing his hands on the receiver in his agitation. "What means it?"

The King told him what it meant in a speech that is still quoted by the Associated Press in presidential messages, monarchial reviews and other state documents. He picked his words carefully, and put them together in a new way. He invented a lot of new adjectives whose meaning, however, was plain. When he had finished, the Duke knew exactly what it all meant.

"And now," said the King, "drag that radio set of yours out on the balcony and point the loud speaker at the crowd. I'm going down to YAWP and talk to them and save your worthless life!"

With tears streaming down his cheeks, the defeated Duke dropped the telephone and rushed for the radio. While the Duke of Veronal aided him to skid it onto the balcony just beyond the southern portcullis, he repeated all he could remember of what the King had said—which was not much. But Veronal got the idea, and his knees fell to cracking like a pair of aged castanets.

"The horn—quick, the horn!" cried Peruna.

The mob was distinguishable now, clamoring across the flatlands toward the castle, brandishing its crude weapons, coming steadily like a huge, ruthless snake. The Duke of Peruna turned on his receiving set and kicked in all his amplifiers, his companion beside him.

"Give her the gas!" muttered Veronal, brokenly. "Give her the gas!"

In a high-powered machine the King and Nervana, with all the officials that could cling on the running board, hurried to station YAWP. The King thrust his way into the presence of the astonished chief operator.

"Quick—turn on the set!" he commanded.

The operator gave a look at his storage batteries.

"They are weak, sire, but for the King!" He bowed low. "For the King—we will try!"

"Cut the palaver and give us the juice!" snapped the King, looking quite impressive, considering the fact that his suspenders were now hanging down from excitement.

The operator handled the controls and

the great generators sprang into life. The King stepped to the telephone and called Peruna again. He was answered almost immediately, after getting the wrong number three times. This time it was Veronal who took down the receiver.

"Quick, sire, they but clamor at the castle gates!"

"That's what I wanted to know," said the King. "These batteries are weak. I didn't want to waste any. Stick the loud speaker over the wall and hold tight!"

He motioned and the operator thrust the microphone into his hand. He cleared his throat.

"My people!" he called.

The old familiar words, bellowed from high up on the Castle wall caught the crowd and held it.

"My people," said the King. "Unprepared as I am this evening, I have been asked to say a few words to you on this occasion * * * Well, what I wanted to say was this: Go home. Forget it. It's all a mistake. I know how you feel about the two Dukes. In fact, you almost did me a favor. But—don't do it. That was all wrong about the power wires being cut. I closed down the stations myself. It was an official order. The operator got things balled up. Tonight has been declared 'silent night' so you can all try for long distance. Go to your homes and tune in for the great outdoors. And don't tear down them castles. They belong to me!"

A great cheer burst from the crowd as the King finished speaking to them beneath the shadow of Joblots' walls—speaking by proxy.

"Viva la King! Long live his Royal Nibs!"

And such was their confidence in him, that they turned right about face, after giving Joblots' wall a couple of kicks, and went home again without slewing anyone.

The King turned again to the telephone, as the bell tinkled in his ear. It was the Duke of Peruna speaking—a much shattered, but wholly grateful old boy.

"Oh, your Majesty, how can I ever thank you?" he said.

The King came closer to the transmitter.

"Did you hear what I said about those castles—that they belong to me?"

"Yes, sire."

All right. You make that stick. You get the deeds to 'em down here by 9:00 o'clock tomorrow morning, or I'll sic the grand jury onto you for conspiracy. I can use them castles."

"It shall be done, sire. And ourselves?"

The King considered.

"Aw you two old wrecks go out to the Old Men's Home and play checkers with each other!"

He banged up the telephone. The Princess Nervana came forward and snuggled into his arms.

"And do I get a new gown out of this deal, popsy?" she demanded, archly.

The King gazed at her fondly.

"Out of what deal?" he asked.

"The castles? You are going to sell 'em, ain't you?"

The King stared at her.

"Sell 'em?" he yelled. "With those battlements that have come down from the time of the Crusaders? Why, girl alive, with a couple of poles on those towers, and a fifty-foot aerial and 1500 volts on the plate, they'd hear me in Paris! "Sell? Not in 10,000 years!" And his voice rang clarion clear in the great operating room.

IT was the following afternoon that Princess Nervana sat on the edge of the fountain in the Garden of Dreams and bit viciously upon a wad of royal gum with her tiny, perfect teeth. Beside her, her mother, the Queen, juggled the colored beads of a cubist stomacher and sighed softly.

"There are times," said the Queen, softly, "that the King, they father, is—well, trying!"

The Princess gave her mother an exceedingly dirty look.

"My distinguished male parent," she remarked, "gives me the weeping willies. I'm simply in rags. I haven't had a gown since * * *"

But everybody knows what happens when you start reflexing a plot.

SHORT WAVE TRANSMISSION

Continued from page 30

unless he notifies the distant station. This may seem unnecessary, but, with the frequency as high as it is, the slightest change will very easily change the wavelength by the small amount necessary to entirely detune the set for the receiving operator. The operator should never even come near the transmitter, or this effect will be noticed. Keying should always be done with a relay key in the circuit, and the relay controlled by d.c. If this is not done, the keying of the operator, as he moves his arm, may even cause the note to flutter. The antenna ammeter reading can even be changed, due to detuning effects, if the operator brings his hand into the field surrounding some of the inductances. Long handles are not necessary for the condensers, or anything of the kind, but simply keep away from the set, and the antenna lead as well, if you hope to keep the note anywhere near enough constant to receive on a heterodyne receiver.

A. F. TRANSFORMERS

Continued from page 27

quencies, we lose out on the low frequencies, since the inductance of the primary is not sufficient to take them up. It is also well to remember that, while the range from 100 to 10,000 cycles covers most of the frequencies in ordi-

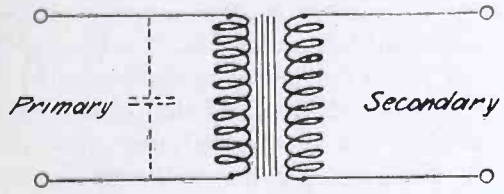


Fig. 4. Effect of Distributed Capacity in Primary Winding

nary speech or music, there are certain types of instruments such as the organ which give out frequencies which are even lower than 100 cycles, so that it is desirable to have the inductance of the primary winding just as high as is compatible with the preservation of the higher frequencies.

CIRCUITS

Continued from page 18

oscillations are produced, at which point a loud click will be heard. Beyond this point incoming signals and static will be greatly distorted. If the regeneration is now increased a little further the set will start to produce violent squeals. This squealing is due to the fact that the grid current charges the grid condenser more rapidly than the grid leak can carry the charge off and periodic discharges occur through other paths. As the regeneration is still further increased the frequency of these periodic discharges decreases and the squeal gradually changes to periodic thumps occurring two or three times a second.

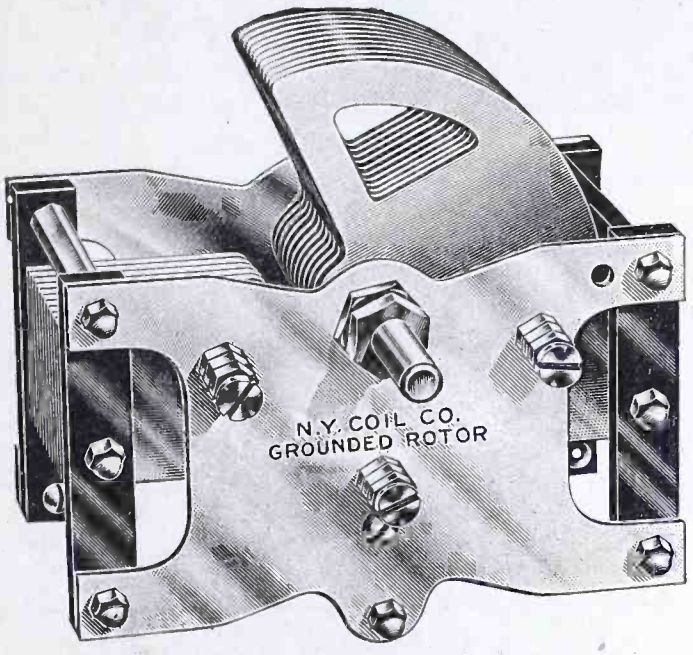
In order to adjust the resistance of the grid leak to its correct value, the regeneration control should be adjusted several degrees beyond the oscillation point where the loading up of the grid produces squeals. If the resistance of the grid leak is reduced by drawing soft pencil lines connecting the blackened areas, the frequency of the squeals will increase and finally disappear entirely. If now the regeneration control is moved back and forth through the oscillation point, no violent click should occur. The change from the non-oscillating state to the oscillating state should take place gradually and smoothly. The value of the grid leak resistance should be decreased until this point is reached. If decreased too much oscillations will again start with a violent click when regeneration is carried to the oscillation point but no audio frequency squealing will result. These adjustments should be made at a time when the radiated currents from the receiving set will not bother other operators. In operating a regenerative receiving set the tuning and regeneration controls should be operated simultaneously as changes in the regeneration controls will produce slight variations in the tuning of the set. The regeneration control should always be kept just below the point of oscillation as an oscillating receiver is a small transmitter. All present-day regenerative receivers in which the regenerating tube is connected next to the aerial will radiate when in the oscillating state. There is no concrete evidence to substantiate the statement that single circuit receivers are worse than coupled circuit receivers in this respect. The energy radiated from a nearby receiver combines with the energy from a distant broadcasting station when the station and interfering receiving set are adjusted to almost the same frequency. The combination produces beats which when rectified in nearby receiving sets are audible.

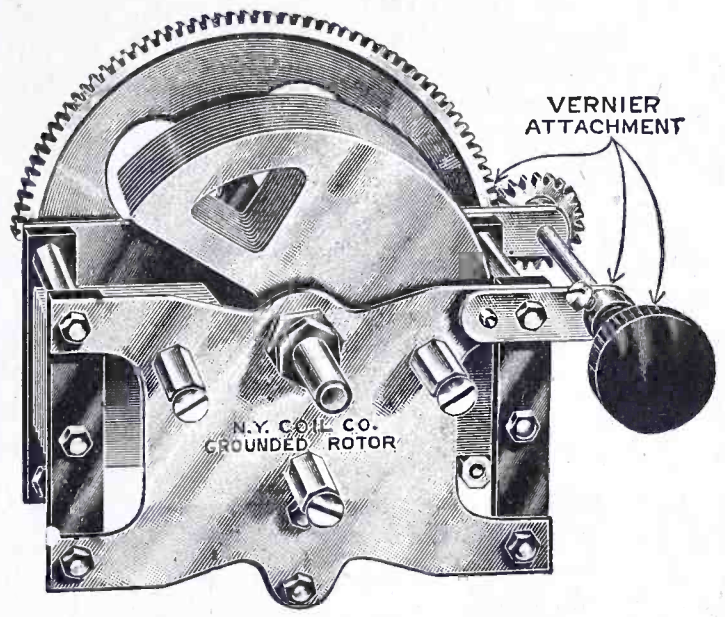
This principle is used in the reception of continuous wave telegraph stations. If it is desired to receive a transmitter sending on a wave length of 100,000

Continued on page 70

Why be Satisfied with a Jumble of Interfering Stations?

Install a New York Low Loss Grounded Rotor Variable Condenser in Your Present Set and receive the Full Pleasure of Broadcasting





OUR NEW LOW LOSS CONDENSER is in a class by itself — superlatively better — no other condenser manufactured incorporates so many vital improvements.

Adjustable cone type bearings, pig tail connections and stop, straight line capacity, geared vernier action (which may be purchased separately if desired)—only geared vernier that swings a 4-inch dial. Dielectric of genuine hard rubber with wide spacing of plates. In a word a precision instrument possessing the absolute minimum losses, the maximum obtainable efficiency, insuring greatest distance, sharpest possible tuning and wonderfully clear reception.

.0005 (23 plate) without Vernier $4.50

Geared Vernier attachment, complete, $1.50

Unequalled for Super-Heterodyne, Neutrodyne and all exacting circuits. ***September deliveries***

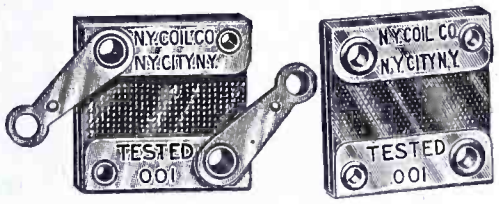
OUR SUPER-HETERODYNE KIT at $20.00, consisting of oscillator coupler, input, and three matched intermediate air-core transformers, makes up the best set known to date.

Other items of proven superiority: Distortionless Audio Transformers, Tuned Radio Frequency Transformers.

BY PASS CONDENSERS	
.05	$ .90
.01	1.25

PRECISION MICA FIXED CONDENSERS

"More Uniform Capacity"



Type B **Type A—No Clips**

Adapted by Leading Heterodyne Manufacturers on account of truthful capacity rating.

This is the only laboratory precision-built condenser on the market, yet sold at a commercial price. It is standard equipment with some of the largest and most discriminating set manufacturers.

Guaranteed for capacity and against leakage or breakdown.

The following sizes always in stock:

Capacity	Retail Price
.0001 Mfd.	.35
.00015 "	.35
.00025 "	.35
.0005 "	.35
.001 "	.40
.002 "	.40
.005 "	.60
.006 "	.75

.00025, with Grid Leak Mounting attached, 45c list. Type C

NEW YORK COIL COMPANY

338 Pearl Street, New York City, N. Y.

Pacific Coast—MARSHANK SALES CO., 1240 S. Main St., Los Angeles, Calif.

Continued from page 68

cycles (3000 meters) the distant receiver is set oscillating at a frequency of say 101,000 cycles. The 100,000 cycle signal from the transmitter combines with the 101,000 cycle current in the receiving set and produces a frequency in the head set equal to 101,000—100,000 = 1000 cycles. The audio frequency may be changed at will by changing the oscillation frequency of the receiving set. The explanation of the production of beats by interference will be found in any good book on physics.

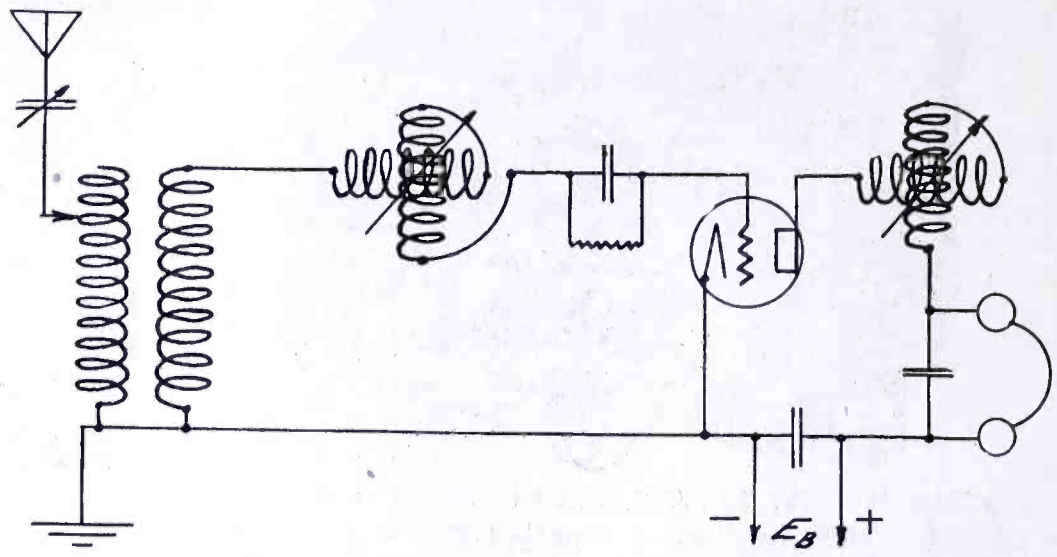


Fig. 9. Variometer Tuned, Variometer Feedback Coupled Receiving Circuit

Fig. 9 shows a receiving circuit which has been very popular among amateur telegraph operators. Tuning is accomplished by the aid of a variometer in the grid circuit, the distributed capacitance of the coils taking the place of a condenser. This set is often erroneously called a "three circuit receiver" or a "tuned plate receiver." Both of these terms are misleading. As the plate circuit is not tuned the second designation is entirely incorrect. This circuit might be designated as a coupled circuit or two circuit receiver with variometer regeneration to distinguish it from a two circuit receiver using tickler feedback. There is no logical reason why substitution of a plate variometer for a tickler should change a two-circuit set to a three-circuit set. It is possible to use a variometer for regeneration in a single circuit receiver with excellent results. Fig. 10 is a circuit for such a set. Obviously this is a single circuit receiver but if Fig. 9 is to be called a three-circuit set, Fig. 10 must be called a two-circuit set, as one high frequency circuit has been eliminated.

Regeneration is increased in circuits like Figs. 9 and 10 by increasing the inductance of the plate circuit variometer. The circuit is a capacitive feedback circuit and makes use of the capacitance which exists between the grid and plate of the tube itself. A rise in plate current will cause a drop in the voltage of the plate with respect to the filament and grid due to choking effect of the plate variometer. The drop in voltage of the plate with respect to the grid will electrostatically induce a plus charge on the grid. The increase in voltage of the grid tends to increase the plate current which tends to cause the plate voltage to drop still further and it is easy to see on the basis of our previous discussion that we have the conditions necessary for regeneration and oscillation. The plate variometer therefore acts as a variable choke coil and the *plate circuit need not necessarily be tuned to the frequency of the incoming signal.* If the plate circuit is tuned to the frequency of the incoming signal the impedance will be high and in general strong oscillations will be produced. In tuned radio frequency amplifiers the grid plate capacitance is neutralized to prevent these oscillations. This will be discussed in a later article.

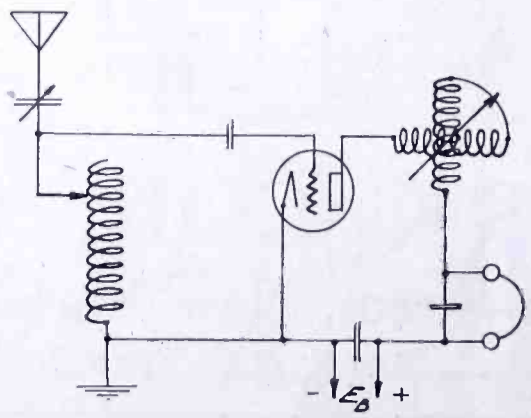
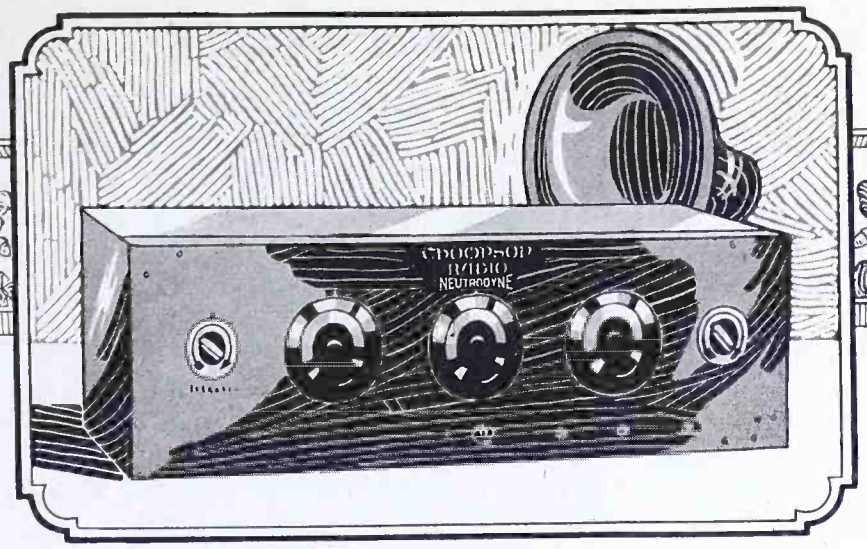


Fig. 10. Single Circuit Variometer Feedback Regenerative Receiving Set

In general, circuits like Figs. 9 and 10 can not be made to oscillate above 600 meters (below 500 kilocycles) without large values of inductance in the plate circuit unless an auxiliary condenser is connected between grid and plate. They are, however, very efficient for short waves and possess the decided advantage that changes in the regeneration control do not produce marked changes in the tuning of the set.



"EXPERIENCE IS THE VITAL FACTOR IN EXCELLENCE"

THOMPSON RADIO

Thompson radio products are as fully developed and as standardized in radio as is the telephone in wire communication. Thompson owners do not worry about how their set and speaker will compare with "next year's model." Perfection remains Perfection.

Thompson simplicity of operation as well as Thompson range and power makes it possible to receive the desired radio program just exactly as it is given before the microphone. Those who wish *real* radio entertainment at low cost will be decidedly interested in the Thompson Neutrodyne Radio Receiving Set—*NOW* $125—and the Thompson Speaker—*NOW* $28.

The fully developed Thompson Radio Products at such reasonable prices are possible only to an organization that has been making radio products *exclusively* for many years.

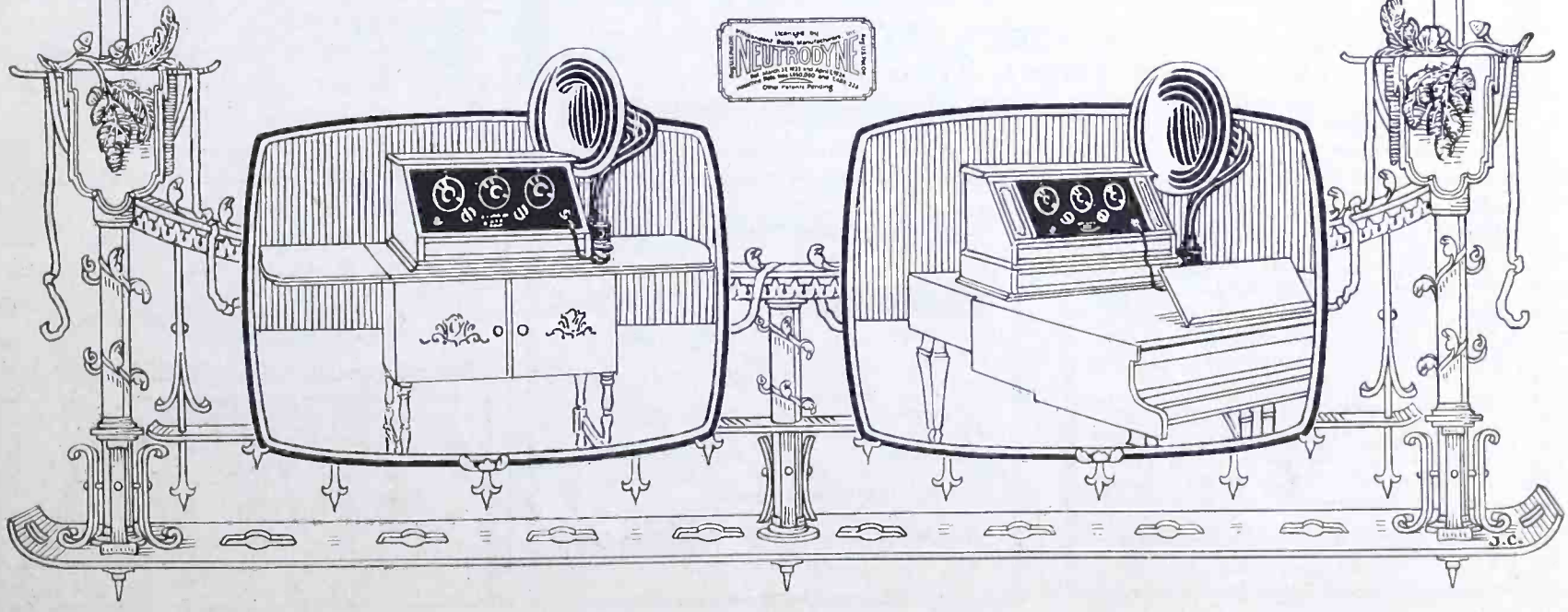
If your dealer does not handle Thompson radio products, write to us for descriptive literature and the name of a Thompson dealer near you.

R. E. THOMPSON MANUFACTURING CO.

Manufacturers of Radio Apparatus for the U. S. Army and Navy and numerous foreign governments

30 CHURCH STREET • • NEW YORK, N. Y.

FACTORY: JERSEY CITY, N. J.



STATIC

Continued from page 24

of signal received by the loop antenna will be only a small fraction of what it would be with the other antenna, but the static interference will be even a smaller fraction. Hence by a good amplifier the signal may be brought to a readable intensity and, provided the amplifier increases signal and static equally, the amplified weak signal from the loop will be clearer than an equally loud, unamplified signal from an open antenna.

Aperiodic Antenna

THE term, "aperiodic antenna," is used to describe an aerial circuit which contains no added inductance and the resistance of which is at least of such a value as to render a discharge non-oscillatory. With such a circuit the necessary resistance is usually added at the base of the antenna and its ends are connected to the terminals of a selective

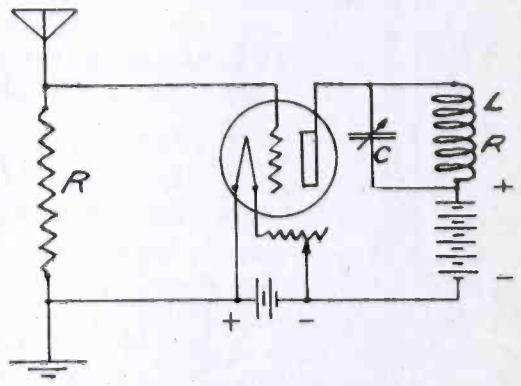


Fig. 6. Aperiodic Antenna

amplifier. See Fig. 6. All necessary tuning is then performed in the circuits of the amplifiers.

If the value of R is indefinitely great, the potential difference applied between the terminals of the amplifier will be nearly equal to the e.m.f. of both signal and atmospheric. However, since the frequency of the signal is likely to be at least a hundred times as great as the frequency of the atmospheric, it is possible to choose R so that while the potential difference developed across it by the signal is sensibly equal to the signal e.m.f., the potential difference developed by the atmospheric is only a small portion of the atmospheric e.m.f. In this way the signal is passed on to the amplifiers while the static interference is considerably reduced. For a signal wavelength of 6000 meters and an antenna capacity of 0.001 microfarad, R can vary from 5000 to 50,000 ohms.

REVERSED FEED-BACK TRANSMITTER

Continued from page 33

dimensions of the inductances should be used. A 2 in. diameter for the antenna inductance is about right, with a correspondingly small grid coil. The small size will allow a greater number of turns in the antenna circuit for the wavelength used. The series condenser should be adjusted to include the greatest possible capacity and least number of turns in the antenna circuit, possible for whatever wave you decide to use. The proper values of both can be told by watching your antenna ammeter and the wavelength of course; the wavelength being kept constant by the proper adjustments.

As a final word, be careful in your details. Buy good sockets with either porcelain or hard rubber insulation and side wiping contact to the tube prongs. Connect your sockets in such a manner that the leads to the elements have the same length to each socket. Don't be satisfied with low capacity condensers across your filament transformer; above No. .006 mfd. at least. Use rosin core solder preferably. Never use acid core solder in a set. And, finally, see to it that leads at a high radio-frequency potential, such as the antenna lead, are kept well away from leads at lower potential such as the counterpoise, or ground. This last is a case where distance leads efficiency. Mount your antenna inductance about 4 in. from panels and instruments; in other words, let its field be clear; a greater distance is even more efficient.

RADIO IN THE ANTIPODES

Continued from page 12

cent higher priced than in the United States, and some of it, especially variable condensers, is of poor quality.

New South Wales has 130 transmitting amateurs; Victoria, 120; Queensland, 20; Tasmania, 10; South Australia, 30 and West Australia, 20. New Zealand boasts of less than fifty transmitting amateurs. Yet, in this radio paradise, the familiar complaint is frequently heard, "The QRM's fierce here sometimes!" Really! Verily, few of us are ever content with our lot in life.

The amateur wave-band runs from 150 to 250 meters, with each amateur assigned to a definite wave length. Restrictions as to silent hours are unknown, as amateur interference with broadcast listeners is seldom, if ever, experienced. Indeed, a great many of the listeners, those having experimenters' licenses and those operating illegally, eagerly await the transmission of phonograph music over amateur radiotelephones, which operate upon regular schedules, the times of the various transmissions being printed in every issue of the *Wireless Weekly*. Regulations prohibit transmission of music by amateurs, but while knowledge of the continual violations is of course universal, nothing is said or done about it. As a matter of form the music is ostensibly sent as a test of the transmitter to another station, which may or may not be upon the air at the time. The average transmission is one-half hour and allotment of time is settled over the air by mutual agreement.

Even ordinary amateur conversation is listened to with the greatest enjoyment by the broadcast listeners, if they may be termed such, the commencement of a talk being followed instantly by a series of howls and wails on the air as dozens of listeners begin fishing for the wave of the transmitter with their illegal oscillating receivers. Quite the reverse to America; instead of the amateur "busting up" the BCL, the latter interferes with him, at times really seriously hampering communication.

The Australian amateur believes in extracting the last full measure of efficiency from his transmitter and using incredibly low filament and plate voltages works equally incredible distances. How they make a 5-watt tube oscillate with 6 volts supplied to the filament and 150 to the plate is a mystery, the trick is not in the circuit, for the Hartley and reversed feedback are used almost without exception. As in America, chemical and kenetron rectifiers are employed and for the same reasons.

The goal of the Australian amateur does not lie in covering the greatest number of miles, irrespective of power, but in working the greatest number of miles per watt. Aside from the fact that this plan is the only fair method of compari-

son between two stations, it is an excellent idea in that it stimulates the amateur to make for increasingly greater efficiency in his transmitter. It is unnecessary to detail the advantages resulting from such an action. Incidentally, it lightens the drain on one's pocketbook not inconsiderably. One Australian displayed three 5-watt tubes which were still "perking" after two years of service, during which time music transmitted from the set was heard in West Australia, 3000 miles distant. His power consumption was 2 watts!

This power consumption is typical of the average Australian station. In some instances tremendous distances have been covered with but a really small fraction of a watt (measured in the plate circuit) while a great many use but 3 or 4 watts of actual power, not the overloaded five-watter of the American amateur with its 1000 or 1500 volts on the white hot plate and developing possibly 50 or 100 watts as measured by the Australians.

Procedure on the amateur telephones is a little startling to a stranger, as witnessed by the following communication: "Hello 2XX, hello 2XX—2YY here, 2YY here, hello 2XX, are you there 2XX? 2YY here—righto! over!" I need not say that the calls are fictitious.

In the matter of receiving apparatus the Australian appears to be considerably ahead of the American. For one thing, while radio frequency amplification is still being looked upon with suspicion by most Americans, it is an everyday matter to the Australian, who puts one, two, and even as many as four steps ahead of his detector. The Marconi QX tube, with its tiny elements, constitutes a wonderful radio frequency amplifier, and it is quite probable that this tube has much to do with the universal success of R. F. amplification in Australia. The Marconi "R" and "V-24" tubes are used considerably for detectors, while American tubes are prime favorites for audio frequency amplification, and are also frequently used for detectors. American power tubes are used almost without exception. The popular "ham" receiver consists of one step of radio frequency amplification, detector, and one step of audio amplification. And their radio frequency works wonderfully, well up to the wildest flights of fancy indulged in by American ad writers.

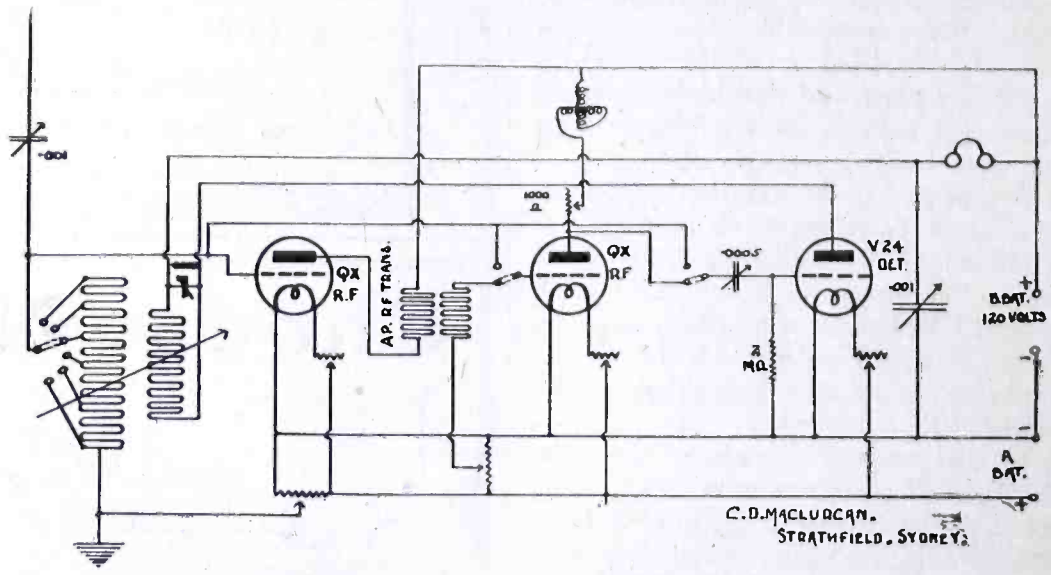
Australia has long had a reputation among American amateurs as being a paradise for receiving, and it is true that the constant reception of American amateur signals there and a lack of reciprocity seems to bear it out. C. D. Maclurcan, probably the foremost radio experimenter in Australia, offered an interesting explanation of this condition, the gist of which is here repeated as faithfully as possible:

"Due to the network of high and medium powered transmitting stations throughout the United States, the American amateur has always had loud, easily readable signals pounding into his telephones, no matter what kind of receiver, good, bad or indifferent, he might own. He simply hooked up a set and the signals were there, dozens of them, working day and night. If not commercial stations, then a dozen or so amateurs racking the ether with a kilowatt or so. Thus there was no great incentive to add to the efficiency of his receiver; the signals were simply forced upon him. The same applied in the matter of transmitters. When his sending apparatus failed to give him the results he wanted, he simply increased the power until he got them.

And when we failed to reach out we could not simply add another tube or load up the ones we already had; government regulations prohibited it. We had to improve the set, make it still more efficient. Thus bitter necessity has made us skillful, as it would have so made anyone else in our places."

This quite logical argument is well borne out by the fact that dozens of 5 and 10 watt transmitting stations easily work New Zealand, 1500 miles distant, during the hours of darkness. Mr. Maclurcan, who operates the well-known A-2CM, often receives KDKA broadcast programs, while KGO is heard regularly, not only by him, but by not a few other Australian amateur stations.

In this condition we have the peculiar situation of what might be called an



Popular Australian Receiving Circuit

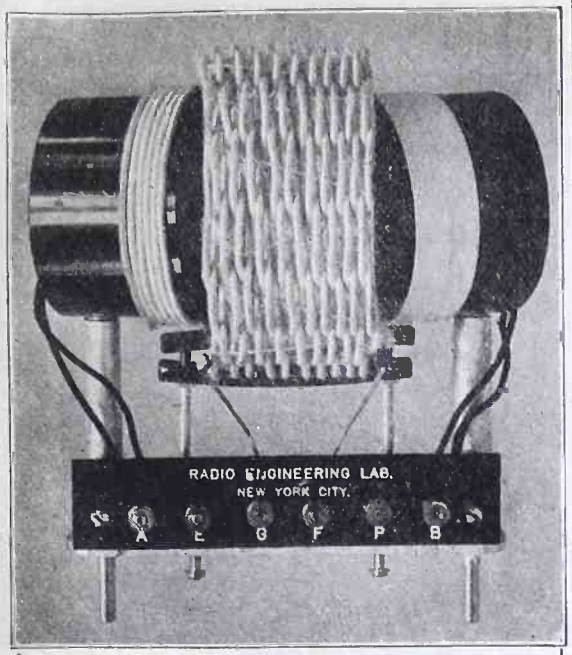
"In Australia it is another matter altogether. Transmitting stations, both amateur and commercial, are few in number, the former all low powered, using as a rule about 10 watts of actual power. It followed then, that the amateur had to build a really good receiver to hear any signals at all, and if he wished to listen over any distance he had to put the last ounce of skill and ingenuity into the manufacture of a tuner. And even so, he still had to become adept at tuning and code-reading before he could do any real work. Thus he has become skilled, both in the construction of receivers and their manipulation, more so than his American fellows.

"From this I do not want you to get the impression that I believe the Australian to be inherently more skillful or superior to your countrymen. Americans would have done the same thing had they been in our place. It is simply a natural result of circumstances.

"It was the same thing in the transmitting end of the business. We do not get results which can pardonably be termed extraordinary by reason of some beneficent quality of the ether in Australasia. We had to make our transmitters right or our little dole of power was lost before it ever got upon the air. antagonistic or restrictive government policy against the amateur resulting in his eventual benefit. His meager power allotment only resulted in his reaching heights of efficiency which would have otherwise been undreamed of, and at the same time the scarcity and high price of apparatus has kept out of the field the "small boy" element, who are only a detriment to the advancement of the art. This last is not meant as any depreciation of those amateurs of tender years, for even as there are "old maids" of both sexes, so are there "small boys" of almost any age upon the air.

The case of the Australian amateur finds a parallel in that of the American, to whom was allotted a band of waves thought to be useless for transmitting over any great distance, and yet who today finds himself possessed of the very best portion to be had, the development of which may in time lead to things as yet undreamed of.

In conclusion the writer desires to express his appreciation of the aid rendered by C. W. Watt, editor of the *Wireless Weekly;* George A. Saunders, announcer and manager of 2BL; C. D. Maclurcan 2CM, and others who so kindly aided in the collection of facts for this article.

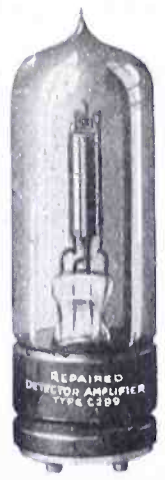


LOW LOSS TUNER UNIT

Most Efficient Tuner Available
Real DX. Reception — Extremely Sharp Tuning
TWO TYPES { AMATEUR— 45 to 225 METERS / BROADCAST—250 to 550 METERS
Special Types for Very Short Waves
Price $10 each — Write for Information

A. C. LOPEZ & CO.
Sole Distributors
334 FIFTH AVENUE — NEW YORK CITY

RADIO TUBES REPAIRED



"In a wilderness of radio tube mail-order gyps, this is one honest concern—good tubes and a square deal to everybody."—Volney G. Mathison.

What is the difference between our tube repairs and the common, cheap new and repaired tubes flooding the market? Costly imported filaments, which contain the proper ingredients and coatings; tubes bombarded gas-free in high-frequency external induction furnaces; fifteen-hour endurance test; rigid inspections; and heavy shipping packages. These tubes are loud, clear-toned, and long-lived. They pull exactly normal filament current. They work on super-heterodyne, neutrodyne, reflex, and all other circuits. Best of all, they are remarkably uniform. Absolute satisfaction or your money cheerfully refunded. Send in those burnt-out tubes today.

We make no pretense of competing with frauds. We could furnish fake tubes at one dollar apiece.

S. P. HANKINS & CO.
1411 Castro Street — Oakland, California

REPAIRED TUBES
Cash or C. O. D. Postpaid.

UV-199	$2.75
UV-201-A	2.75
UV-200	2.75
WD-11	2.75
WD-12	2.75
C-299	2.75
C-201-A	2.75
C-200	2.75
C-11	2.75
C-12	2.75

Dealers invited to write for proposition on our quality products.

Just what you need

Valley Battery Charger

Here is just what you need to increase the pleasure and entertainment of your radio. With it as part of your equipment, you need never miss a program because of a dead battery, you can recharge a battery between signing-off time tonight and listening-in time tomorrow night.

The Valley Battery Charger will completely recharge 2-volt peanut tube cells, 6-volt A batteries and from 1 to 4 B 24-volt batteries. It is the only charger necessary for all radio batteries.

It plugs into the ordinary light socket like a fan or other household necessity, and is just as easy to operate. Takes only about a dime's worth of current to bring your battery up to full charge.

It has grained and engraved Bakelite panel which harmonizes with any radio set. Clear glass top shows the simple, patented working parts at all times.

At radio dealers everywhere.

VALLEY ELECTRIC CO.
3157 S. Kingshighway — St. Louis, Mo.

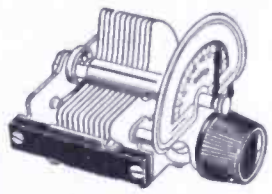
6 MONTHS FOR $1.00
"RADIO" - San Francisco

SIGNAL

Vernier Variable Condenser

Here is the condenser radio fans have been waiting for.
Note these features—'nuff said.

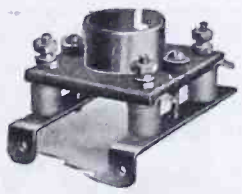
1—Soldered Rotor
2—Pigtail Connection
3—Logging Dial
4—Adjustable Stator Plates
5—Soldered Stator Plates
6—Ample End Spacing
7—Unique Clock Hand
8—Main shaft free from Dial.
9—Cone Bearings
10—Grounded Rotor



Ask your dealer to let you examine this condenser.
Write us for illustrated folder giving full particulars.

23 Plate
$5.00 List

SIGNAL TUBE SOCKET



85c
List

Thousands of these sockets are in daily use giving satisfaction. Metal neck with bakelite base.

Extremely Low Loss. The springs are double, phosphor bronze—they spring right back into place when tube is withdrawn. Give your set the best.

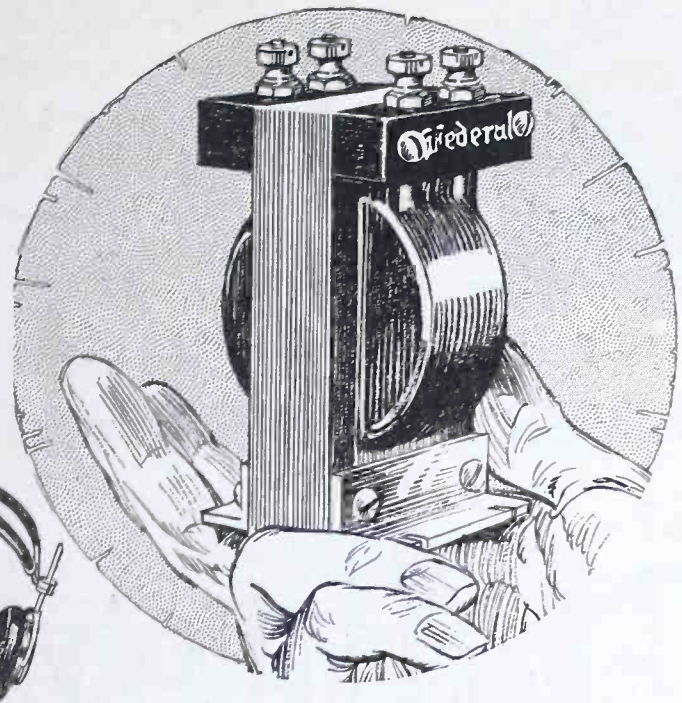
SIGNAL Electric Mfg. Co.

Factory and General Offices
1913 Broadway,
Menominee, Mich.

Boston, Pittsburg, Chicago, Havana, Cuba, Seattle, St. Louis, Los Angeles, Minneapolis, San Francisco, Winnipeg, Montreal, Toronto, New York, Philadelphia

You'll find our local address in the Telephone Directory.

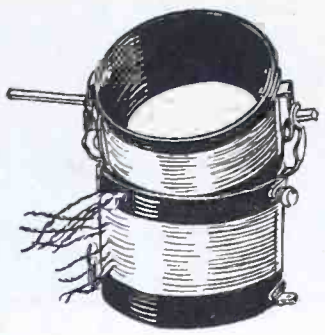
No. 65 Audio Transformer



Head Telephones

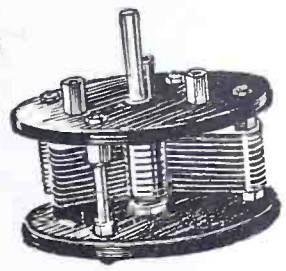
Look for this sign

Federal
Standard RADIO Products



No. 95 Variocoupler

Variable Condenser



"Guaranteed by Federal"

THE famous Federal No. 65 Audio Frequency Transformer and over 130 other standard radio parts now bear the Federal ironclad performance guarantee.

If you want exceptional tone beauty, selectivity and distance range in your home assembly, insist that each part bear the Federal Guarantee.

A Book "The Radio Work Bench" aids you in avoiding construction pitfalls. Sold by Federal dealers—25c—Canada 35c.

FEDERAL TELEPHONE AND TELEGRAPH CO.
Buffalo, N. Y.

Boston
New York
Philadelphia
Pittsburgh
Chicago
San Francisco
Bridgeburg, Canada

Federal
Standard RADIO Products

BestoneV-60

"The Aristocrat of Radio"

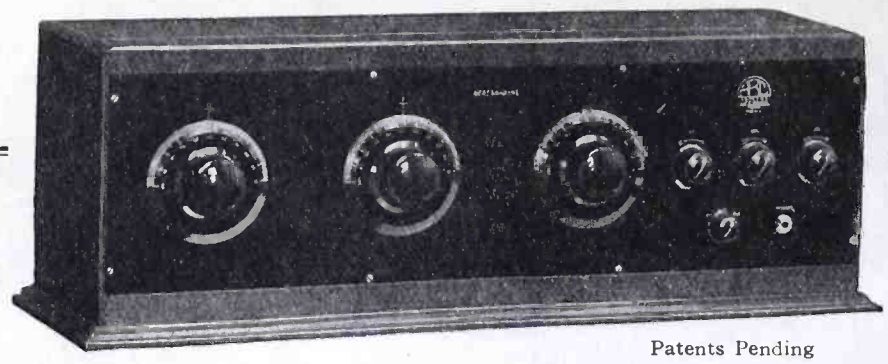
"The 'Bestone' Receiver under tests conducted by the Radio Editor has proven superior in tonal quality to any set, commercial or home-made, tested under similar conditions. It was noteworthy that volume was not sacrificed for clarity as is commonly the case."
New York Telegram-Mail

In beautiful distinctive cabinet, with built-in loudspeaker and battery compartments. **$165.00**
West of Rockies, **175.00**

Same receiver in other cabinet without loudspeaker.
$115.00
West of Rockies, **$125.00**

Write for Particulars
Manufactured and Guaranteed by
HENRY HYMAN & COMPANY, INC.
476 Broadway, NEW YORK
212 W. Austin Ave., CHICAGO

"The 'Bestone' Circuit combines the essentials of the ideal radio Receiver in an economical, practical combination. The outstanding features are its quietness of operation without distortion, its extreme sensitivity, simplicity of operation, faithful reproduction and distance-getting qualities."
New York World



Patents Pending

DERESNADYNE RECEIVER

The Andrews DERESNADYNE establishes a higher standard in radio. Some of the universally desired qualities made possible by this wonderful new receiver are—**unequaled clarity and beauty of tone, knifelike selectivity, remarkable range and tremendous volume, and freedom from oscillation.**

The DERESNADYNE is constructed on a new principle which is fully protected by pending patents. Undesired oscillations that produce whistling and distortion have been eliminated by properly proportioning and placing the fundamental elements of the circuit. The instrument is enclosed in a hand-rubbed solid mahogany case. The best of apparatus is used. The workmanship and finish are the finest.

With the DERESNADYNE you have the whole continent at your finger tips. It is an instrument that you will be proud to own because of its unexcelled performance and handsome appearance.

Write for a complete description of this wonderful new receiver, which has established a higher standard in radio.

RADIO LABORATORY
OF THE
CHICAGO DAILY NEWS

Andrews Radio Company
Chicago. Ill.

May 20, 1924

Gentlemen:

I have said enough about the Deresnadyne before this to indicate how I feel toward it. But I believe that the preachers of better sermons and the designers of better mouse-traps should have the world's commendation brought to their doors more personally than through the medium of the so-called public prints.

You have developed a peculiar radio set in that it continues to work after it has been praised to its face. The scientific world until now has never heard of such a thing.

For years while toiling away with soldering irons and other delicate apparatus I used to long for the day when I could find a circuit that would work as well in the presence of company as it would after the company went home. I confess that I was not at all modest in this hope. It was frankly a wish for the impossible. And there you may read the reason for my enthusiasm.

I tried out the Deresnadyne for the first time six weeks ago and have had it sifting static ever since. As I have written before, the circuit combines selectivity, range and quality in a degree that will not astonish the neophyte nearly as much as it will the old experimenter who long ago abandoned his belief in Santa Claus and radio ads. But that's not the remarkable part of it...it is as untemperamental as an adding machine. You turn the dials and there's the station--and the set doesn't seem to care whether the audience is only yourself or the critical Jones family from across the hall... you'll hardly believe it possible...hence this message.

Well, so much for that. In translation of the foregoing I may capitulate:

I find that changes in atmospheric conditions have very little effect upon your circuit.

The differential between signal and static remains pronounced, even with distant stations and voluminous static.

Variations in battery charge do not impair its quality

Changes in tubes have made very little difference in performance and this in spite of the fact that tube characteristics are widely divergent.

It is virtually impossible to make the set oscillate above 300 meters--and I know who have faithfully tried.

You set the dials, you turn the switch, you hear the music. And I congratulate you...But maybe I've said that before.

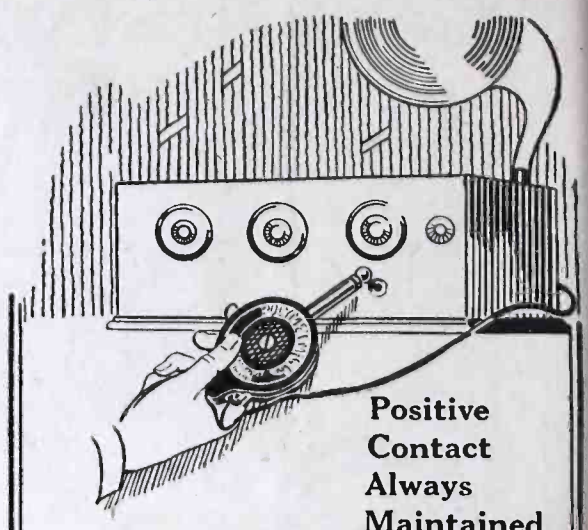
Sincerely,

Robert J. Casey

Andrews Radio Company

327 S. La Salle Street **Chicago, Ill.**

Exclusive Territory to Foremost Jobbers and Dealers Only



Positive Contact Always Maintained

Poly Plug

The tension slot, a big feature of POLY PLUG, permits the phone cords to be pulled and jarred without the slightest disturbance to the contact.

Eliminates every inconvenience so annoying in the operation of the unsatisfactory screw type plug.

No necessity to take POLY PLUG apart—not a single screw to tighten.

At your dealer's or sent postpaid on receipt of purchase price. **75c** *"worth it"*

POLYMET MFG. CORP.
70-74 Lafayette Street
New York City

NEW LEFAX FREE !

Only a Few on Hand

Just Out—The new seventh edition of the Lefax Radio Handbook. Get a copy free of charge in return for your subscription to "RADIO" for one year. Full price of this offer—$2.50. The Lefax book will be sent to you postpaid. Get in on this big offer right now. Mail your subscription today.

"RADIO"—Pacific Building, San Francisco

RADIO LOG BOOKS & MAPS

Both for 50c

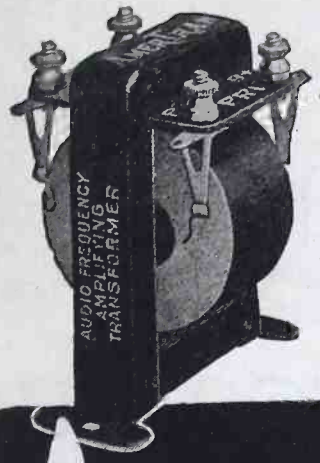
— Postpaid —

The new 32-page Log Book for recording stations heard and a copy of the Radio Map of the U. S. in colors should be in every station.

Mail Your Order Now!

"RADIO"
Pacific Bldg. San Francisco

STANDARD of EXCELLENCE
for audio amplification



Made in two types:

AmerTran AF-6 (Turn ratio 5) for use in the first stage.

AmerTran AF-7 (Turn ratio 3½) the companion transformer for use in further stages of amplification where AF-6 is used in the first stage.

AMERTRAN
TRADE MARK REG.U.S. PAT.OFF.

Improve your set with an AmerTran

Price, either type, $7 at your dealer's

Send for booklet containing much helpful transformer information

AMERICAN TRANSFORMER COMPANY
Designers and builders of radio transformers for over 23 years

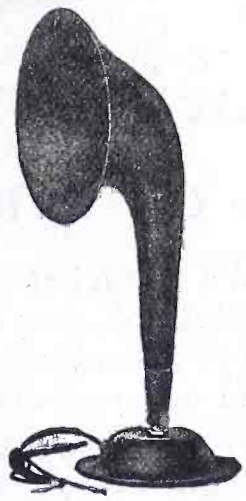
174 Emmet St., Newark, N. J. Cal. Office, Rialto Bldg., San Francisco

New Models BRISTOL RADIO RECEIVERS

Incorporating the Patented Grimes Inverse Duplex System

Watch for furtherannouncements in all leading radio publications

Grimes System Insures Natural Tone Quality



Improved Bristol Audiophone Loud Speakers—gives greater volume, is more sensitive, and still maintains its round, full tone and its distinctive freedom from distortion.

Ask for Bulletin No. 3017-R.

BABY AUDIOPHONE
With Fibre Horn
Price $12.50

Manufactured By

The Bristol Company
Waterbury, Conn.

Pacific Coast Branch Office—332 Rialto Bldg., San Francisco, Cal.

BUY TRIMM *for* BETTER REPRODUCTION

Even though you pay more money for a loud speaker you will not obtain a better value than the Home Speaker. Its size, appearance and efficiency ranks with that of speakers costing twice as much.

A wooden base enclosing the speaker unit eliminates "tinny" tones and guarantees mellow reproduction. Non-adjustable, factory-regulated diaphragm assures maximum satisfaction.

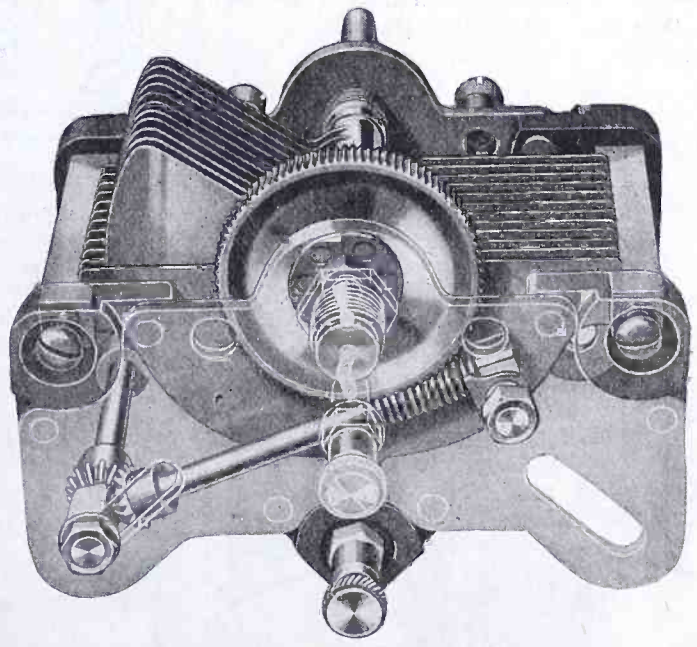
Incomparable tonal quality, with natural clarity and superior volume is characteristic of Trimm Quality Reproducers. They are sold at all good dealers, or write direct, giving your dealer's name.

Trimm Radio Mfg. Company
24 So. Clinton St. Dept. E Chicago, Ill.

Praised by Experts Everywhere and acclaimed by the Public!

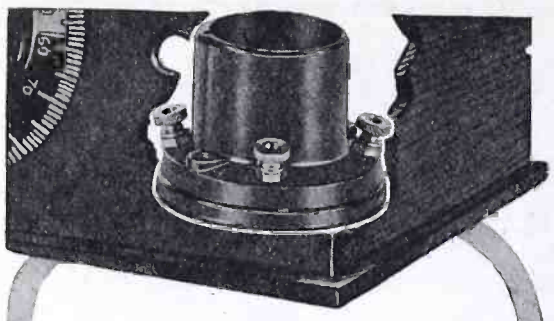
American Brand Condensers

With the 100 to 1 worm drive vernier
23 plate, only $5.00 **In Canada $7.00**



Note to Dealer: If your jobber can't supply you, write us.

AMERICAN BRAND CORPORATION
8 West Park Street, Newark, N. J.
FACTORY, PHILADELPHIA



Get Directly at Them

Are the contacts in the sockets of your radio set easily accessible for ordinary and necessary cleaning?

With Na-ald De Luxe Sockets in use you need neither sand-paper or an extra reach to keep contact strips and tube terminals bright and clean.

Just rotate the tube three or four times. Instantly the dual-wipe laminated contacts remove corrosion, making a bright perfect connection. This action is on the side of the tube terminals away from the soldered ends. *"It's the contact that counts."*

Make your Super-heterodyne set free from socket trouble by using Na-ald De Luxe Sockets.

Sockets and panel mounts for all tubes. Prices 35c to 75c. Send for catalog.

ALDEN MANUFACTURING CO.
Dept. H SPRINGFIELD, MASS.

Police Sergeant Charles E. Pearce who erected and operated the first successful police radio station in the world — a former student of the Radio Institute of America.

Radio - your chance

Write for Information Today

From no knowledge of radio—to licensed operator. From operator up the opportunity ladder to the big jobs at the top. And a life of fascinating interest, well paid. That is every man's chance now that the famous course of America's oldest radio school is offered for ***home study.***

The Radio Institute of America is conducted under the auspices of the Radio Corporation of America, the greatest radio organization in the world. This insures the most thorough and up to date instruction and therefore means preference for positions when you earn your government license.

The demand for trained men is great—and growing. Now, no matter where you live you can *study at home* under the best instruction. Write today! Get your start—and grow with radio.

Advanced Radio Course

Great popular demand by the advanced student, experienced amateur and wireless operator has led to the opening of an ADVANCED HOME STUDY RADIO COURSE, specializing in C. W., I. C. W., telephone and radio measurements. Investigate!

Radio Institute of America

(Formerly Marconi Institute)
Established 1909

322 Broadway, New York City

Indicate by a cross X the course you are interested in:

Radio Institute of America,
322 Broadway, New York.

Please send me full information about radio opportunities today, and your
COMPLETE RADIO COURSE ☐
ADVANCED RADIO COURSE ☐

Name.....

Address.....

.....

MAHOGANITE Dials that match the set

Like all other distinctive products, Mahoganite has its imitators. But, these imitations are on the surface only. Mahoganite is not a surface finish. The electrical values of Mahoganite extend through the material.

The only way to assure yourself of genuine Mahoganite Panels, or Dials which match the panels is to make sure that the RADION Trademark is on every one that you buy.

21 Stock Sizes

Mahoganite and Black

6x7	7x10	7x24	9x14
6x10½	7x12	7x26	10x12
6x14	7x14	7x30	12x14
6x21	7x18	7x48	12x21
7x9	7x21	8x26	14x18
			20x24

RADION

The Supreme Insulation

PANELS

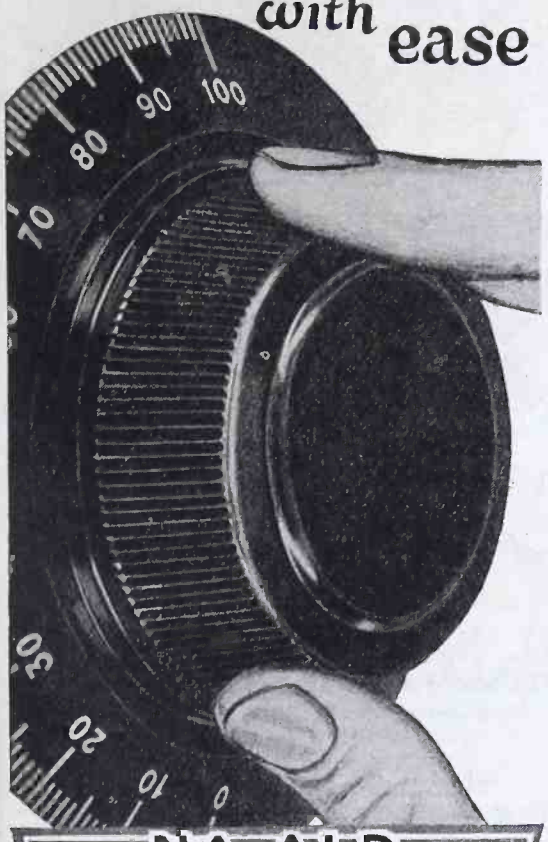
Dials, Sockets, Knobs, Insulators

Look for this stamp on every genuine RADION PANEL. Beware of substitutes and imitations.

At the best Radio shops, or write to

AMERICAN HARD RUBBER CO.
11 Mercer St., New York

Tune in with ease



NA-ALD

Super DeLuxe Dials

Where eye and hand are in scientific balance

Test these dials with any other and see how much more quickly you can turn to any degree or fraction of a degree. Shorter intermediate lines, numerals on the bevel and a generous knob are the reasons.

These are truly beautiful creations which give that final touch of dignity and attractiveness to the quality set. On the set you buy look for the minute Na-ald trademark as you would for "Sterling" on silver.

75c. Other prices of Na-ald Dials are: 3⅛" 50c. 3" 35c and 2" (rheostat) 35c.

ALDEN MFG. CO.
Dept. H. Springfield, Mass.

NA-ALD

Choose the safe– and leak-proof way

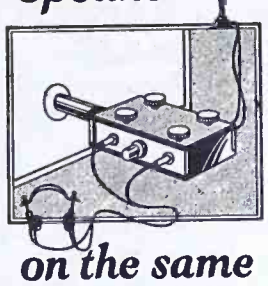
THE amount of radio energy you actually conserve by using MAR-CO parts may be small. The difference between MAR-CO precision and parts of unknown quality can scarcely be recognized when you buy them.

Using MAR-CO parts may mean that you get just one or two more stations out of a hundred. But those one or two are almost sure to be DX stations or special programs you *particularly* want to get.

It costs virtually no more to choose the safe and leak-proof way—specify MAR-CO whenever you buy plugs, jacks, switches, condensers, and other small parts. Martin-Copeland Company, Providence, R. I.

MAR-CO
RADIO PRODUCTS

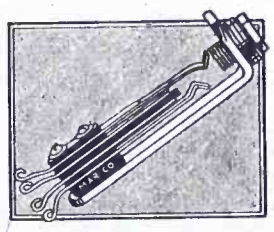
Phones and Speaker on the same plug—



One plug now serves for *both* phones and speaker. Both are permanently connected—and the handy switch shifts reception from one to the other instantly! A big step forward in plug design! You'll wonder why you ever put up with inconvenience of two separate plugs!

MAR-CO SWITCH PLUG $1.00

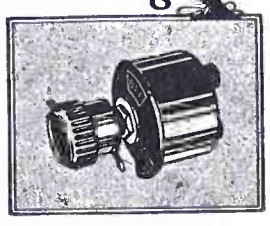
SHUR-GRIP JACKS



with hooked terminals—make set construction easier—short circuits impossible—and leak-proof connections permanent!

Formica insulation thruout—heavily nickeled finish—sterling silver contacts—five types—60 cents to $1.00—and mighty well worth the difference!

When the Phone rings



No modern set lacks the convenience of a MAR-CO filament battery throw switch. Its definite on and off positions make it far superior to any pull switch. Saves tubes and batteries—you don't forget to turn them off! Saves annoying interruptions when you only want to stop reception for a minute!

$1.00

RADIO MAP OF THE U. S. 35c

For Sale by

Pacific Radio Pub. Co., Inc., San Francisco

Lefax Free!

A copy of the new 7th edition of the Lefax Radio Handbook given free with one subscription to "RADIO" for one year.

Full price **$2.50**

"RADIO"

Pacific Bldg. San Francisco

Noiseless Grid Leak

40c
each in any value from ¼ to 10

FRESHMAN SUPERIOR

You can depend upon them to remain accurate at all times

Made of high resistance material impregnated throughout (not coated paper). Unaffected by climatic conditions. Will not deteriorate. Clamped between solid knurled ferrules assuring rigid construction and firm contact at all times.

At your dealer's, otherwise send purchase price and you will be supplied postpaid.

Chas. Freshman Co., Inc., 106–7th Ave., N. Y.

fits any Grid Leak mounting

FRESHMAN PLUNGER TYPE VARIABLE GRID LEAK

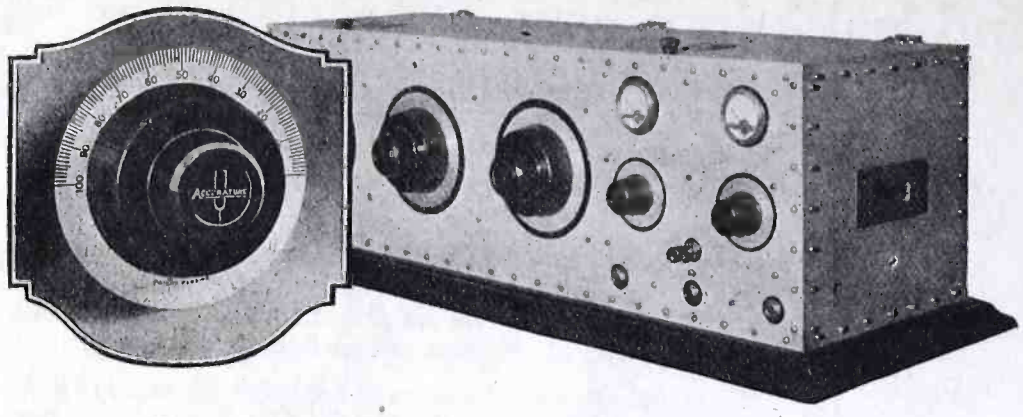
was designed especially for the non-technical set owner who can replace in an instant the fixed grid leak with this new, efficient cartridge type Variable Grid Leak: without requiring the change of a single wire.

At your dealer or by mail postpaid. Write for free catalogue.

65c

106-7th Ave.
New York

Geared 80-1 ratio



Preferred by Radio Experts

Commercial operators, men who know tuning efficiency, use Accuratune Micrometer Controls. L. M. Cockaday, Arthur Lynch and R. E. Lacault, technical editors of the three leading radio publications, use and recommend Accuratunes for best tuning results to their thousands of readers.

Pioneer manufacturers of quality vernier devices.

RADIO Ltd., Montreal, Canadian Representatives

Accuratunes are actual Micrometer Controls, geared 80 to 1 ratio for infinite tuning precision. More efficient than built-in verniers or any other tuning device. An absolute necessity on Super-Heterodynes and other Receivers requiring unusually close tuning.

Accuratune Micrometer Controls give you greater distance, greater selectivity, greater volume. Well worth their price of $3.50.

At your dealers, otherwise send purchase price and you will be supplied postpaid.

ACCURATUNE

80 to 1

MICROMETER CONTROLS

MYDAR RADIO CO., 9-G-Campbell St., Newark, N. J.

You Should Read It!

The Only Book of Its Kind

"The Radiobuster"
A remarkable book of 12 complete radio stories.

Only $1 Postpaid Per copy

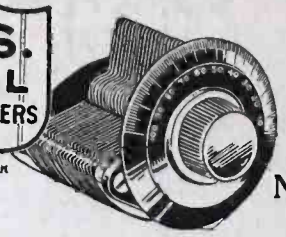
112 pages full of genuine radio humor. Many thrilling stories of radio life at sea.

Mail Your Order Today. The Supply Is Limited!

Pacific Radio Publishing Co., Inc.

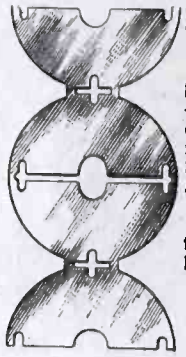
Pacific Building, San Francisco
17 West 42nd St., New York, N. Y.
157 E. Ontario St., Chicago, Ill.

U.S. TOOL CONDENSERS
TRADE MARK



Point Number One

ONE PIECE STATOR



One of Several New Features in Four New Types

Stamped out of one piece of aluminum—the one piece stator eliminates broken contacts and soldered joints. Positive results—no leakage. Found in types 3 and 4, celoron end plates, and types 5 and 6, low loss—metal end plates.

ASK YOUR DEALER to Show You the ONE PIECE STATOR and Other Improvements.

100% GUARANTEED
Write for Literature

U. S. TOOL CO., Inc.

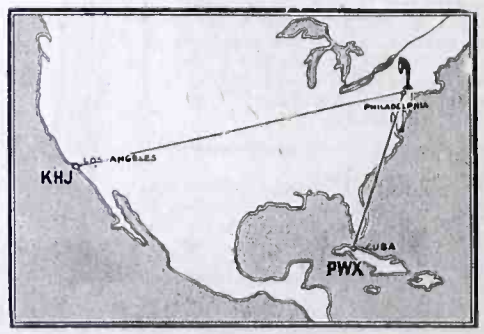
114 Mechanic St., Newark, N. J.

Manufacturers of special tools, dies, jigs, automatic machinery and sub presses.

Pacific Coast Representatives
RADIO ELECTRIC DISTRIBUTING CO.
1113 Wall St., Los Angeles, Cal.

VOLUME!

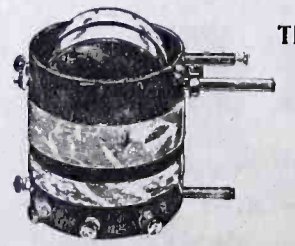
Mr. R. V. Montgomery, 33 Lambert's Lane, Port Richmond, S. I., entertained a committee of engineers to a demonstration on a loud speaker using only 3 tubes, bringing in clearly and loudly such far distant stations as KHJ and PWX. A step of radio frequency is unnecessary when you use the all Litz.



UNCLE SAM MASTER TUNING COIL

THE MOST WONDERFUL COIL IN THE HISTORY OF RADIO FOR

Volume - Distance - Selectivity



The Only Licensed All Litz Tuner

$5.50

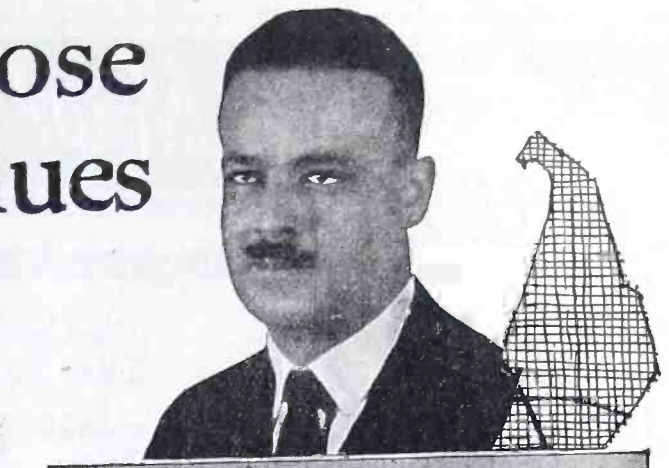
At all Good Dealers

Ask your dealer or send self-addressed, stamped envelope for FREE wiring diagrams of circuits using this coil.

UNCLE SAM ELECTRIC COMPANY

213 E. 6th St. Plainfield, N. J.

Tune in, and end those Super-Heterodyne Blues



Since the close of the great war I have been working on the simplification of Super-Heterodyne.

This done I said to our Laboratory Chief early last Fall, "Meissner, thousands of fans bless us for the Pink-A-Tone crystal sets with which they tuned in for the first time. Let's give them Super-Heterodyne."

So Meissner went to work on "input" and "intermediate frequency." He tried every available type of transformer. After months of costly experimenting he perfected the new Pink-A-Tone 150,000 cycle Transformers and Oscillator Coupler.

When friends hear my Super-Heterodyne they cannot believe their ears. A simple adjustment of two dials and Chicago Grand Opera or Georgia Minstrels are in the next room.

I began to supply hook-up and parts to a friend. He put them together and retailed them for $450.00 to $750.00 each. The other day he bought a Rolls-Royce

"Now, Meissner," said I finally, "how can we give it to the fans?"

"Suppose the fan could have your set on his work table before him," said Meissner, "while he put together the perfectly matched and balanced parts which you supply at cost, plus overhead, plus 10%!"

He had taken life-size photographs, top and rear, and then made blue prints showing each part numbered and in place. From plates costing a round thousand dollars he had made life-size reprints of these photographs and prints, exactly as illustrated, of which a radio publisher said the other day, "I have never seen anything like them in all my life."

You may have a complete set for $2.00—on approval.

AFTER BUILDING

"I have built ten. Yours the best."
New York.

"It works very fine. The—— is not in it."
Texas.

"Surprised myself and many customers."
Louisiana.

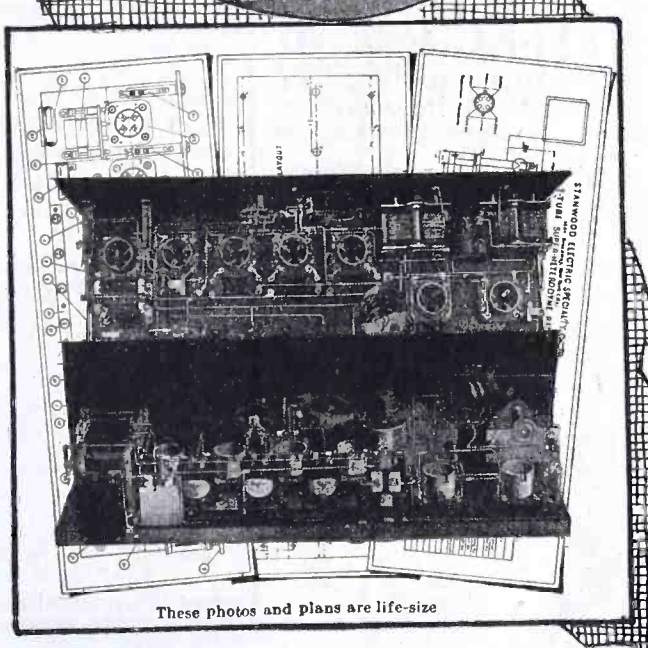
About intermediate frequency transformers. Upon their proper construction and balance depends the "equal amplification in each successive step of the signal as it is passed along from stage to stage," says Captain Robert Scofield Wood in a two-page description of Engineer Meissner's masterpiece in the New York Evening World's Radio Section.

That is why Meissner was not satisfied until he had built and balanced his own "heart of Super-Heterodyne," the wonderful Pink-A-Tone Transformers and Oscillator Coupler—see illustration—which may be had, carefully matched, with life-size plans for $32.50.

The other parts necessary for the construction of this Super-Heterodyne that will not "repeat" (*no station comes in twice on the dials*) are pictured below. We sell and like Captain Wood urge the use exclusively of the best products of manufacturers like Pink-A-Tone, Bakelite, Paragon, General Radio, Hammarlund, Acme, Dubilier.

We will send all of these parts, carefully matched and balanced for you in our Laboratories, with life-size plans, complete, for about 10% less than list, or $80.00. Our references are the Publishers or any New York bank.

THOMAS N. PINKERTON, *President*



These photos and plans are life-size

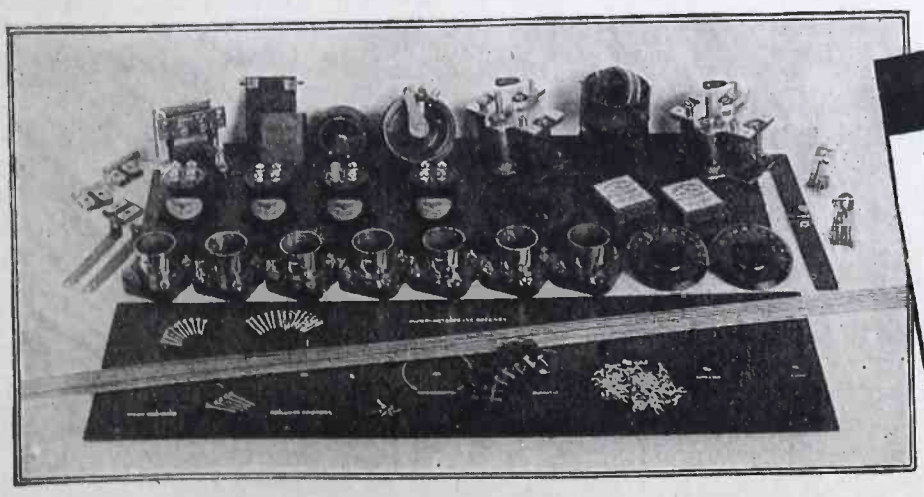
Own the best—built with your own hands!

Our Service Department will help you out of any little difficulty, by wire if necessary.

But do not make the *fatal* mistake of trying to use any but the best made matched and balanced parts for Super-Heterodyne.

Pinkerton Radio Corporation
SUPER-HETERODYNE EXCLUSIVELY

1834 Broadway **New York City**
Dept. 105



RADIOGRAM

Please send Photographs and Blue Prints, complete. On Approval —— I enclose $2.00——.

Four matched and balanced Pink-A-Tone Transformers and Oscillator Coupler.
I enclose $32.50——
Or 25% C.O.D.——

Complete Pink-A-Tone Super-Heterodyne Kit at approx. 10% off list.
I enclose $80.00——
Or 25% for C. O. D. shipment.——

NAME _____
ADDRESS _____

Remit by certified check or money order.

FIL-KO-PARTS

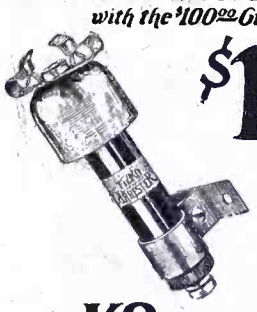
FIL-KO-STAT
SCIENTIFICALLY CORRECT RADIO RHEOSTAT
with Battery Switch

$2

FIL-KO-LEAK
SCIENTIFICALLY CORRECT VARIABLE GRID LEAK
its calibrated

$2

FIL-KO-ARRESTER
LIGHTNING
SCIENTIFICALLY CORRECT RADIO LIGHTNING ARRESTER
with the $100.00 Guarantee



$1.50

FIL-KO-SWITCH
SCIENTIFICALLY CORRECT "A" BATTERY SWITCH
Simple-Sturdy-Sure

50¢

If your dealer does not carry these FIL-KO-PARTS for Radio, send his name, with your remittance for parts wanted, direct to the factory.

New! Remember—These parts are new this season! Be Sure to see them at your dealer's.

Improved Reception

The One Big Thing in Radio That Interests *Everyone!*

Improved Reception Through "Tube Tuning" with a Scientifically Correct Radio Rheostat.

There have always been plenty of rheostats that served to open and close the "A" battery circuit, but until the Fil-Ko-Stat was made it was impossible to adjust the filament heat to the most efficient operating point, giving maximum audibility in phones or loud speaker. Only the Fil-Ko-Stat, designed to give improved reception, allows infinite control of filament current, making possible louder, clearer signals from distant and local stations in any Radio Receiver using any type of tubes. And now—the NEW model (*insist on the NEW model at your dealer*) gives even finer control than ever before. It's $2 including the battery switch attachment. And it's unconditionally guaranteed.

Improved Reception Through Maintaining Correct Grid Bias with a Hand Calibrated Grid Leak.

Likewise, there are many forms of grid leaks, some variable, others fixed. The Fil-Ko-Leak, however, is the only grid leak that can be set for a *specified* resistance and adjusted for best results. It's hand calibrated (and double checked) over the operating range for all tubes—¼ to 5 megohms. Markings can be read through a panel peep-hole, and it's also equipped for table mounting [bracket packed with each instrument]. Guaranteed perfect electrically and mechanically, it gives scientifically correct control of grid potential —for $2.

Leakage Losses You Never Thought of are Eliminated by this Scientifically Correct Radio Lightning Arrester.

Even were the Fil-Ko-Lightning Arrester no better than the average, it would still be worth far more because it comes to you with a guarantee that is virtually an insurance policy. You get $100 or we repair or replace your set if damaged through fault of the arrester. But the Fil-Ko-Arrester is better. It eliminates all leakage losses from aerial to ground, all radio impulses reaching the antenna are sure to pass through your radio set, insuring maximum reception. Hermetically sealed *Bakelite* insulation is protected by an umbrella-shaped shield that keeps off dust, moisture and other conductive matter. You get positive protection for $1.50.

There's also the Fil-Ko-Switch, at 50c. It won't improve reception—but it's one of the few battery switches that won't impair it. Made of non-magnetic metal, wipe-action contacts, assuring sharp, clean "make and break", entirely insulated from nickel-plated brass housing and knob. Scientifically correct to avoid current leakage and extra capacity. Carries the usual Fil-Ko-Part for Radio guarantee!

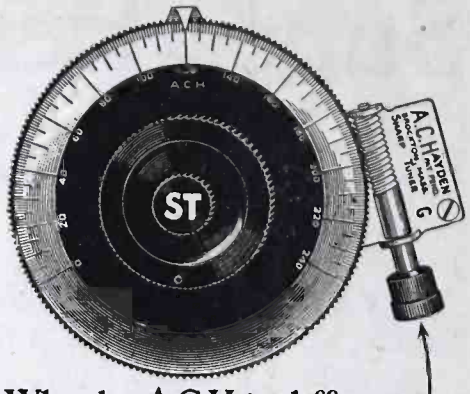
Improved Reception Through Scientific Tube Tuning
A book that will help you get better results; tells all about vacuum tubes and how to control them so as to get more DX, greater volume, longer tubes and battery life—maximum regeneration and clearest signals.
Write to Dept. R1024 for free copy.

Foreign Representatives: Radio Stores Corporation, NEW YORK

MADE AND GUARANTEED BY
DX INSTRUMENT Co
HARRISBURG — PENNSYLVANIA

NEW YORK OFFICE 220 W. 34th St.

A Pleasant Surprise Awaits the User of the A.C.H. Sharp Turner Dials



Why the A.C.H. is different

3 in. DIAL → ACH → 156-TO-1
4 in. DIAL → ACH → 215-TO-1

Will improve any receiving set, making difficult tuning easy

Money Back Guarantee

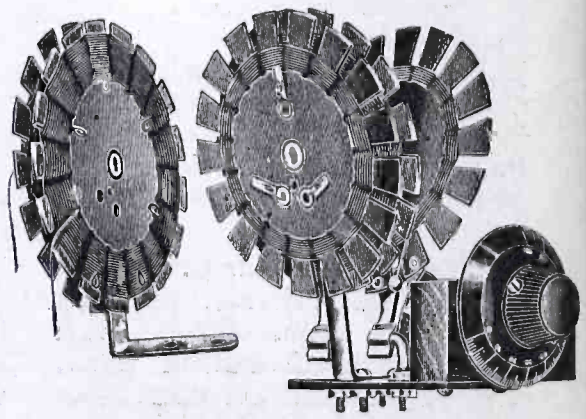
Price 3-inch size..$2.50 Price 4-inch size..$5.00
Regular fitting 5/32 shaft ¼ and ⅛....5c each extra

Extra Advantage of the A. C. H.

1. Can be attached or removed from any instrument.
2. Rough tuning same as any dial.
3. Movement so fine that the eye cannot detect but the ear can.
4. Automatically locks instrument so no jar can disturb it.
5. Dial grounded reducing the body capacity to a minimum.
6. Special dial 2 graduations where ordinarily one.

Mail Orders sent Prepaid in U. S. A.

A. C. HAYDEN RADIO & RESEARCH CO.
BROCKTON, MASS., U. S. A.



ROBERTS UNITS
(Trade Mark)
THE WONDER CIRCUIT OF THE YEAR

Combining Neutrodyne—Regeneration—Reflex Developed by Walter Van B. Roberts, EE., Ph. D. Editorially Endorsed by Radio Broadcast, as Without Doubt The Best We Have Ever Seen.

California Actually Heard at Princeton University On The Loud Speaker, WITH TWO TUBES.

ROBERTS UNITS consist of Five Coils in Two Mountings Ready for Installation. Packed complete with all instructions, Hook-up, Schematic Print, Cut of Complete Set, etc.

BUILD A ROBERTS AND REACH THE COAST
Coils Mfg. under Zig-Zig Pat. Aug. 21, 1923.

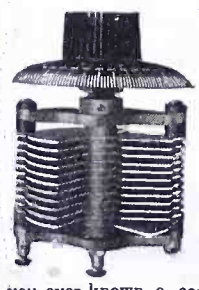
$8.00

ROBERTS KIT
(Trade Mark)
Complete Kit of High-Grade Parts for the
ROBERTS TWO TUBE KNOCKOUT SET

Genuine Bakelite Panel, completely drilled. General Radio Condensers, F. M. C. Transformer, Sockets, Condensers, Genuine Roberts Units, Baseboard, Dials, Knobs, Busbar, Spaghetti—Everything, except Tubes, Batteries, Cabinet.

$60 with Portena Folding (Loop for Local Use)
$53 Without Loop

J. NAZELEY COMPANY, Dept. B
571 Hudson St. (Sole Mfgs.) **New York**



For Low Losses You Can't Beat The PROUDFOOT

A phase angle of 14.2 seconds! A loss of only seven one-thousandths of one per cent! Think of it. Have you ever known a condenser with such efficiency? And this record was made with our 25-plate model.

REQUIRES ONLY SMALL SPACE

The Proudfoot One-Knob Vernier Condenser is a lean, but sturdy unit that has a world of efficiency and strength without bulk. It's built to fit into tight places. Just the condenser for that compact set you are planning.

Both group plate and vernier plate adjustments are ingeniously made with one knob. Two separate scales give definite readings.

If you want the best results, demand the Proudfoot One-Knob Vernier Condenser. It's priced right—13 plate (M. F. C. .00025)—$3.75; 25 plate (M. F. C. .0005)—$4.50; 43 plate (M. F. C. .001)—$5.75. If your dealer cannot supply you, write us.

Jobbers and Dealers: We will be glad to give you detailed information about the Proudfoot if you will address us on your letterhead.

CRUVER MANUFACTURING CO.
2456 W. Jackson Blvd. Chicago, Ill.

RADIO K.B. PARTS

Formerly
"MASTER" Line

REDESIGNED AND IMPROVED

For ACCURACY, EFFICIENCY and APPEARANCE, insist on "K.B." products from your dealer. Ask to see our new type Variable Condensers with important Special New Features.

Jobbers and Dealers write for attractive prices and discounts.

K. B. MANUFACTURING CO.
Dept. C—No. 54 Washburn St.
San Francisco

BAKELITE Mouldings, Dies, Custom Work

The Radio Magazine You Have Been Waiting For!

As you sit and listen on your radio to a beautiful voice singing one of your favorite songs, to a splendid orchestra playing irresistible dance music, to the vibrant voice of some minister as he delivers a powerful, stirring sermon—many times haven't you wondered what these people were really like—haven't you wished that you could meet them face to face, could watch them as they broadcasted their songs, music, talks, and sermons?

Of course, you have felt this desire to know these people, we have often wondered ourselves about them, these entertainers whose voices we often hear and whose faces we never see. And now we are going to bring you face to face with them. Our big new magazine, Radio Stories, is going to bring you this information you have wanted since the first time you set your dials and tuned in on a broadcasting station.

The Human Side of Radio

Radio Stories will show you the human side of radio. It is going to give you thrilling true accounts of happenings in the big broadcasting studios. It is going to tell you of the personalities behind the programs, show you the faces behind the voices. Radio Stories is going to be so intensely interesting, is going to contain so many things you have always wanted to know, that you will not want to lay this magazine aside until you have read it through to the last page.

Things You Have Always Wanted to Know

There will be features by and about famous broadcasting stars. Dozens of attractive illustrations, many actual photographs taken in broadcasting stations. There will be thrilling fiction, short stories, serials—but read the list of contents shown here, it will give you some idea of what awaits you in the first issue of Radio Stories.

Special Offer

In connection with our first issue we are making a special subscription offer of six months for one dollar. Radio Stories will be on sale at practically every news-stand in the country, but if you want to insure yourself against missing a single issue of the next six numbers, or if you prefer to have the magazine sent to your home, use the coupon here which is provided for your convenience.

CONTENTS OF OCTOBER ISSUE

Radio Stories

MACFADDEN PUBLICATIONS, Inc. P.R.10
1926 Broadway, New York City

I am enclosing one dollar. Please enter my name for a six months' subscription to Radio Stories beginning with the first issue. This is in connection with your special offer.

Name.....

Address.....

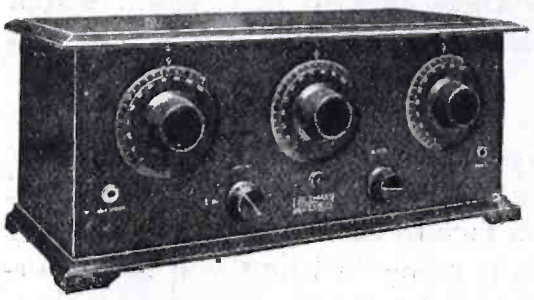
Radio Stories

1926 Broadway - New York City

FRESHMAN MASTERPIECE

The Greatest Value Ever Offered in a Radio Receiving Set

Here it is at $60.



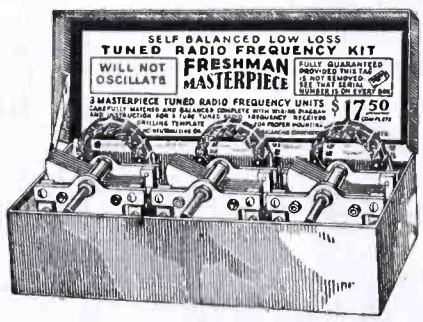
CLARITY ★
BEAUTY
VOLUME
DISTANCE
ECONOMY
SELECTIVITY

A Five Tube Radio Frequency Set

Built of the finest low loss material and in a beautiful, genuine, solid mahogany cabinet. A receiver that will bring even the most distant stations to your home with surprising clarity and volume. So selective that you can pick up any station you want, night after night, at the same dial settings, and, what's more, it's the easiest set in the world to operate.

If you want to Build your Own, we have made Set Building Easy

FRESHMAN MASTERPIECE Tuned Radio Frequency Kit



No Neutralizing or Balancing Condensers Required

With these marvelous units you can easily build a five-tube tuned Radio Frequency Receiver that will be highly selective as well as a remarkable distance getter, bringing in all stations with pleasing clarity and volume.

Kit consists of 3 Masterpiece Tuned Radio Frequency Units carefully matched and balanced. Complete with wiring diagram and instructions for building any 5-tube tuned radio frequency receiver and also drilling template for proper mounting.

$17.50

Our new catalog is now ready. It's free. Write for it.

CHAS. FRESHMAN CO., Inc., 106 Seventh Ave., New York City

The Romance of the Sea

Read the Story of the Life of a Sea-going Radio Operator—

"THE RADIOBUSTER"

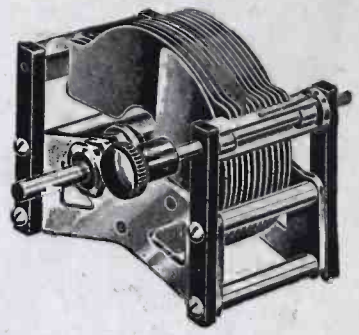
$1.00 Per Copy

SENT POSTPAID ANYWHERE

PACIFIC RADIO PUB. CO.
PACIFIC BLDG., SAN FRANCISCO, CAL.

$1.00 Per Copy

HICO
Variable Condenser



5 Engineers Built This Low Loss Condenser

"HICO" will work in any circuit.

Finest features of up to the minute construction.

Low loss, brass plates, perfect and minute control.

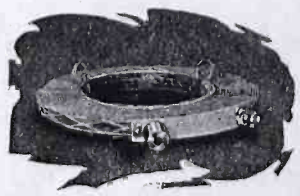
Made in 11-17-23-43 plate proper capacities.

At all good dealers

Hartford Instrument Co.

309 Pearl St. Hartford, Conn.

Western Agent: F. L. Tomlinson Co.
San Francisco, Los Angeles, Seattle



Tuned Transformer Coil No. 14
Price $2.00

SICKLES
DIAMOND WEAVE COILS

PATENTED AUGUST 21, 1923

HOLD THAT STATION!

You can get and hold the station you want, and keep out the others, with Sickles Diamond Weave Coils.

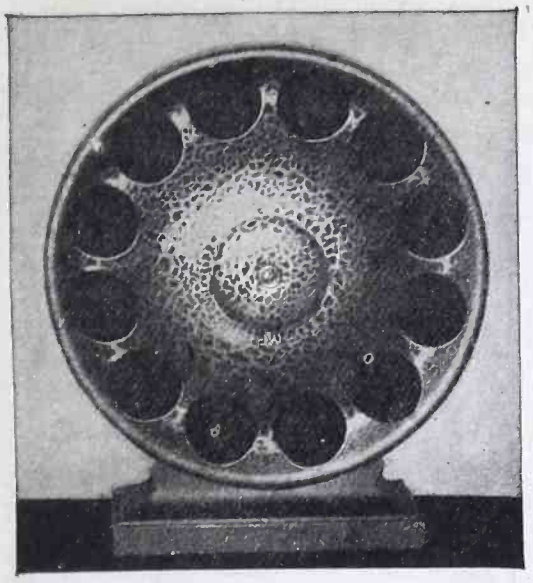
Sickles Tuned Transformer Coil No. 14 and the Knockout Reflex Coil No. 8 especially designed for popular circuits make a receiving set remarkably selective.

The No. 14 Tuned Transformer coil is absolutely self-neutralizing when placed at the proper angle in a set.

Write for particulars.

THE F. W. SICKLES CO.,
338 Worthington St.,
Springfield, Mass.

Knockout Reflex Coil No. 8
Price $4.00 a Pair



This loudspeaker is made of a new light-weight material which eliminates rattling and rasping. Requires no batteries. Operates on all ordinary plate voltages, 45 to 150. 14 in. high. Choice of artistic finishes. Write for Free Descriptive folder.

N&K

Imported

LOUDSPEAKER

TYPE W

new!

AS REVOLUTIONARY—in principle, in design, in *tone quality*—as the now famous N. & K. Imported Phones.

Its principle is that of *sound reflection*. The sound waves issue from the speaker in their full roundness, and are carried to every corner of the room.

Its shape is new and artistic. And it is made in several handsome finishes, which harmonize with all types of home decoration.

Its material is new. Burtex, a scientific product, which, unlike vibrant wood or metal, prevents counter-vibrations, thus eliminating unpleasant twanging, rasping, or rattling.

Its tone is surprisingly distinct, mellow, natural, free from distortion, thus delighting and enthusing the most critical listener.

Listen to this new invention on your own set. We authorize N. & K. Dealers to put it into the homes of responsible customers on

FIVE DAY'S FREE TRIAL

Price, complete with 6 foot cord, $27.50. If your dealer has not yet been supplied, notify the Th. Goldschmidt Corporation, Dept. J. 10, 15 William St., New York City, and you will be given prompt opportunity to listen to this new N. & K. Imported Loudspeaker.

Made by the makers of N. & K. Imported Phones, price $8.50, and the N. & K. Imported Phone Unit, $7.50

DEALERS:

This new Loudspeaker has made an instant sensational success, wherever displayed. It is a big profit maker because it meets every demand put upon high grade loudspeakers—tone quality, appearance, price. If your regular jobber cannot supply you, write us for name of nearby N. & K. authorized Distributor.

Th. Goldschmidt Corporation
Dept. J10, 15 William St., N.Y.C.

N&K
STAG OF THE AIR

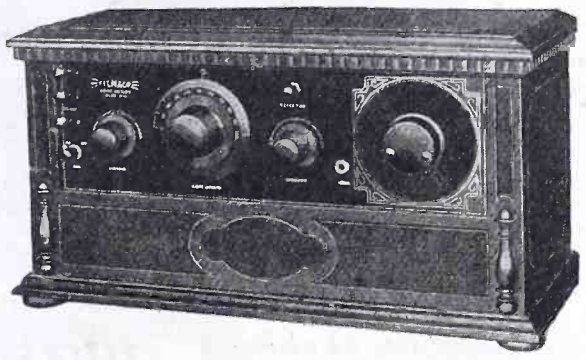
Telmaco Acme Receiver

The Ideal Receiver for all Seasons

The Telmaco Acme Receiver is truly portable. Entirely contained in beautiful traveling case. Tubes, batteries, loop, loud speaker, everything built into set. No outside loop, no aerial, no ground required.

Size of Case 8" x 10" x 18". Weighs only 27 pounds complete.

Easily Carried.



Acme 4-Tube Reflex Circuit Used

securing selectivity, distance and volume with minimum battery consumption.

Complete in itself. Easily carried from room to room in your home or to office, neighbors, etc. Take it along and have music, entertainment, speeches, news, market reports wherever you happen to be.

Instantly ready for use as it is. You can use external antenna and ground, loop and loud speaker if desired. 4 tubes (fully protected by shock absorber sockets)—equal to 7 tubes, due to reflexing and use of crystal detector.

Reasonably Priced Write for Free illustrated circular fully describing Telmaco Acme Receiver.

Complete Telmaco 64 page catalog containing 20 circuits in blue and describing the best in radio sent postpaid for 10c.

Dealers! Catalog and Price List furnished to all bona fide dealers making request on their business stationery.

TELMACO

Quality Radio Exclusively
Established 1918

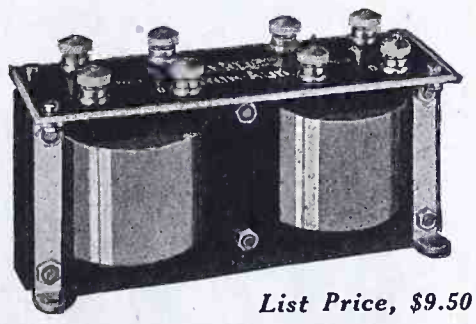
Radio Division

TELEPHONE MAINTENANCE CO.

20 South Wells Street **Dept. A** **Chicago, Illinois**

The PEERLESS TWIN-AUD

Double Audio Transformer



List Price, $9.50

MAY be used in any circuit where two audio transformers are specified. It is the transformer that gives greater volume and clearer reproduction with its two stages of balanced audio amplification.

WITH Twin-Aud you will have music that demands no apology. Voice reproduction that is intelligible—pure, sweet tones over the entire scale—all the high notes and all the low notes. No howls, squeals, wails, hisses or hums.

Twin-Aud Stands Out in Performance as it Stands out in Appearance

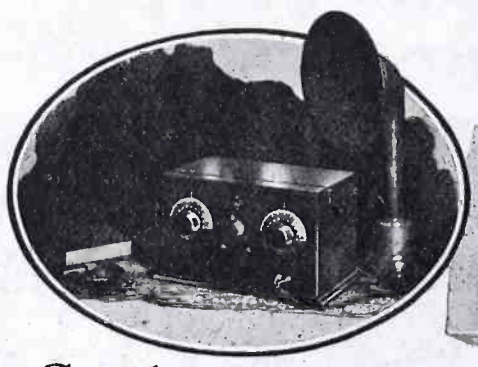
WESTERN REPRESENTATIVES

UNIVERSAL AGENCIES

693 MISSION STREET, SAN FRANCISCO, CALIFORNIA

PEERLESS RADIO CORPORATION

NEWTON LOWER FALLS, BOSTON, MASS.



Such applause must be merited

The set for the masses, as well as the classes.

SHAMROCK-HARKNESS KIT
contains all parts to build the Shamrock-Harkness Reflex.

LICENSED MANUFACTURER
HARKNESS REFLEX
NONE GENUINE WITHOUT THIS

Licensed under U. S. Patent Office, Serial No. 719,264 for Radio Receiver Stations.

Send 10c for Radio Builders Guide Book.

List Price $35 Complete

SHAMROCK
FOR SELECTIVE TUNING

There's a reason why crowds gather at this window. Within is featured the sensational Shamrock-Harkness Receiver—combining: distance from the neutrodyne, clarity from the reflex, and volume from the regenerative.

FEATURES

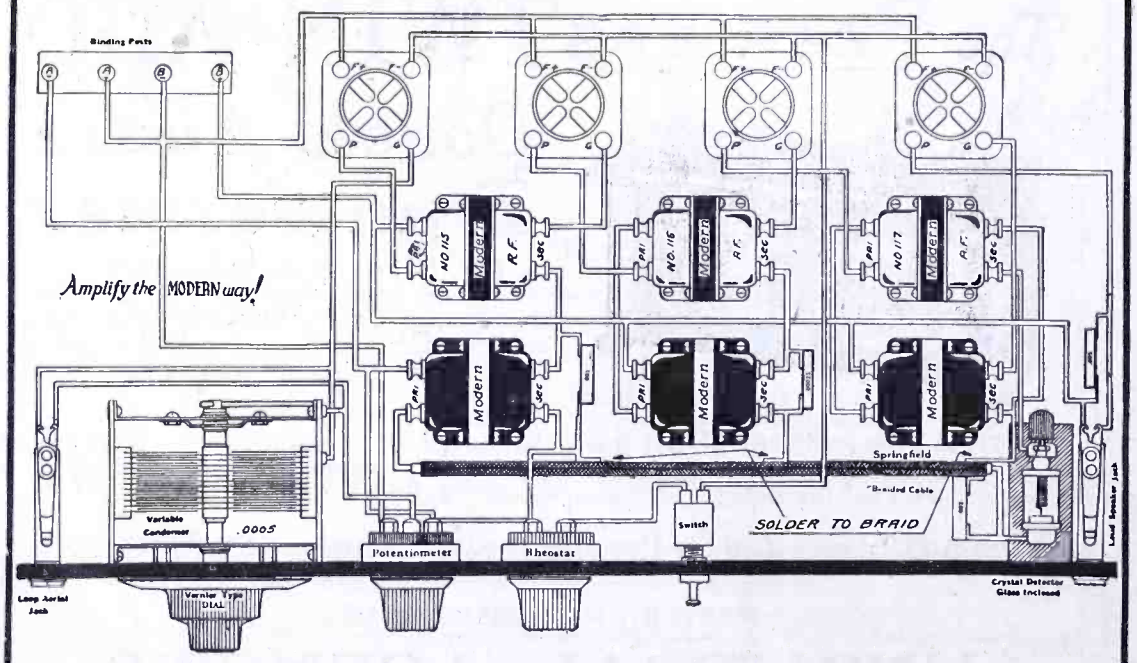
Operates a loud speaker. Two tubes do the work of five. Cuts battery cost 60 per cent. Does not squeal or radiate. Stations can be logged. Amazing clarity and volume.

The amazing performance of the Shamrock-Harkness Receiver depends as much on the use of specially designed parts and the mechanical arrangement of these parts as upon the wonderful circuit itself.

The Shamrock Kit contains genuine guaranteed Harkness parts. Avoid imitations. Accept only the genuine.

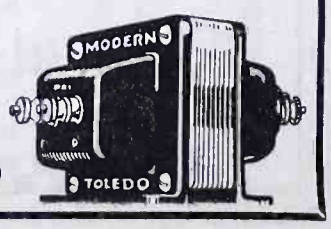
SHAMROCK MANUFACTURING CO.
Dept. 55 Market Street - - - Newark, N. J.

MODERN Super-Six Reflex



The Set You Will Eventually Build

Large size wiring diagram and list of parts necessary to build this set sent on receipt of 4 cents in stamps.

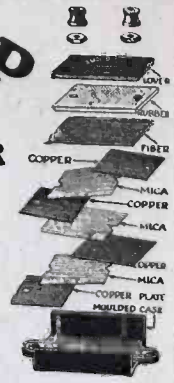


The Modern Electric Mfg. Co., Toledo, Ohio

BUILD-UP

MICA CONDENSER

Patent Pending



insure high efficiency and the Build-Up feature enables the operator to obtain any definite capacity from .00025 to .006 by simply adding extra plates of copper and mica to the Build-Up base.

Each alternate copper and mica plate has a capacity of approximately .0002 Mfd.

Build-Up Mica Condensers of the following capacities, each assembled complete in carton, at the following prices:

.00025 Mfd	List price	50c
.0005 "	" "	50c
.001 "	" "	55c
.002 "	" "	60c
.0025 "	" "	65c
.005 "	" "	70c
.006 "	" "	75c

Extra envelope containing 20 copper and mica plates, or sufficient to build up a condenser from .00025 to .006, list price 25c.

Table showing required number of plates needed for any capacity is furnished with each condenser.

Ask your dealer—or order direct

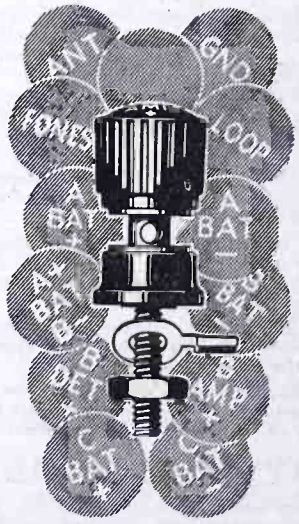
CHAS. SCHINDLER
1402 W. Delaware Ave., Toledo, Ohio

Establishing A New Standard

The New and Improved

"Read'em" Binding Posts

"The Knobs Can't Come Off"



New Markings Fulfill Every Demand

The Utmost in Quality and Appearance at the Lowest Price

15c

At Your Dealers or Sent Postpaid
THE MARSHALL-GERKEN CO.
Toledo, Ohio

Lefax Free!

A copy of the new 7th edition of the Lefax Radio Handbook given free with one subscription to "RADIO" for one year.

Full price **$2.50**

"RADIO"
Pacific Bldg. San Francisco

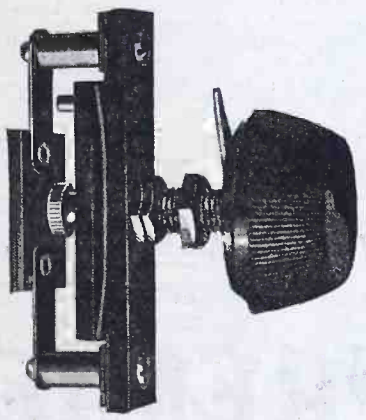
Lefax Free!

A copy of the new 7th edition of the Lefax Radio Handbook given free with one subscription to "RADIO" for one year.

Full price **$2.50**

"RADIO"

Pacific Bldg. San Francisco



A smoothly adjustable

Grid Leak

that gives even regulation from $\frac{1}{4}$ to 8 megohms

The Centralab (formerly CRL) was one of the first and most successful variable grid leaks on the market. It gives smooth, unbroken adjustment through 900 degrees — 2½ turns of the knob—and gives absolutely uniform variation from ¼ to 8 megohms. It makes possible the finest gradations and holds the value at which the knob is set. Single hole mounting.

No. 106 . . . . . **$1.25**
No. 107 (*with .00025 condenser*) . . . **1.60**

We also manufacture the

Centralab RHEOSTAT
No. 206—6 ohms, **$1.25**
No. 230—30 ohms, **$1.25**

Centralab BATTERY SWITCH
No. 300—**50c**

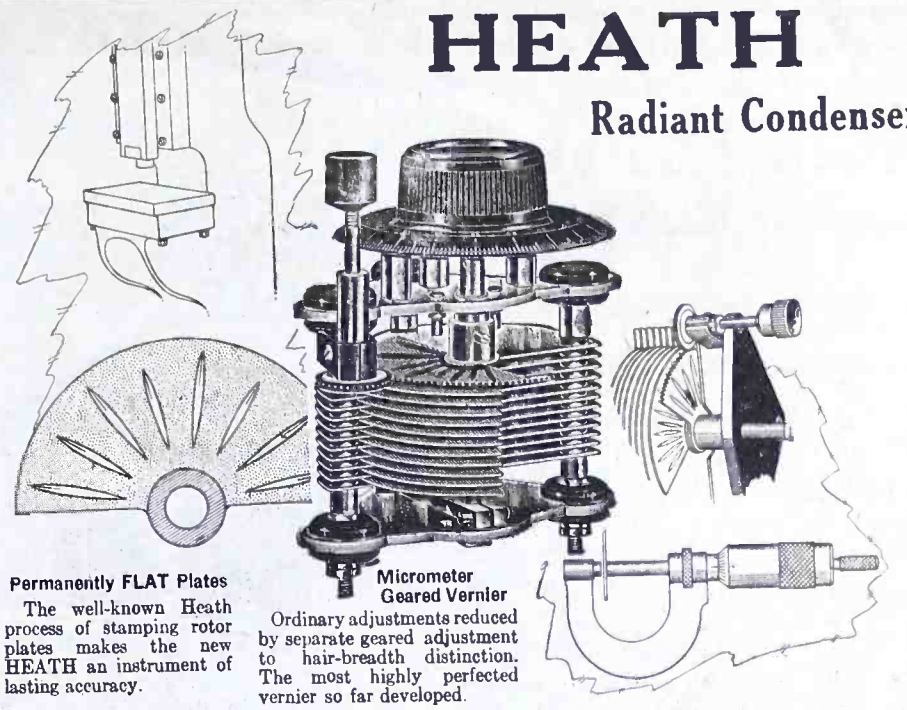
Centralab NON-INDUCTIVE POTENTIOMETER
No. 110—400 ohms, **$1.50**
No. 111—2000 ohms, **$1.75**

TO JOBBERS AND DEALERS: *The trade mark of products of the Central Radio Laboratories has been changed from* **CRL** *to* **Centralab.** *Write for literature.*

Centralab
CENTRAL RADIO CRL LABORATORIES
295 Sixteenth St. Milwaukee, Wis.

HEATH

Radiant Condensers



Permanently FLAT Plates

The well-known Heath process of stamping rotor plates makes the new HEATH an instrument of lasting accuracy.

Micrometer Geared Vernier

Ordinary adjustments reduced by separate geared adjustment to hair-breadth distinction. The most highly perfected vernier so far developed.

Non-Dielectric Condensers

A NEW all-metal condenser, **plus**—new rigidity! A shaft perfectly centered in accurately machined bearings—true—running—for smoother operation. No contacts through bearings. Use Heath Condensers in your new set or hook-up.

PRICES

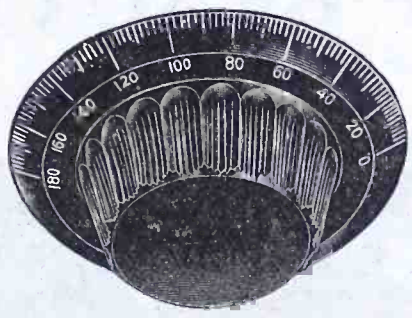
No. 102—2-inch Dial for ¼-inch shaft . . . . . 50 cts
No. 103—3-inch Dial for 2-inch shaft . . . . . 65 cts
No. 1105—4-inch Dial for 2-inch shaft . . . . . 80 cts

Prices of Model "A" Vernier Type With Dial

No. 12 A. V. 12 plate $5.00
No. 24 A. V. 24 Plate 5.50
No. 44 A. V. 44 plate 6.50

Plain Types in all sizes.

New HEATH Products

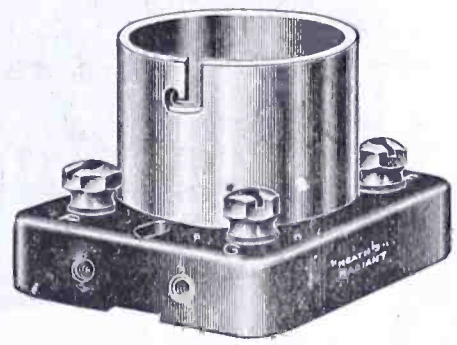


Heath Bakelite Dial

Specially designed easy grip-knob, beautifully proportioned, highly polished and clearly incised. Brass bushing centered by precision machinery to positive accuracy for perfect balance. Made in two (2) inch, three (3) inch and four (4) inch diameters. A typical HEATH product.

Heath Sockets with the Exclusive Shock Absorber Feature

Bakelite base into which re-enforced phosphor bronze, self cleaning contacts are securely embedded. Binding posts are slotted hexagon nuts. HEATH Standards of material and workmanship. . . . . **Price 75c**



Write today for Literature

Heath Radio & Electric Mfg. Co.

208 First Street, Newark, N. J.

Distributors for Northern California
ELECTRIC APPLIANCE CO.
807 Mission Street San Francisco, Cal.

Distributors for Southern California
THE ELECTRIC CORPORATION
836 S. Los Angeles St. Los Angeles
WESTERN RADIO INC.
637 S. Hope St. Los Angeles

TURNABOUT PEDESTALS FOR
Radiola Super-Heterodyne
and other directional receiving sets. Permits your set to revolve freely upon a mahogany-finished base.
Sent postpaid upon receipt of $1
Special quantity prices to dealers.
Levison Radio Laboratories
58 Collins Street, San Francisco, California

BALDWIN Phones Free!
for best long distance record on my hook-up. Other prizes, too. Particulars free.
LEON LAMBERT
542-K Kaufman Bldg. Wichita, Kansas

SIX MONTHS FOR ONE DOLLAR
"RADIO" San Francisco

Send $1.00 now for this regular $2.50 value, postpaid anywhere in U.S.A. Write for Big Free Radio Catalog. Atwood-King, Inc. Dept. G 105
163 W. Washington St., Chicago
ONLY $1 POST PAID

ATWOOD KING INC.

Thousands Now Know This to be the Greatest Radio Value Ever Offered

"Pacific Quintet"

Super-Het Kit $15.00

(45,000 Cycle)

Another Leader Product of the Popular "Pacific" Line

A remarkable value, made possible through huge quantity production. Build your own Super-Heterodyne. Rebuild or convert your old set to a modern and advanced type Super-Heterodyne. All other parts required are standard. Hook-up print with complete and simple instructions packed with each "Pacific Quintet" kit.

Foresight and Advanced Engineering Efficiency now bring the latest and most popular developments within a price range to suit the average pocket-book.

Satisfaction Guaranteed

Finely finished merchandise built for real work.

"Pacific Quintet" Super-Het Kit

Consisting of 1 Pacific "Ranger" No. 30 Oscillator Coupler, 3 Pacific "Ranger" No. 25 Intermediate Frequency Transformers and 1 Pacific No. 20 "Ranger" Filter Transformer.

If Your Dealer Cannot Supply You, SENT TO ANY ADDRESS Upon Receipt of $15.00, or by Parcel Post or Express C.O.D.

BALDWIN-PACIFIC CO., Pacific Bldg., San Francisco

"HEGEHOG" TRADE MARK

Puts the Ban on Distortion

With the "HEGEHOG" on guard you will get plenty of volume without distortion,—that plague of radio. The "HEGEHOG" is a marvel for purity and perfection of tone. Its exclusive self shielding feature effectively shuts out foreign noises.

The size of the "HEGEHOG" is a revelation. It occupies half the space of any other transformer,—hardly larger than an English Walnut. Mounts anywhere. Easy to connect. Ideal for portables.

Ratios 1 to 3, 1 to 4 and 1 to 5—$3.50.

Ratio 1 to 10—$4.50.

Write for Free Bulletin No. 94 showing complete line of Premier Quality Radio Parts. Ask your dealer if he has Premier free hook ups. If not, send his name and receive a set free.

Premier Electric Company

3813 Ravenswood Ave., Chicago

Makers of

PREMIER

Quality Radio Parts

"A THING OF BEAUTY"

THE "RF22"

A "Five-Tuber" That Acknowledges No Peer

Write us for

Pamphlet and Testimonials

HALLOCK & WATSON RADIO SERVICE

192 Park Street "KGG" Portland, Oregon

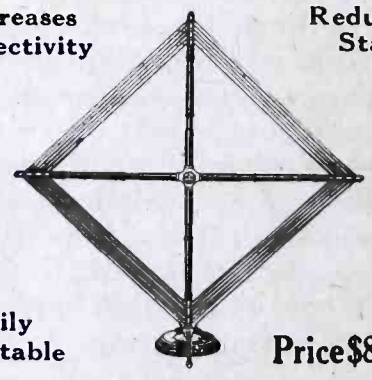
WESTERN DEALERS—MAY WE QUOTE YOU?

Duo-Spiral

Folding Loop

Increases Selectivity

Reduces Static



Easily Portable

Price $8.50

Patents pending

The highest development in a portable aerial. Compact, convenient and self contained. No outside aerial or ground wire necessary. Can be used anywhere. Brings in distant stations with remarkable volume.

The Duo-Spiral has a swivel base graduated in degrees for calibration. A convenient handle permits adjustment without body capacity effects. It has been adopted as standard equipment by leading manufacturers. Its handsome silver and mahogany finish harmonizes with the finest furniture. The folding feature makes it easily portable.

Duo-Spiral is made by the manufacturers of Tiny-Turn, the superior vernier control which makes perfect tuning easy. If your dealer is unable to supply you with either of these standard products, write us direct.

Radio Units Inc.

Maywood, Illinois

1303 First Avenue

BROWNLIE CRYSTAL

"REFLEX SPECIAL" QUICK CONTACT RECTIFIER GUARANTEED

$1.00

The Acme Apparatus Co. says "prevent distortion and howling by using a BROWNLIE CRYSTAL in REFLEX SETS."

Order From Your Dealer or Direct

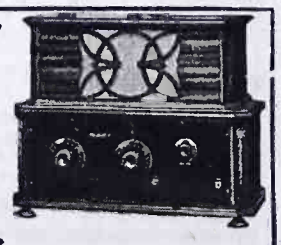
ROLAND BROWNLIE & CO.

24 Saunders Street, Medford, Mass.

Latest Development In

RADIO

The New Pfanstiehl Non-Oscillating Principle Complete Outfits



$5 DOWN *Easy Monthly Payments*

The season's biggest sensation. Carl Pfanstiehl's improvement over Neutrodyne, Super, Reflex, etc. Positively non-regenerative. Brings a new degree of musical quality, selectivity, and simple operation. Solid mahogany cabinets. Accessories included.

Write Today for FREE Trial Offer!

Write quick and get our special price offer with 2 week's FREE Trial, and easy payments. 3, 4 or 5 tube sets. Write.

MARSHALL RADIO PRODUCTS., Inc., Dept. 59-36

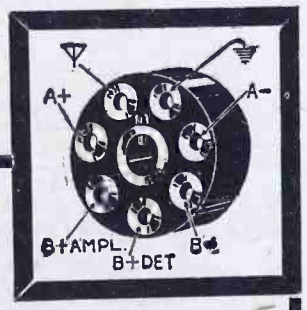
Marshall Blvd. and 19th Street, Chicago, Ill.

Tops Don't Come Off. 25 Different Markings Scientifically Made, Beautifully Finished.

Insist on and get
Genuine EBY Binding Posts

H. H. EBY MFG. Co. **Phila., Pa.**

Jones Multi-Plugs are supplied for panel or bracket mounting. Also (as illustrated below) with seven leads coded for attaching to binding posts of any set.



Complete $5.00

ONE PULL---

on the Jones *MULTI-PLUG* instantly disconnects antenna, ground, A and B batteries from your set! One push reconnects! Long cable permits placing batteries out of way—in basement, closet or elsewhere. All leads coded.

JONES MULTI-PLUG

Can't be plugged in wrong. Prevents burning out tubes or shorting batteries. 100% foolproof. Enables anyone to connect your set with safety. Standard on Zenith, WorkRite and many other leading sets. Jones Multi-Plugs, complete for panel mounting, $4.00; for bracket mounting, $4.50. Binding Post type, $5.00. Carried by all jobbers. If your dealer isn't supplied, state his name when ordering. Folder free.

Pat. Applied for
HOWARD B. JONES
614 S. Canal St. **Chicago**

PACIFIC COAST DISTRIBUTORS:

San Francisco, Calif., A. S. Lindstrom, 111 New Montgomery St.
Los Angeles, Calif., Lombard J. Smith, 451 East Third Street.
Seattle, Washington, George H. Mayer, 95 Connecticut Street
Portland, Oregon, H. A. Killim, 312 McKay Building.

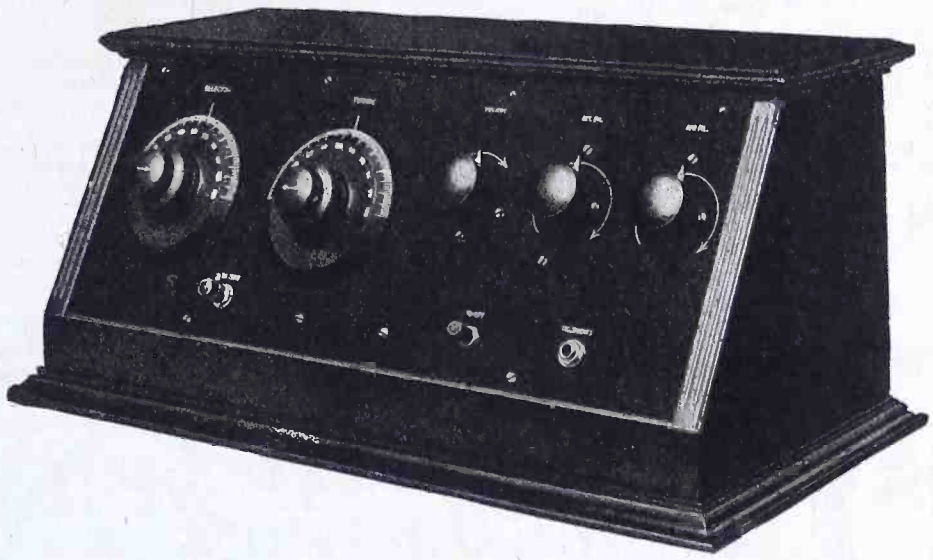
Quality Volume Selectivity

All Combined in the New Chelsea Set

A SET OF BEAUTY FOR THE HOME

It has a loud speaker range of from two to three thousand miles

It is extremely selective.
It gives enormous volume.
It reduces re-radiation to a minimum.
Its quality is unexcelled.
It is simple to operate.



Licensed under Armstrong U.S. Patent No. 1113149. Price $75.00

It has that essential pleasing appearance.
It is fully guaranteed.
It requires a small antenna, and, with such, will give results equal to or better than the average five, six or eight-tube set now on the market.

Chelsea offers a full line of parts and sets

SINGLE tube regenerative set.....$17.00
Two stage audio amplifier.....$16.00
Three tube regenerative set.....$35.00
Four tube tuned radio frequency.....$75.00

CHELSEA RADIO COMPANY

179 Spruce Street **Chelsea, Mass.**

Western Agents — FREDERIC L. TOMLINSON CO.
447 Pacific Bldg., San Francisco 1113 Wall St., Los Angeles, Cal.
116 13th Ave. North, Seattle, Wash.

AMPERITE

The "SELF-ADJUSTING" Rheostat

PERFECT for every CIRCUIT
Simplifies wiring
Eliminates hand rheostats
RADIALL COMPANY
50 Franklin St., N. Y.

$1.10

From Your Dealer

Write Dept. R-3 for Free Hook-ups

RATHBUN

SINGLE-HOLE MOUNTING

SUPERIOR CONDENSERS

LEAD *by Efficiency and Superior Values*

Plain and Vernier Types

DEALERS and JOBBERS write!

Rathbun Mfg. Co. Inc.
Jamestown, N. Y.

The Success of B-T Products

Is the Reward of Unequalled Merit

The first *Low-Loss* Tuner—
For Broadcast 200-565
For Short Wave 50-150

Consider: 1st, A development in coil winding and arrangement so effective that the full broadcast range is covered with an 11-plate B-T Condenser—Results: Louder signals, more distant stations and greater selectivity.

2nd, An adjustable untuned primary, one of those things so simple no one thought of it—but it solves the problem of varying local conditions.

3rd, An equally simple but efficient loss-proof frame.

4th, A family history beginning with the first 3-circuit coupler and including nothing but original parts—all leaders.

5th, A record of its own of being the first LOW LOSS Broadcast or **Short Wave Tuner** on the market.

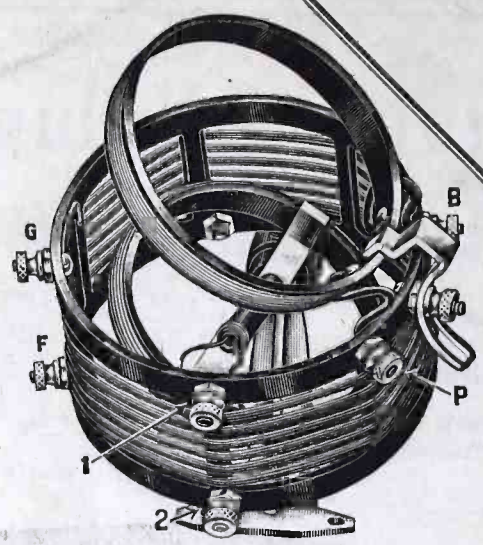
You can't beat it For Broadcast 200-565 Meters
For Short Wave 50-150 Meters

Price $5.00

P.S. If it's a 5-Tube set you want, read what George Colman, Kedvale Ave., Chicago, says:

Am getting wonderful results with the B-T "Nameless." With four Chicago stations and Elgin going full blast, I am pulling in such stations as Louisville, Philadelphia, Detroit, Cincinnati, Davenport, Pittsburgh, Iowa City, etc. Have had as many as 14 outside stations in an evening regardless of Chicago. The "Nameless" is all that's claimed for it.

Write for Descriptive Matter



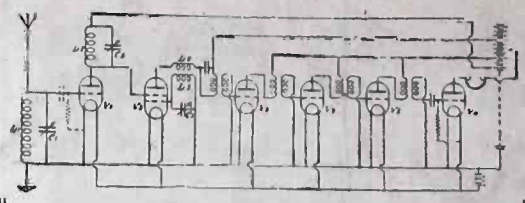
Two Types
Broadcasting 200 to 565 meters
Short Wave 50 to 150 meters

(These ranges covered with B-T 11-plate "Lifetime" Laboratory condenser.)

"Better Tuning" (now in 6th Edition) tells you why—shows you how. Complete instructions and diagrams for progressive construction from Crystal to Reflex and Radio Frequency Circuits. Sent on receipt of ten cents.

Send for information on B-T Low Loss Inductances, Condensers, Tuners, Couplers, Transformers and Oscillator Units—Successfully meet all radio circuit requirements.

BREMER-TULLY MFG. CO., 536 S. Canal St., Chicago



Greater Results than Ever!

Send for this diagram

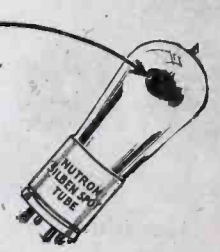
The Nutron Solodyne (double-grid) Tube acts as both oscillator and modulator in the Super-Heterodyne Circuit, thereby not only eliminating one of the tubes but obtaining greater efficiency as well. In Reflex Sets the Nutron Solodyne (double-grid) Tube can be used as both detector and amplifier (dual amplification) thereby doing away entirely with the crystal or detector tube.

The Nutron Solodyne (double grid) Tube made possible the No. "B" Battery (Solodyne) Circuit. Thousands are now enjoying this smooth reception and its rapid gain in popularity is ample proof of its unusual qualities.

Send at once for Nutron Solodyne (double-grid) Tube and diagram illustrated above or for Tube and diagram of 2-tube reflex circuit, or for Tube and No. "B" Battery hook-ups. See them for yourself. If your dealer does not yet carry these tubes, order direct from us. Always look for the Silben Spot (Pat. Pending). It is your assurance of tube perfection. Each Nutron Tube is rigidly tested and guaranteed.

Price, $6.00.

This Silben Spot Does it—



Use Silben Spot Tubes

(Pat. Pending)

After years of chemical and electrical research a startling process of tube treatment has been discovered! What appears to be an ordinary 6 volt storage battery tube actually works like a $12 power tube. It makes weak reception strong and good reception stronger.

Ordinary tubes have three measurements. The Silben Spot Tube 1 A has a fourth, known as the "rendement." The secret is in the Silben Spot (Pat. Pending). Furthermore, every Silben Spot Tube is DEPENDABLE because each one is rigidly tested before it leaves our factory. Each Silben Spot Tube gives known results. **Price, $4.00.**

Nutron Matched Tubes

SILBEN SPOT (Pat. Pending)

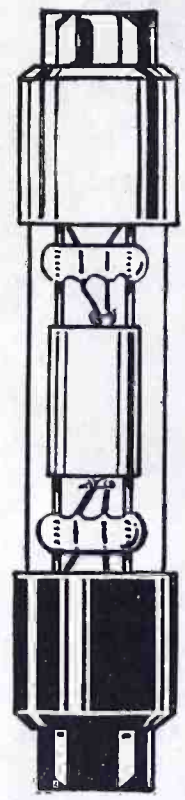
Mr. Set Manufacturer: You can now guarantee everyone of your sets working perfectly on tube operation. Our Service Department will match tubes for your particular set, pack them in cartons of three or six, as required, each tube individually marked and guaranteed correct for your set. Complete specifications for each tube will be packed in each carton. This is a service that will be welcomed by your distributors, dealers and customers. Nutron Matched Tubes—matched to your set requirements—identified and improved further with the Silben Spot (Pat. Pending)—tested and guaranteed—can be made available to your customers if you say so.

We can accommodate a few reliable set manufacturers with this service and furnish Nutron Matched Tubes in sufficient quantities to meet all their requirements. Mr. Set Manufacturer, this represents tube insurance to you. Write, wire or phone for consultation.

Note: We recommend to owners of Super-Heterodyne and reflex sets the use of Nutron Matched Tubes in conjunction with the Nutron Solodyne (double-grid) Tube—The Silben Spot (Pat. Pending) on all these tubes is your guarantee of perfect satisfaction with your set. Nutron Matched Tubes: Set of 3, $12.00; set of 6, $24.00; Nutron Solodyne (double-grid) Tube $6.00.

NUTRON
Silben Spot

Nutron Manufacturing Co.
717 Main Avenue, Passaic, New Jersey



They Roll in On Ball Bearings

The Y.M.C.A. Radio Instructor at Detroit says that with Myers Tubes "the stations roll in on ball bearings"—the long distance stations that cannot be tuned in with ordinary tubes. You can put the world on your dial with

Myers Tubes

Practically Unbreakable

Get England, France, Canada, Cuba, Hawaii, Porto Rico and Japan as others are doing with one, two or three Myers Tubes. They eliminate all noise—function perfectly as Detectors, Amplifiers and Oscillators—increase the radius of your set 50%. Two types: Dry Battery and Universal for storage batteries. (4 volts)

Demand Myers Tubes at your dealers or send price and be supplied postpaid. See "Made in Canada" on each tube. Others not guaranteed.

Complete with clips. No extra equipment required.

$4

E.B. Myers Co. Ltd.
Radio Vacuum Tubes
240 CRAIG STREET, W.
MONTREAL, CANADA

B-METAL 50

HERE IS A CRYSTAL that is worth its weight in gold to any radio owner. It is sold on the very broadest guarantee to SATISFY THE PURCHASER, and thousands of letters of grateful appreciation testify to the merits of B-METAL LOUD TALKING CRYSTALS. Get them from your dealer but remember that there is no substitute for B-METAL CRYSTALS.

B-METAL REFINING COMPANY, Detroit, Mich.

COAST RADIO SUPPLY CO., 648 Howard St., San Francisco, Cal.

Greater Distance--Less Noise

TURN-IT
ADJUSTABLE
GRID LEAK

Only $1 at Your Dealer's or Direct From Us

TURN-IT RADIO SALES, Inc.
30 Church St., N. Y.