JUNE, 1924

25 CENTS

RADIO

(Reg. U. S. Pat. Off.)

Cunningham RADIO TUBES

The Standard Tube of the World for

RADIO RECEPTION

The Radio Tube, through radio telephony and public broadcasting, has been largely instrumental in establishing the new and increased interest to humanity attuned to Radio. This tremendous progress in Radio has brought about the development of radio receiving sets resulting in clearer reception of voice and music throughout the broadcast world.

Cunningham Radio Tubes are the product of years of research and experimental work by the engineers of that great scientific organization, the Research Laboratory of the General Electric Company.

There is a Cunningham Radio Tube designed to meet the requirements of your particular set—ask your dealer.

PATENT NOTICE

Cunningham tubes are covered by patents dated 2-18-08, 2-18-12, 12-30-13, 10-23-17, 10-23-17, and others issued and pending. Licensed only for amateur, experimental and entertainment use in radio communication.
Any other use will be an infringement.

Cunningham 40-page Data Book fully explaining care and operation of Radio Tubes now available by sending 10c in stamps to San Francisco office.

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PRICES ON CUNNINGHAM RADIO TUBES

Now in Effect

C-301A—5 Volts 1-4 Ampere filament..$5.00
C-299—3 Volts.06 amp. Dry Battery Det. & Amp.....$5.00
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C-11—1.1 Volts.25 amp. Dry Battery Det. and Amp. Special Base $5.00
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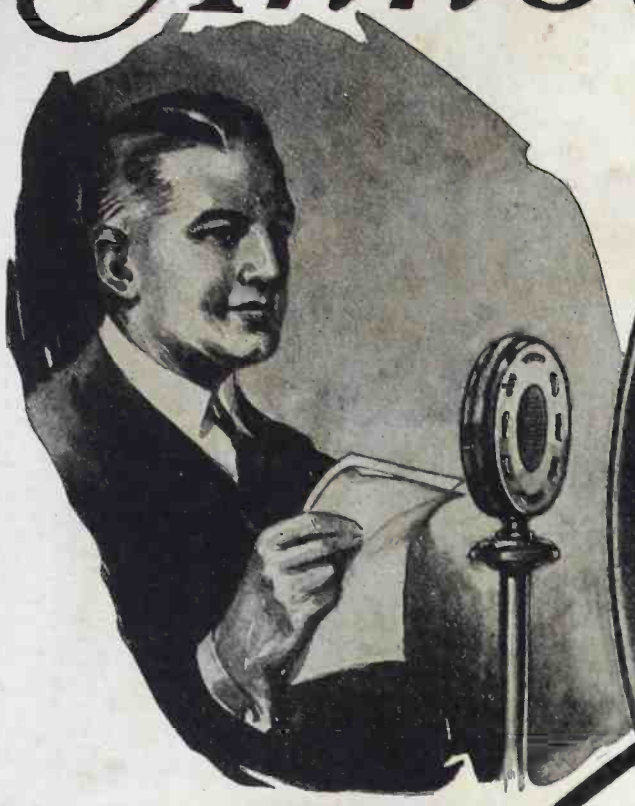
Announcing:—



A new Magnavox that will broadcast satisfaction *to the* radio world

Here's big news "on the air"

M 4

$25.00

Requires no Battery

The supreme achievement of Magnavox engineers represented in a reproducer of truly *exquisite* tone quality.

THE efficiency, the appearance and the price of this new instrument clearly reflect the research and production facilities of The Magnavox Company, largest builders of radio reproducing equipment in the world.

Its exquisite tone quality results from a further perfecting of the Magnavox semi-dynamic operating principle—magnetically balanced armature, improved diaphragm and extremely high resistance winding.

Beautifully finished in dark enamel with gold high lighting, the graceful appearance of M4 suggests its use in the most dignified surroundings.

The amazingly low price of this Magnavox Reproducer establishes an absolutely new standard of value in the radio industry.

THE MAGNAVOX CO., OAKLAND, CALIF.

New York Office: 350 West 31st Street

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6R

MAGNAVOX

The Reproducer Supreme

Tell them that you saw it in RADIO

RADIO

Established 1917 as Pacific Radio News

Volume VI *for* JUNE, 1924 *Number 6*

CONTENTS *for* JUNE, 1924

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

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

Forecast of Contributions for July Issue

Prof. C. M. Jansky, whose series of articles constitute a veritable college course in radio, will next discuss receiving aerials, the theory of detection and crystal detector circuits.

Arthur S. Garbett, the music interpreter, presents an interesting analysis and conclusion as to "What The Public Wants."

In this number will be presented the first of the prize-winning suggestions on how to improve Best's 45,000-cycle super-heterodyne. May RADIO containing Mr. Best's original article was completely sold out within a few days after it was placed on the stands. Consequently a reprint has been made and will be sent postpaid for twenty-five cents.

The reflex circuit will receive considerable attention. L. R. Felder has a good article on its theory and Paul Oard gives complete constructional details for building a three-tube reflex set.

Jerome Snyder comes to the defense of the vacuum tube detector in "Crystal vs. Vacuum Tube," exploding the myth as to the superiority of the former.

C. H. Campbell describes a simple and effective means for determining the natural period of an antenna.

The dyed-in-the-wool amateur will be greatly interested in and helped by Dr. A. E. Banks' (6ZN-6ZB) article on "Six Cylinder Magnetic Control for C. W. Transmitters."

In an article on "Construction of Power Amplifying Transformers." Paul Oard tells how three to five stages of audio-frequency amplification may be successfully accomplished.

Wallace Kelk's "Direction Finding for the Amateur" and Edward T. Jones' "Reducing transmitter Interference," announced for June, will appear in the July issue.

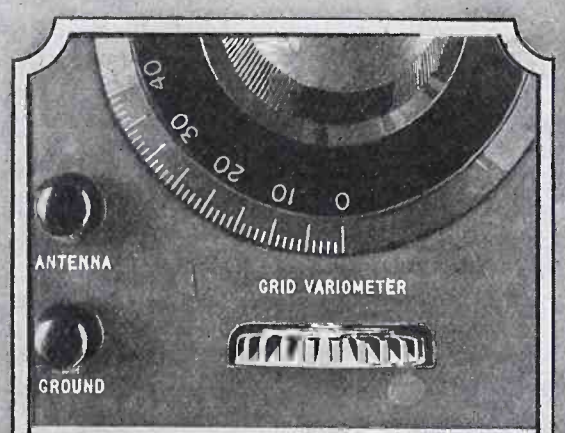
L. W. Hatry has revamped the familiar one-tube regenerative set so as to give good selectivity, loud signals, minimum radiation, full control of volume and good distance reception. His description is such that anyone can do likewise.

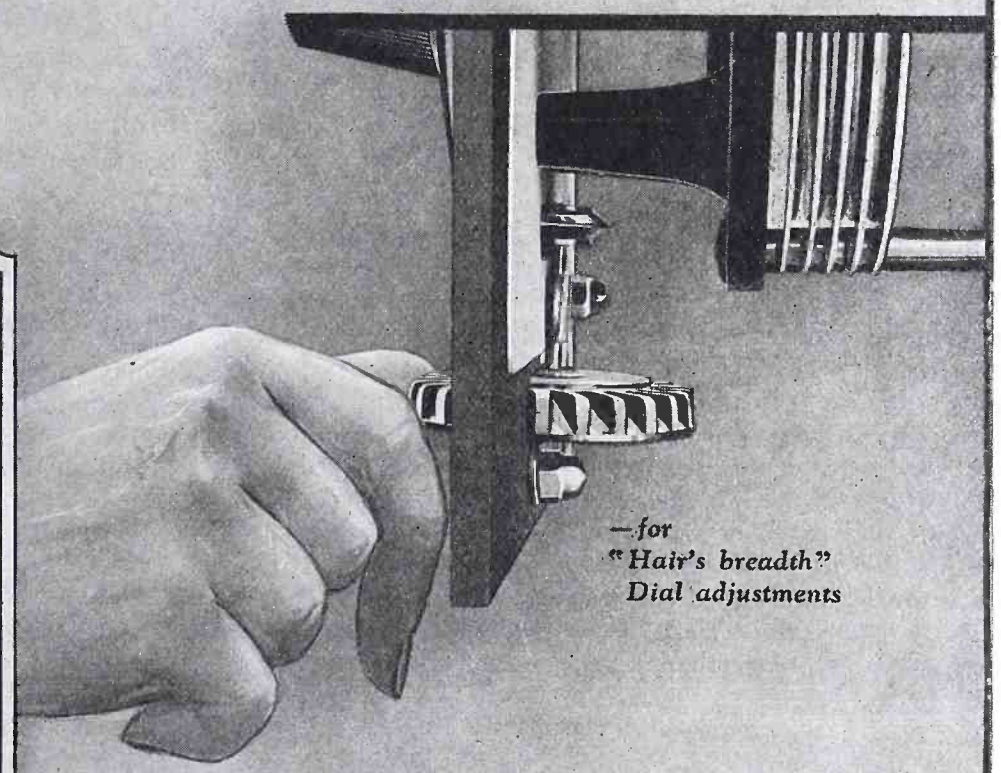
For lighter summer reading there will be a thrilling tale of radio piracy by Harry P. Bridge, Jr., another funny "Letter from A Lid" by Henry Speedwell Mosdike," and an interesting experience of a ship operator, B. W. Fordham, entitled "The Finger of God."

Walter Emmett discusses "Regeneration vs. Tuning." Thos. W. Benson tells of "Neutralization of Tuned Radio-Frequency Amplifiers," and H. T. Gallaher describes "A Selective and Efficient Tuner."

The GREBE TANGENT WHEEL VERNIER

A Device found only on GREBE Receivers





—for "Hair's breadth" Dial adjustments

"The accomplishment of great things consists in doing small things well."
—Confucius

Perfection of detail is a big factor in the success of the Grebe Receivers.

Doctor Mu

Grebe Regenerative Receivers are licensed under Armstrong U. S. Pat. No. 1,113,149

THE man who has once operated a Grebe Receiver reaches instinctively for the Tangent Wheel Verniers on every other receiver he thereafter tunes.

This and other details of Grebe craftsmanship are fully covered by patents granted and pending. Inspect these details at your dealer's today.

A. H. GREBE & CO., Inc.
Van Wyck Blvd. · Richmond Hill, N. Y.
Western Branch: 451 East 3rd Street, Los Angeles, Cal.

Approved By Over 200 Experts

New Crosley Engineering Achievement

A three tube set with five tube efficiency—the greatest selectivity with the minimum effort—positive calibration to any wave length between 200 and 600 meters. These are only a few of the many advantages offered in the remarkable new Crosley Trirdyn Radio Receiver.

It was only after a year of constant experimenting, that our engineering department perfected this exceptional receiver. Thorough tests proved to us that it would outperform any receiver ever before produced. But we were not satisfied with our own opinion. So we shipped out 200 of these sets to experts in every part of the United States. Their criticisms are one and the same—"tried out your new Trirdyn Receiver Saturday night and logged 13 stations, among them Cuba, New York and Omaha, between 9 and 10 o'clock. The set was very selective. During the time this test was on local station KSD was operating and we went through them without any difficulty or interference whatever. The range of the local station was not more than three points variation in the dial setting."

"Tried one of these sets out and obtained wonderful results. Were able to log all stations, which we heard very successfully. This set should go over big." "The set has wonderful volume and is selective"—etc.

This new Crosley triumph is called the Trirdyn because of its original combination of the three "R's"—Radio frequency amplification, Regeneration and Reflex. The first tube incorporates non-oscillating, non-radiating tuned radio frequency amplification; the second tube, a regenerative detector is reflexed back on the first tube for one stage of audio-frequency amplification. Then it has a third tube which acts as a straight audio-frequency amplifier. It uses the ultra selective aperiodic antenna circuit and external selector coil, which adds to its wonderful selectivity.

The Crosley Trirdyn in range, volume and selectivity is the equal of any five tube receiver on the market. Greater volume will, of course, be obtained through the use of storage battery tubes, but it will function well with any type and can be used with either indoor or outdoor antenna.

The opinions of many experts have convinced us that the Trirdyn is the best receiver ever offered the public regardless of price.

Practically every radio dealer can furnish you Crosley Radio Sets including not only the Trirdyn, but the Model 51, a two tube set for only $18.50; the Model V, a single tube receiver at $16.00; the Model VI at $24.00; the Super VI at $29.00; the Model X-J at $55.00 and the Super X-J at $65.00.

Prices west of the Rockies 10% higher than quoted above.

All Crosley regenerative sets are licensed under Armstrong U. S. Patent No. 1,113,149.

CROSLEY
Better-Cost Less Radio Products
See this new wonder at your dealers

Crosley builds more Radio Receiving Sets than any other manufacturer in the world.

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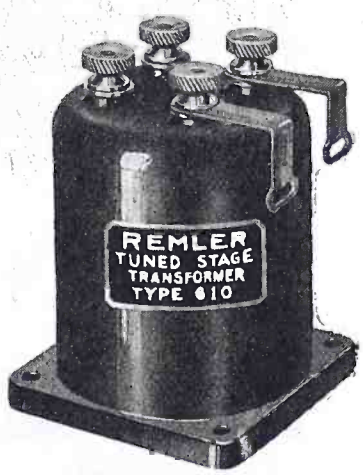
POWEL CROSLEY, Jr., President
Formerly The Precision Equipment Company and Crosley Manufacturing Company
619 ALFRED STREET CINCINNATI, OHIO

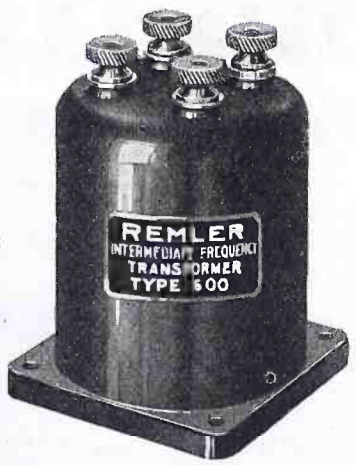
Remler

SUPER-PARTS



Remler Type 610 Tuned Stage Transformer Price $5.00

Remler Type 620 Coupling Unit Price $3.00



Remler Type 600 Intermediate Frequency Transformer Price $6.00

FOR 45,000 CYCLE WORK

Use REMLER Super-Parts Because

They are designed and built by Remler.

The Type 600 Intermediate Frequency Transformer and the Type 610 Tuned Stage Transformer work with maximum efficiency at a frequency of 45,000 cycles. Higher frequencies tend toward instability—lower frequencies may result in distortion.

The Type 620 Coupling Unit has been designed to work with maximum efficiency when used with the Remler Transformers.

Remler Super-Parts are designed to give maximum efficiency when used with the C-299 Tube.

Remler Super-Parts require no stabilizer.

Remler Super-Parts permit the use of a C Battery in the intermediate amplifier circuit, thus giving maximum output from the tubes.

Remler Super-Parts have been designed to form a complete Super-Set that is extremely simple to operate, ultra-selective and super-sensitive.

Write for descriptive literature on the construction and use of these famous Remler Super-Parts.

Remler Radio Mfg. Co., 182 Second St., San Francisco, Calif.

Gentlemen:—

My dealer is unable to supply me with your new Remler Super-Parts. I wish to place my order with you for the following:

3 Type 600 I F Transformers	$18.00
1 Type 610 T S Transformer	5.00
1 Type 620 Coupling Unit	3.00
8 Type 399 Sockets	6.00
Total	$32.00

Enclosed find certified check or money order for Thirty-Two ($32.00) Dollars.

Mail me, free of charge, Bulletin No. 60 describing the use of these super-parts.

Name .....

Address .....

Send us name of your Nearest Radio Dealer

Remler Radio Manufacturing Co.

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Chicago

Home Office
182 Second Street
San Francisco

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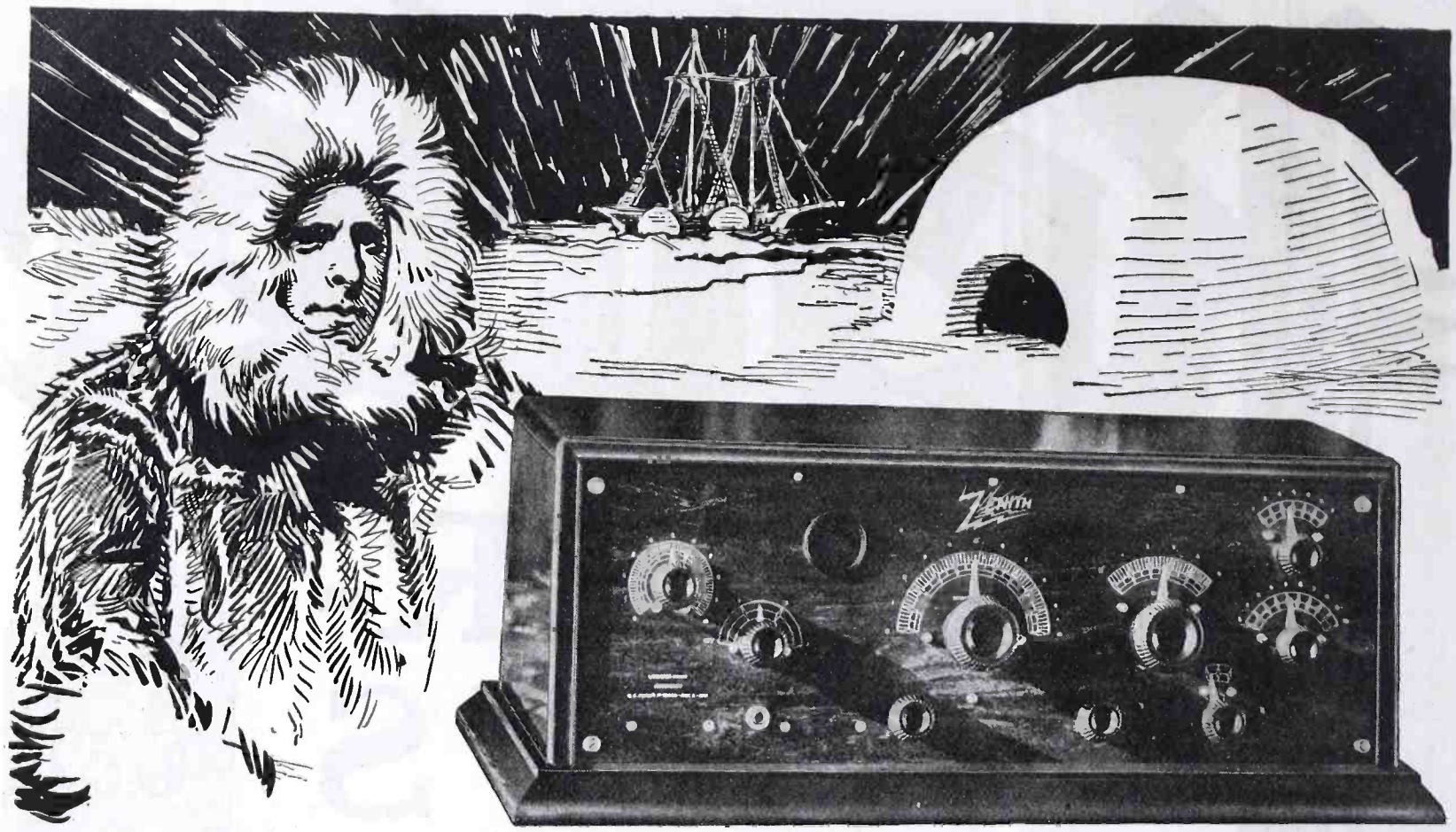
Tell them that you saw it in RADIO



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MacMillan Listens to Honolulu and New Zealand "Tunes In" California

Using ZENITH TRADE MARK Long-Distance Radio

From a little ice-bound schooner—eleven degrees from the North Pole—comes this message:

"Am very thankful that Arctic Exploring Ship Bowdoin is equipped with complete Zenith radio apparatus. Here at top of world, in darkness of great Arctic night, we have already listened to stations practically all over United States, from Europe, and even from far away Honolulu. Zenith has united the ends of the earth."

—"MacMillan"

Again, from far-off New Zealand comes a report of radio reception even more startling:

"It may interest you to know that the writer last evening landed KGO, Oakland, California, between 6:45 and 7:30 P. M. Heard his call four or five times distinctly, and jazz music. The music was not as clear as the voice, but one could pick up the tune all right. As San Francisco is ***6,300 miles from New Plymouth,*** and only one tube was used, we think this is a very fair performance."

—(signed) H. Charles Collier.

The sets used by Captain MacMillan and Mr. Collier are earlier models—since improved by the addition of ***a third stage of audio frequency.*** These new models, described at the right, represent an achievement in radio construction not duplicated in any other set on the market. A demonstration will convince you.

Write today for full particulars and name of nearest dealer.

Zenith Radio Corporation

McCORMICK BUILDING, CHICAGO

Model 3R The new Zenith 3R "Long-Distance" Receiver-Amplifier combines a specially designed distortionless three-stage amplifier with the new and different Zenith three-circuit regenerative tuner.

Fine vernier adjustments — in connection with the unique Zenith aperiodic or non-resonant "selector" primary circuit — make possible extreme selectivity.

The new Zenith 3R has broken all records, even those set by its famous predecessors of the Zenith line. Under favorable conditions, satisfactory reception over distances of 2,000 to 3,000 miles, and over, is often accomplished in full volume, using ***any ordinary loud-speaker.*** The Model 3R is compact, graceful in line, and built in a highly finished mahogany cabinet..... $160

Model 4R The new Zenith 4R "Long-Distance" Receiver-Amplifier comprises a complete three-circuit regenerative receiver of the feed-back type. It employs the new Zenith regenerative circuit in combination with an ***audion detector*** and ***three-stage*** audio-frequency amplifier, all in one cabinet.

Because of the unique Zenith "selector," unusual selectivity is accomplished without complication of adjustment.

The Zenith 4R may be connected directly to any loud-speaker ***without*** the use of other amplification for full phonograph volume, and reception may be accomplished over distances of more than 2,000 miles..... $85

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Gentlemen:
Please send me illustrated literature on Zenith Radio.

Name.....

Address.....

BASEBALL SCORES BY RADIO

SAY THE RADIO BUGS

BASEBALL fans the country over will be counting on Radio this year more than ever before. Most Radio fans are baseball fans. Every one of them should see that his new set of Kellogg radio parts is ready in time for the baseball scores.

Get the Sport records and scores quickest by Radio—build your set of Kellogg radio parts for dependability and economy.

There is a certainity of satisfaction with Kellogg as shown by records of this equipment in use. Kellogg transformers rank among the best. To hear them in operation is to want them. Kellogg tube sockets give the utmost of service, while Kellogg switch arms and knobs are in a class by themselves for quick assembly, low resistance and satisfying operation.

Kellogg variable and fixed condensers, variometers and vario-couplers are all designed and built to give the satisfaction which the word Kellogg expresses in the electrical apparatus field. Kellogg rheostats have but one movable part. They come in six and twenty-five ohm resistances, easily interchangeable. They are simple, yet vary in control on the half turn of the resistance element. Kellogg DX head sets are known wherever radio is in the air. They are built mechanically and electrically for long service, sensitiveness, extreme lightness in wearing, and handling does not affect their tuning. They have Kellogg solid bakelite shells and are furnished with the Kellogg famous receiver cords of which many hundreds of thousands are in use to day in the telephone field. Kellogg radio parts are especially suitable in portable sets because of their strength and high class manufacture. They will stand rough handling as will no other radio equipment and yet have the range and afford the selectivity, in the limits of the circuits used, surpassed by none.

If you don't want to bother to pick out the parts for your favorite hookup buy one of our Radio Kits which include all the necessary and suitable parts including two stages of audio amplification; you can select the tuning units, as you desire.

This summer as never before radio will be heard in every summer resort and camp. See that your set is made of Kellogg radio parts.

Specify Kellogg Radio—

Use—Is the Test

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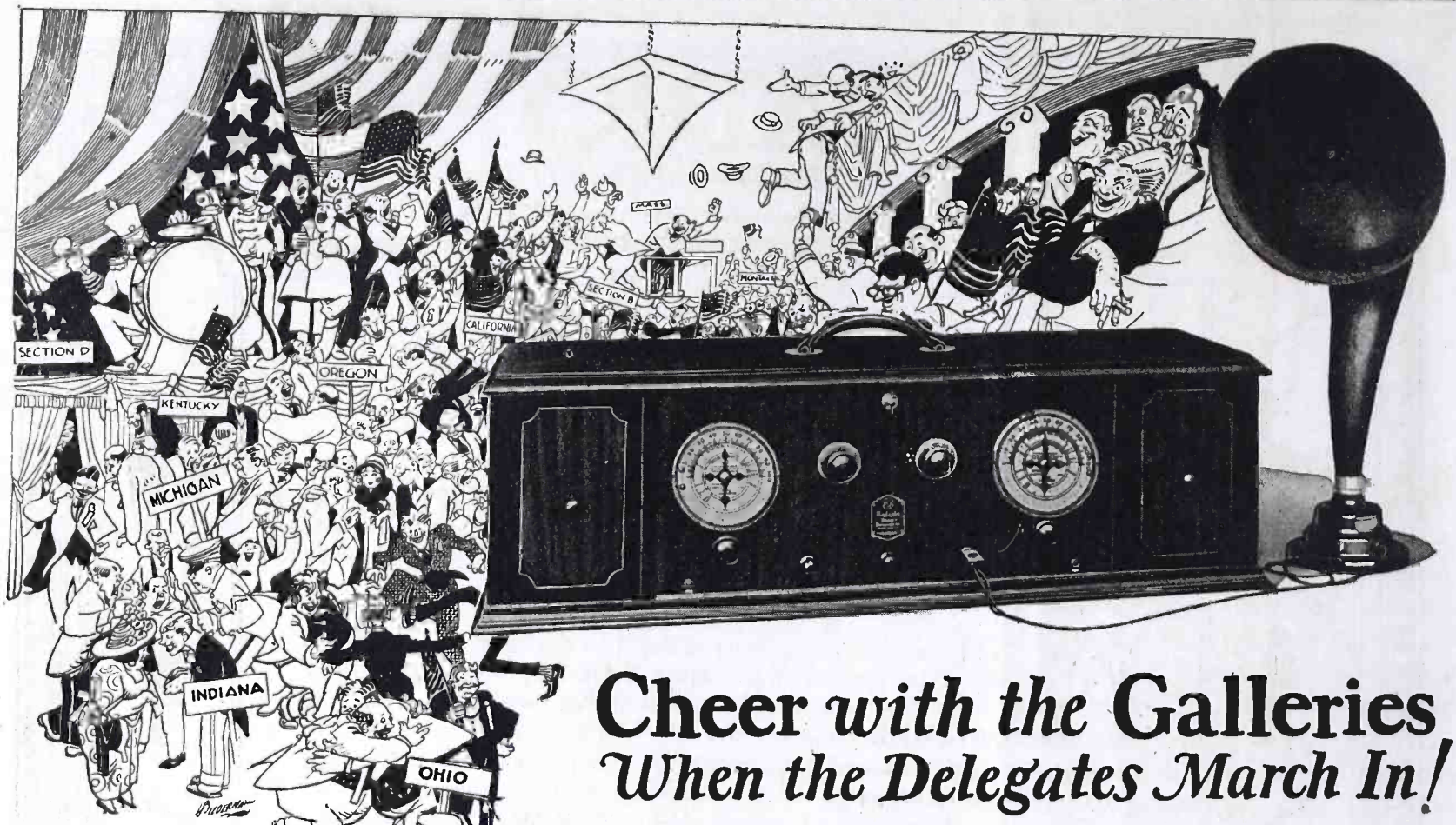
1066 West Adams St , CHICAGO, ILL.



Cheer *with the* Galleries
When the Delegates March In!

No "influence" needed this year for a gallery seat at the big political conventions! Get it all with a Radiola Super-Heterodyne.

When the delegates march in—their banners streaming; when the bands play and the galleries cheer—be there with the "Super-Het." Hear the pros and cons as they fight their way to a "platform" for you. Hear the speeches for the "favorite sons." The sudden stillness when the voice of a great speaker rings out. The stamp and whistle and shrill of competitive cheering. Hear the actual nomination of a president.

It used to be all for the delegates' wives and the "big" folks of politics. Now it's for everybody. Listen in. Get it all! With the *newest* Radiola.

"There's a **Radiola** *for every purse"*

This symbol of quality is your protection

Radiola Super-Heterodyne

is the great Radiola for the big events of summer broadcasting. Listen in, at your office to the conventions and the ball games. Take it everywhere.

It needs NO ANTENNA—no ground—no connections of any kind. Has a handle to lift it by. Tunes in with just two knobs that you turn to marked spots on the dials. Tunes out powerful near stations to get the far ones. A wonderful new achievement in the perfection of its tone—its sensitivity—and its supreme selectivity.

Complete with six Radiotrons UV-199 and Radiola Loudspeaker; everything except batteries . . $286

External, rotating loop, easily assembled, larger than self contained loop in Radiola Super-Heterodyne, for extreme reception range. Loop AG. 814 . $12.00

Operates On Dry Batteries

Watch the radio columns of your newspaper for the big convention broadcast schedules.

There are many Radiolas at many prices. Send for free booklet that describes them all.

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Dept. 56 (Address office nearest you.)
Gentlemen: Please send me your free Radio Booklet.

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Radiola

REG. U. S. PAT. OFF.

June
1924

RADIO
Established 1917
Trademark Registered U. S. Patent Office

Volume 6
No. 6

Radiotorial Comment

WORDS are inadequate to express the general dissatisfaction with the narrow viewpoint of those who proposed and acquiesced in the order requiring all amateurs to be silent from 7:00 to 10:30 p.m., local standard time, during the "daylight saving" period. Statistics are not available to show what proportion of the country is under daylight saving, but it is a safe bet that the amateurs in ninety-five per cent of the nation's area are being penalized so as to prevent code interference with broadcast reception in the other five per cent. To take an hour away from this great majority is so manifestly unjust and ill-considered that letters of protest should be sent to the radio supervisors in each district where there is little or no observance of daylight saving. By this means it may be possible to make the order applicable only to those areas where interference might be experienced.

THE desire of every musician is to have more people interested in music. This comes from no selfish motive but is inspired by the generous impulse that all people may derive the same inspiration and joy from music as do the musicians. It is generally realized that, as chief among the fine arts, music should be increasingly established and recognized as an important national asset. Musicians have longed for and welcomed anything that would popularize music.

Radio is doing this more than any medium yet devised. It is taking music to the masses. In the three short years since broadcasting was started, more new music lovers have been made than in the generation preceding.

Heretofore, radio, like a wild flower, has grown without cultivation by the great majority of musicians. Some few have even regarded it as a weed and tried to eradicate it. But radio is too hardy and too useful a plant thus to be eliminated. Nothing else in history has ever taken such a rapid and firm hold on the public favor. Literally and figuratively, radio has the public ear. Whereas the public eye, surfeited with books, papers and moving pictures, is nearly saturated in its ability to transmit thought to man's inner consciousness, the ear offers quick and easy access to the mind, especially so with radio where the sound comes to the listener instead of the listener's going to the sound.

Few people have yet sensed the ultimate value of radio. Direct evidence of this is given by recent misdirected efforts to distort the meaning of the copyright law so as to require payment for the broadcasting of copyrighted music. But this month the United States Circuit Court in New York ruled that the rendition of a selection by radio is not a "public performance for profit" and consequently dismissed a suit brought on this account.

Already the church, the school and other far-seeing institutions have recognized the value of radio as a medium for universal education and it is to be hoped that the musicians will do likewise.

THE closed season for long distance radio reception is now on. So do not be disappointed if that superlative new receiver does not bring in the stations a thousand miles away every night in the week, or if that superfine old set does not perform as valiantly as of yore. When winter comes, your DX records will pick up again.

Why this is so, no one has yet definitely and conclusively proven. It may be that the summer foliage absorbs more of the radiations. It may be that the longer daylight hours of summer more completely ionize the atmosphere and thus block the radiations, as is apparently the cause for better night than daytime reception in winter as well as in summer. It may be that the summer heat has some similar effect. It may be any or all of these causes. But, irrespective of what the theory may be, the fact remains that the carrier wave from a transmitting station attenuates or dies away more quickly during the summer than the winter months.

Although it is thus the closed season for DX fishing, it is the open season for local reception. The summer of 1924 is to be the greatest radio summer since broadcasting was started. More powerful transmitting stations and more sensitive receivers have been developed so that there is no portion of the country which is not served by at least one good station.

The programs show an even greater improvement, so that the listener often suffers a distinct loss if some of them are missed. Many will have an opportunity to hear the broadcast proceedings of the great political conventions at New York and Cleveland during June and thus be in direct contact with history in the making. These will be followed by the election campaigns, where radio will play an epoch-making part.

Another factor of comparatively recent development is the portable set that can be carried during a vacation trip. Many people that heretofore have left their radio at home because of its unwieldiness and weight can now have an added enjoyment at their temporary summer quarters. Radio gives an even added pleasure in the great outdoors.

Music on the Brain

By Arthur S. Garbett

Carrying forward from the last issue his definition of music as a gateway to the mind, the author now treats of its effects in stimulating thought, imagination and emotion. In July he will analyze what kinds of music the public wants. As this series represents a radical departure in editorial policy, the editor will appreciate a statement of the reader's reaction. Do you want more of it?

LAST month, for the benefit of the listener-in entering the world of music for the first time by way of the loud speaker, we considered music in terms of radio. We found that music consists of two kinds of motion: sound-waves, or vibratory motions of the air, and time-divisions, rhythmic-pulse or "beat." Furthermore, by regarding the soloist or orchestra as the "transmitter" and the listener-in as the "receiver," we found that the latter is equipped with two distinct circuits or hook-ups appropriate to these two forms of motion; his ears take in the sounds (melodies, chords), and his motor-faculties or rhythmic-sense, which is spread over his whole body, take in the rhythmic-beats. In short, there are two musical gateways to the brain—ears and motor-faculties.

Either of these gateways, like radio-receivers, can be tuned to a fine degree of receptiveness, so that, with a little practice, a high degree of musical discrimination can be gained by them alone: the ear can readily be taught to discriminate between sounds, so that we soon leave the pretty tinkles of the jazz-band for something better. Our motor-faculties, which respond eagerly at first to the strong pulse of ragtime and the rigidity of the tom-tom beat on which jazz is founded, soon yearn for something less rigid and more flexible, the sort of rhythm that speeds up or slows down gracefully and is known to us girls in the Friday Music Club as *tempo rubato*. (Pronounce to rhyme with tomato, as in England, please, not potato.)

But these gateways are only—gateways. They lead to the brain. What goes on in the brain when the music gets there?

The human brain is two things: a clearing-house and a storehouse. As a clearing-house it is responsible for our conscious acts; as a storehouse it is responsible for our sub-conscious dreams, memories and desires—a bewildering jumble involving such functions as memory, imagination, emotions, reasoning power, and so forth, the sum total of which, varying infinitely in the individual, give us each our own identity, personality—call it "soul" if you like.

The brain is also, in terms of electricity, a "central": the headquarters of a complicated wiring-system called nerves supplied with current from the infinite number of cells we call our body. So long as these cells work together as a complete organism we live; when the organization disintegrates, we die. As the biologists say, a human being, whatever else he is, is an electro-chemical transformer of energy.

Electro-responsive nerves, a brain which is both clearing- house and store-house—a Man. All right. Let's go.

Music is one of the most powerful brain-stimulants known. It does more than affect our brain through the nerve-system. Some years ago, the British war office, wishing to cut down expenses, experimented to see if it could eliminate regimental bands. It was found that under the stimulus of music troops could march at a steady three-and-a-half miles an hour over a long period, and arrive less tired than without music. Without music, they dropped to three miles an hour and were sooner fagged out. Bands remained.

Music, in fact, because of its rhythmic impulse, mechanically affects the heart action, either speeding it up slightly or retarding it, much as drugs do, but without the evil after-effects. By its rhythm alone it can rouse us or soothe us. Its action, however, is a little uncertain, owing to incalculable emotional responses. "Music is the language of the emotions." David played before Saul, and Saul was soothed. David played once too often and Saul threw a javelin at him!

Anyway, the blood flowing through the arteries reaches the brain, stimulating it, feeding it, eliminating the poisons, and producing an astonishing effect known to psychologists as the "Free Association of Ideas." David's music reached some hidden spring in the recesses of Saul's subconscious, made him think of something that possibly had nothing whatever to do with David or his harp, and—lost his temper.

There is another way of approach to this subject more directly interesting to radio enthusiasts. These nerves of ours, whether electric or not, behave exactly as if they were. Whenever they are highly charged, or "over-loaded," there is just what you'd expect: inductance. A leaping across from one set of nerves to another.

The most common form this inductance of the brain takes is to affect the optic nerve, so that the listener-in, under the stimulus of music, sees "mental-pictures." It is quite common. Psychological investigators have proven their existence by experiment on students over and over again. The optic-nerve is thus affected because we use our eyes far more than any other of our five sense-organs, and it is therefore unusually responsive.

Sounds also can be conjured up in the brain, a faculty known as "tonal imagery." By this means, Beethoven, one of the world's greatest composers, was able to write better music after he went deaf in early middle age than he did before. And wonder of wonders! He gave the world not only new rhythms, new "forms" of music, but new sounds as well—new and untried chord-combinations, new combinations of orchestral instruments of incredible loveliness. And this gigantic genius died during a thunderstorm, shaking his fists, lamenting that he must leave the earth just as he was "beginning" to enter new worlds of tonal beauty! Few listeners-in, however, have the gift of "tonal imagery," though it is easily developed; nor have they need of it unless they aspire to be composers.

But mental "pictures" of forms and colors we almost all have, and they are a tremendous boon to us because they consist fundamentally of things we have seen, read about, or experienced in some way. If listening-in to radio music meant no more than tapping our buried-treasures of memory, that alone would be a tremendous thing.

But along with that is another gift. Memory is closely allied to Imagination. Out of our experiences, out of the things we have seen, we can construct things that nobody has seen—strange images of things unknown. Thus the Greeks, having seen a man and a horse, could "imagine" a centaur which was both. Thus Dante, having read his Virgil and "imagined" the regions of Pluto as the older poet described them (he in turn inspired by the Homeric legends) could "imagine" into existence, a vivid, extraordinarily detailed vision of Purgatory. Thus any painter or sculptor projects his inspiration. First the "visual image" dimly perceived in the mind; then the concrete poem, painting or sculptuary.

Memory, Imagination, Invention—how closely allied they are! And music, reaching the brain through nerves and arteries, setting up powerful inductances in the subconscious, awakening memories of past experiences and imaginative

dreams, is their most powerful stimulant. Many great inventors have been music lovers. Herschel, the astronomer, was a violinist, and gave music lessons for a living at the start. Einstein is a profound music-lover — and knows the technique of it. Oliver Lodge never misses a Birmingham symphony concert (or didn't when the writer attended them). Edison likes music. Do you know that Marconi himself is a pianist? The writer first studied radio under a man who was with Marconi when the latter was experimenting on a little yawl in the English Channel. Marconi had a piano aboard the tiny vessel and played it at all hours. Perhaps it so stimulated his imagination that to that piano we owe radio itself!

Any radio enthusiast listening-in, more than half indifferent to the music he hears, may yet be so stimulated by it that he invents a new hook-up and "gets" a bigger distance than ever!

Music not only stimulates memory, imagination, invention, and indeed all our mental faculties, but also the emotions attendant. It arouses through the association of ideas poignant emotions not connected with the music itself. The musical stimulus, acting upon the nerves, heart and brain, stirs up powerful "memory-pictures" bringing up past events in our lives, and a resurgence of appropriate emotional feelings. Music is the key to these cherished memory-associations which lie dormant in the subconscious—useless—unless some powerful stimulus such as music brings them forth and we "live again."

What with phonographs, radio, and music from other greatly increased sources, we live in a musical age, and our lives, the lives of our children, are going to be immeasurably the richer for it. About the songs we hear now will cluster memories, destined to be roused again in years to come when those songs are reheard. These memories and emotional experiences of today will return powerfully, vividly, but mellowed by time and intervening experiences.

In closing, the writer ventures on prophecy. In a little while, when "the tumult and the shouting dies," and we care less for radio equipment than for what radio brings, we shall cherish it for music's sake—for the powerful reinvigoration of song and dance in their action upon heart, nerves and brain; and for the restoration of past experiences through the rousing of incredibly sweet memories and emotions. Thus we may expect, through radio-music, a generation more mentally and physically alert, more emotionally responsive, capable of making a "better world."

COPYRIGHTED MUSIC

Holding that the present copyright statute does not cover the broadcasting by radio of copyrighted music, Judge Smith Hickenlooper, in the United States District Court, dismissed a suit filed by Jerome H. Remick & Company, Inc., New York City, publishers, against The Crosley Radio Corporation, in which the plaintiffs attempted to compel the Crosley Corporation to pay a special tax for permission to play copyrighted music. The high point in the opinion handed down by Judge Hickenlooper is the holding that the broadcasting of a rendition of a copyrighted musical composition is not a "public performance for profit" within the meaning of the music copyright law, for the reason that to constitute a public performance in the sense Congress intended the words it is essential that there be an assemblage of persons congregated at the place of amusement for the purpose of hearing that which transpires there.

All this talk about the harmful effects of tube capacity in high-frequency circuits suggested the idea that said capacity might be made useful as a grid condenser. Merely use the grid and plate terminals of a burned-out tube in place of a grid condenser. It works.

A portable radio set brings the world to the summer camp.

Radio in the Automobile

By Paul Oard

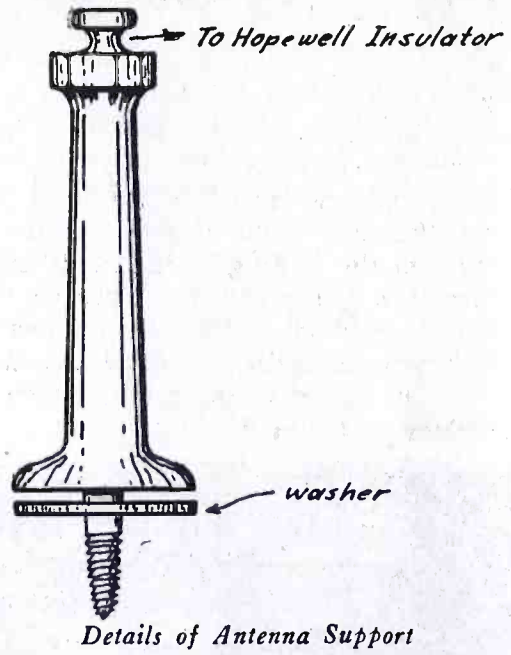
The writer tells how a single-circuit receiver may be made a permanent part of an automobile without in any way detracting from the appearance of the machine. Suggestions are given for receiver construction if one is not otherwise available.

THE belief that a comparatively large and clumsy antenna supported from masts which must be attached to the car, and a radio receiving instrument of complicated design and operation are necessary has done much toward preventing the enjoyment that may be derived from the proper application of radio to the automobile. As a matter of fact, neither is necessary for comparatively long distance reception of broadcast programs. The standard single-circuit receiver may be applied to automobile reception, making use of very limited antenna, with results that will prove astonishing to those who have not before experimented with this form of reception.

Using a standard form of single-circuit receiver, and with an antenna made up of a single cable placed in the top of the car, the writer has during the night hours worked broadcasting stations up to 500 miles with very satisfactory results, with the car in motion. With the car stopped, distances up to 800 miles have been attained without difficulty, and with very satisfactory results from a reception standpoint. No counterpoise connection need be made to the frame of the car, as is popularly supposed, and this factor permits reception with the car in motion. As a great many cars have the ignition system grounded to the frame, the firing of the spark plugs are reproduced in the headset, ofttimes with sufficient strength to paralyze the detector tube, if the receiver is connected to the frame, while without this connection no difficulty is experienced from the motor while it is running. Therefore, the fact that the single-circuit receiver functions efficiently without ground or counterpoise connections lends itself to the purpose admirably.

The first need is a suitable antenna. Standard antenna cable, usually of seven strands of phosphor bronze, is best suited for the purpose, as it is flexible, and may at the same time be kept taut. Enough cable is used to completely encircle the top of the car once, being supported by "door stops" 2½ in. long and provided with a wood screw at one end. The opposite end is provided with a small soft rubber cap, which may be removed. This end has a groove to hold the cap, and this groove is utilized to hold the antenna. These door stops may be obtained in either brass or nickel finish as desired. The nickel finish, in combination with tinned antenna wire, makes a neat combination.

If the car is an enclosed one, four points are carefully spotted in the corner posts of the car, and a small hole drilled into each one to receive the screw of the antenna support. If the car is an open one, the bows of the top are utilized. It is advisable to insert a thin washer of the same diameter as the base of the stop, between the base and the top fabric, so that, in being screwed down, the turning of the base will not catch and rip the fabric.



Details of Antenna Support

Four Hopewell insulators, a strip of bakelite or fibre 3 in. long by ½ in. wide with a hole large enough to receive the antenna cable in each end, and two springs, about 3 in. long, and ¾-in. diameter make up the balance of the antenna equipment. The insulators are wired directly to the front supports and to the springs, which are in turn wired to the back supports. The cable is then fastened to the insulators, being stretched taut, and the two ends fastened to the fibre strip, in the center of the front of the car. The springs tend to take care of any flexing of the top of the car. If the job has been done with care, the installation will not detract from the appearance of the finest car.

If the operator has a single-circuit receiver, he is ready for reception. All that remains is to attach a short length of flexible cable with two spring clips on the ends to allow of ready connection. If one does not possess dry cell tubes, it is better that a separate storage battery be carried rather than to attempt to use the one in the car, as the same annoyance will result from the firing of the ignition system as if a counterpoise ground is used.

Local stations should be selected at first. It will be found that the instrument will tune exceedingly sharp on the small antenna, and also that capacity effects from the hands will be more noticeable than usual. The operator should bear one caution in mind—while operating the receiver with the car in motion, and with the headset strapped over the ears, outside sounds are cut off to a great extent, and this should be taken into consideration when working in traffic or on crowded roads. If the instrument is a two-stage one, a loudspeaker may be installed in the car, this being particularly adaptable to the enclosed models.

So far, the writer has specified the use of standard equipment for the reason that the majority already possess such. There are, however, many who will want to construct special receivers for the express purpose of application to the automobile, and a few hints are given here with this in view.

The vario-coupler primary is made up on a cardboard tube 3½ in. in diameter by 2¾ in. long. Starting the winding ½ in. from the end, the tube is wound to the opposite end with No. 30 S.C.C. The first tap, starting from the end which is not wound, is taken off at 40 turns. The balance of the winding is tapped off at approximately 20 turns

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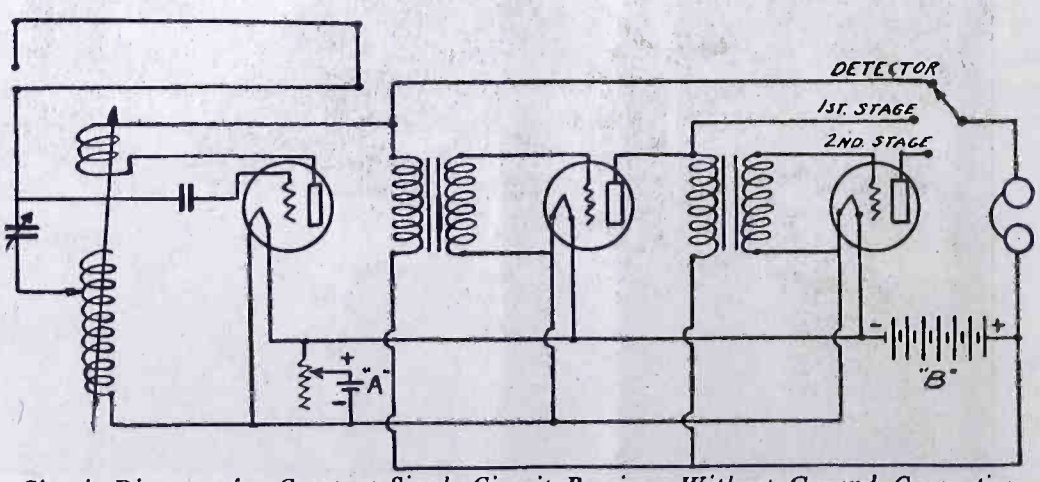

Circuit Diagram for Compact Single-Circuit Receiver Without Ground Connection

Transmission and Types of Radio Waves

By C. M. Jansky, Jr.

This, the second of the series of Prof. Jansky's Lectures on Radio Communication, explains the physical meaning of wavelength and its dependence upon the circuit characteristics of the transmitter. Damped and undamped waves are discussed and the meaning of side bands made clear. The article is concluded with an explanation of the assignment of wavelengths to Class B stations.

RADIO communication is carried on by the aid of electromagnetic waves ranging in wavelength from 100 to 24,000 meters which are generated by frequencies ranging from 3,000,000 to 12,500 cycles per second. These waves are identical in character with the waves which produce the sensation of light except that they are much longer. They are generally produced by connecting a source of high-frequency current to an antenna from which they are radiated.

An open antenna or aerial is a system of elevated wires suspended above the earth, or a similar series of wires called a counterpoise. For the purposes of analysis, an aerial, with its counterpoise or ground, may be considered as a condenser with its plates far apart. The aerial also has some inductance and some resistance.

If we connect in series with an antenna a device for producing high-frequency alternating currents we will have high-frequency currents running in and out of the antenna as they would in and out of the plates of a condenser. These high-frequency currents in the down leads of the antenna produce electromagnetic or radio waves which travel out in all directions with a definite velocity of 186,000 miles, or 300,000,000 meters, per second.

As these waves are produced by the high-frequency currents there is a definite relationship between the frequency of the current in the antenna and the wavelength of the electromagnetic wave. We may find this as follows. Suppose a stick of wood loaded with lead on one end is dropped into a pool of water. The stick will rise and sink in the pool with a definite period in seconds T and a definite frequency per second f. The oscillating stick will send out water waves in all directions as shown by Fig. 21.

The distance between crests or between troughs in a wave motion is called one wavelength and is usually indicated by the Greek letter λ. The time it takes the stick to sink in the pond and rise again to its maximum height is the time of one period T. During this time the previous crest will have travelled out a distance λ as shown by Fig. 21. As distance is equal to the product of velocity and time, the wavelength λ equals the velocity v of the wave multiplied by the period T. In algebra $\lambda = v\,T$.

Since the frequency of the oscillations of the stick is the reciprocal of the period of the oscillations

$$\text{wavelength} = \frac{\text{velocity of the wave}}{\text{frequency produced by the generating device}}$$

$$\text{or } \lambda = \frac{v}{f}$$

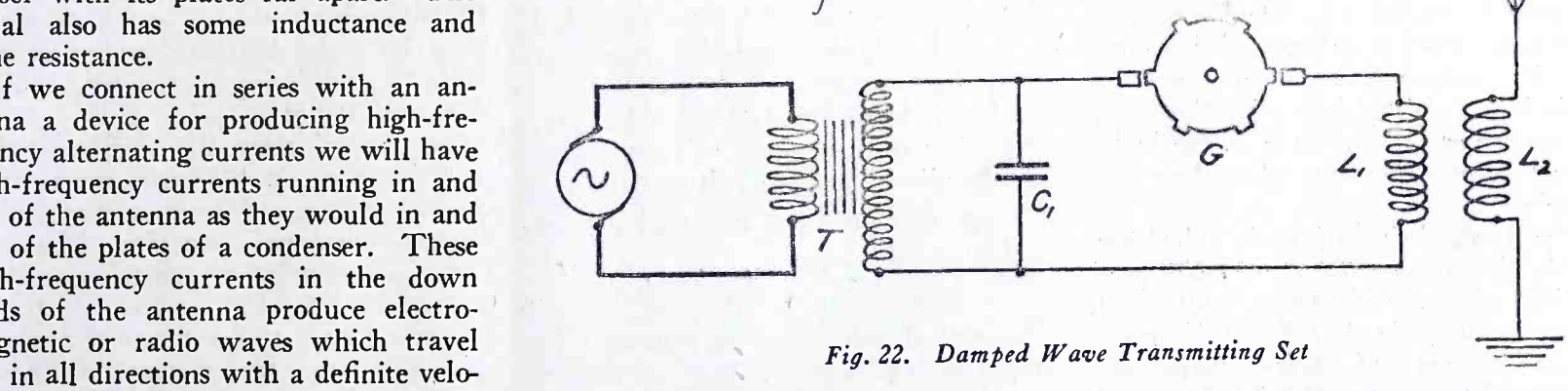

Fig. 21. Water Wave Produced by Moving Stick

As $v = 300{,}000{,}000$ for electromagnetic waves, $\lambda = 300{,}000{,}000 /$ frequency of electric current producing wave.

We have seen that a circuit containing resistance, inductance and capacitance in series is resonant to a frequency $f = \frac{1}{2\pi\sqrt{L\,C}}$ if the inductance L is in henries and the capacitance C is in farads.

By substituting the value of f when L is in microhenries and C in microfarads in the equation for λ we get $\lambda = 1.884\sqrt{L\,C}$, thus expressing the wavelength in terms of the inductance and the capacitance. Furthermore, wavelength equals 300,000,000 divided by cycles per second and frequency (cycles per second) equals 300,000,000 divided by wavelength in meters.

Types of Radio Waves

LET us briefly consider the type of wave received from two separate types of radio transmitters, damped wave or spark radio telegraph transmitters and radio telephone transmitters. Fig. 22 shows the circuit for a damped wave spark transmitter. The transformer T delivers a charge to the condenser C at high voltage. This condenser is periodically discharged through the inductance L_1 as the rotating points of the gap G pass close to the stationary

Fig. 22. Damped Wave Transmitting Set

electrodes. Such a discharge of a condenser through an inductance is oscillatory and at a frequency approximately equal to $f = \frac{1}{2\pi\sqrt{L_1\,C_1}}$. The secondary high-frequency circuit composed of the aerial and L_2 is tuned to resonance with the frequency generated by the primary circuit and consequently we have the secondary high-frequency current passing in and out of the aerial. As this current is produced by the periodic oscillatory discharge of a condenser through an inductance, a graph of it will look like Fig. 23. The frequency determined by the L and C of the primary circuit is called the radio-frequency. The frequency determined by the speed of rotation of the gap is called the group frequency. The radio-frequency may be 1,000,000 cycles per second. The audio-frequency will probably be about 1000 cycles per second.

Signals as they are received from a radio telephone set are entirely different in character from those received from a spark damped wave telegraph transmitter. The circuits used in radio telephone transmitting sets will be discussed in a

later article after we have discussed the theory and operation of the three electrode electron or vacuum tube in various circuits. An understanding of the nature of the wave radiated from a radio telephone station is essential, however, if we are to understand the principles entering into the detection of these waves by crystal and vacuum tube detectors.

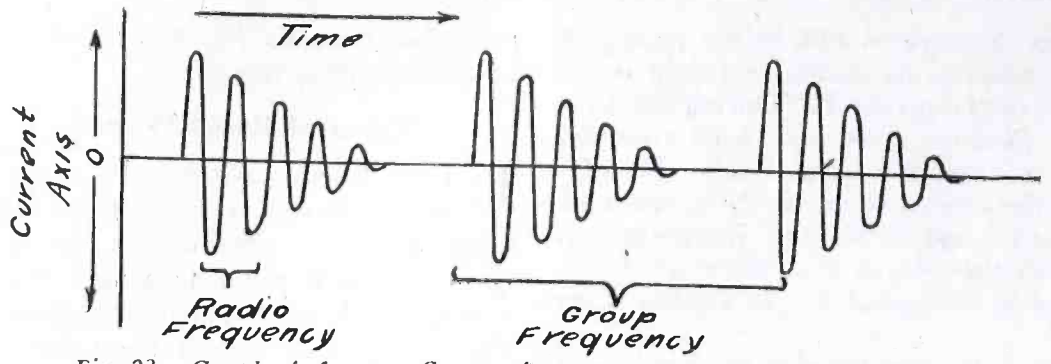

Fig. 23. Graph of Antenna Current from Damped Wave Transmitting Set

Speech may be considered as composed of sound waves produced by vibrating sources which generate frequencies ranging from 200 to 2000 cycles per second. Music may contain waves from sources whose frequency varies from 20 to 10,000 cycles per second. When speech or music is carried over telephone wires electrically, electric currents of these frequencies are present. When speech or music is transmitted by radio telephony, the variations in amplitude of the high-frequency source correspond to these frequencies.

The transmission of radio telephone speech, therefore, requires (1) the production of radio-frequency energy of constant amplitude, (2) the variation of the amplitude of this energy to correspond to the modulations of the human voice, (3) the radiation of this modulated energy from a radio telephone station in the form of electromagnetic waves. The process of varying the amplitude of the current from a radio-frequency generator to correspond to the modulations of the human voice is called modulation. This process requires that the energy of the human voice be converted from sound waves to electric currents, which currents are amplified until they are of sufficient magnitude for the purpose.

The output current from a radio telephone station when no modulation is taking place plotted as a function of time would look like (a) of Fig. 24. The output, after being modulated by *one* frequency out of the possible number between 20 and 10,000, would look like (b) of Fig. 24. The frequency of the radio current of (a) is of the order of 1,000,000 cycles per second. The frequency of the modulating component as shown by the dotted lines of (b) Fig. 24, might be, for instance, 1000 cycles per second. The radio or carrier frequency, as it may therefore be called, is approximately 1000 times higher than the modulating frequency. In actual practice the character of the modulating frequency is much more complex, as it may contain any or all frequencies between 20 and 10,000 cycles per second. For the purpose of analysis, therefore, we often graph the current curve for a single modulating frequency.

Let us analyze the graph shown in Fig. 24. The radio-frequency, 1,000,000 cycles, corresponds to a 300-meter wave. The frequency shown in (b) is the same except for a modulating frequency 1000 cycles. For the benefit of those who have had trigonometry we will express (a) by the equation $i = R \sin 2\pi f_R t$, in which i is the antenna current, R is the amplitude factor, f_R is the radio-frequency and t is time expressed in seconds. The modulating frequency we will express as $A \sin 2\pi f_A t$.

The mathematical expression for (b), which is a radio-frequency f_R modulated by an audio-frequency f_A, is

$$i = (R + A \sin 2\pi f_A t)(\sin 2\pi f_R t)$$
$$= R \sin 2\pi f_R t + A \sin 2\pi f_A t \sin 2\pi f_R t$$

The second term may be expanded by trigonometry and we have the final equation:

$$i = R \sin 2\pi f_R t \quad (1)$$
$$- \frac{A}{2} \cos 2\pi (f_R + f_A) t \quad (2)$$
$$+ \frac{A}{2} \cos 2\pi (f_R - f_A) t \quad (3)$$

This equation expresses the following important factor: *A high or radio-frequency modulated by a lower audio-frequency results in an antenna current which consists of three components:* (1) *A carrier frequency* f_R, (2) *A frequency higher than the carrier equal to* $(f_R + f_A)$, (3) *A frequency lower than the carrier equal to* $(f_R - f)$.

Those who have studied trigonometry will have no trouble in understanding the truth of the above statement. Those who have not will have to assume its correctness, as I know of no other method of proving it. This derivation is concrete evidence of the value of mathematics as an aid to the study of radio circuits and the principle of radio communication.

The sounds of the human voice and musical instruments are largely produced by frequencies which range from 20 to 10,000 cycles per second. In actual practice all frequencies between these limits are present in the microphone circuit of a broadcasting station. The radio wave, therefore, is composed not of a carrier and two side frequencies, but of a carrier and two *side bands*. The upper side band extending from 20 cycles above the carrier to 10,000 cycles above, the lower band extending from 20 cycles below the carrier to 10,000 cycles below. Practically, a transmitting station operated with modulating frequencies as high as 10,000 cycles occupies a frequency band which extends 10,000 cycles below the carrier and 10,000 cycles above. The width of the band in cycles is, therefore, twice the highest modulating frequency, or, in this case, 20,000 cycles.

Let us calculate the width of this band in meters at 1,000,000 cycles, that is 300 meters. Using the formula already developed, we find that the upper side band will extend to a frequency of 1,010,000 cycles, which the formula shows to be a wavelength of 297 meters. The lower side band extends to 99,000 cycles or 303 meters. *The band occupied by a radio phone station whose modulating frequency extends as high as* 10,000 *cycles is, therefore,* 20,000 *cycles wide, which is* 6 *meters wide at* 300 *meters.*

If we assume the same station operating at 3000 meters or 100,000 cycles, the upper band extends up to 110,000 cycles or 2700 meters approximately and the lower band extends down to 90,000 cycles or approximately 3300 meters. At 3000 meters the band is still 20,000 cycles wide, but the width in meters is 600. *The width of band occupied by a radio telephone station in the ether measured in cycles per second is always the same, but the width in meters depends upon the wavelength of the carrier.*

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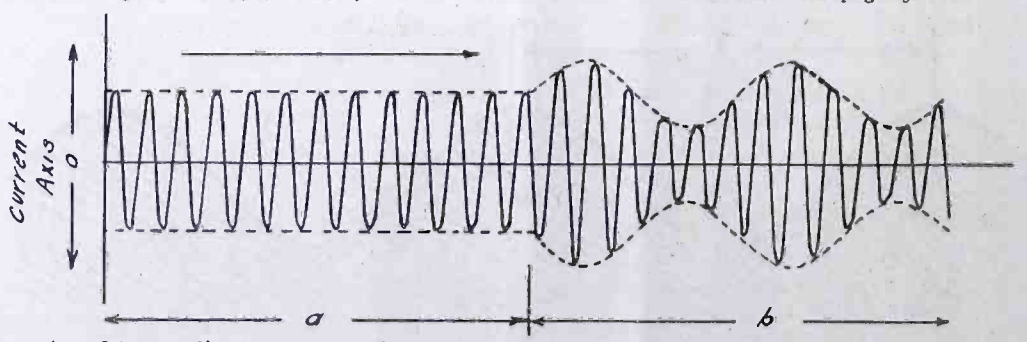

Fig. 24. Radio-Frequency Current Modulated by a Low Frequency Sine Wave

Mechanical High Frequency Generators

By Samuel G. McMeen

For the experimenter here are some interesting suggestions which have a practical application. These simple devices give small scale results closely approximating those secured from the most elaborate machines.

FOR the amateur who likes to explore all the odd corners of his art, the mechanical production of various frequencies has something to commend it. The three generators here described are of the mechanical type. That first treated has something in common with the generators developed by Alexanderson and used in trans-Atlantic radio telegraphy.

To make such a device, select a toothed cutter or saw with a goodly supply of teeth; the more teeth the better. The saw is to be mounted so as to be driven at different high speeds by means of a conical and a cylindrical pulley. As noted in Fig. 1, the conical

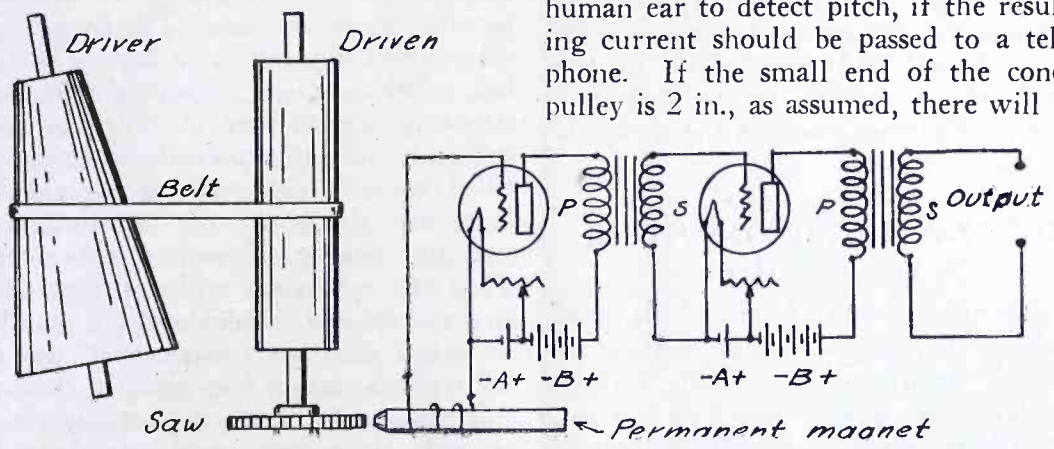

Fig. 1. Variable Frequency Generator with Vacuum Tube Amplification

pulley is the driving and the cylindrical pulley is the driven element. The driving pulley may be on the extension of a motor shaft, or may be mounted between bearings and driven by a further belt, not shown, from a pulley on the motor shaft.

In either case, the position of the belt between the two long pulleys will govern the ratio of speed-increase. If the belt be shifted to the large end of the coned pulley and the diameter there is 6 in., and if the diameter of the cylindrical pulley is 2 in., the ratio of speeds will be three to one. Thus, if the coned pulley is driven directly by the motor, and the latter has a speed of 1800 per minute, the cylindrical pulley and the saw will run at 5400 per minute. This is not an excessive speed, being within safe limits for small saws.

Mounted with one end close to the saw is a permanent magnet about 5 in. long, having a coil wound on one end as in the earliest type of telephone receiver. The end of the magnet presented to the saw shall be made wedge-shaped, so as to be about the width of one tooth of the saw. This coil may well have many turns of fine wire. Its purpose is to be the portion of the circuit in which the high-frequency currents are generated.

The separation between the permanent bar magnet and the saw should be as small as clearance will permit. It is simple to provide a screw-actuated method of controlling this separation. In our own arrangement of the device we have used a plan identical with the sliderest on a precision lathe, in which sidewise motion and fore-and-aft motion both are possible, making the adjustment very simple.

With this set-up, and with the belt at the large end of the coned pulley, and with a saw having 400 teeth, the teeth will pass the end of the permanent magnet at the rate of 36,000 per second. This is well above the power of the human ear to detect pitch, if the resulting current should be passed to a telephone. If the small end of the coned pulley is 2 in., as assumed, there will be 12,000 cycles per second in the output of the little coil, which would give an audible, though high, pitch if passed to a telephone receiver.

In this way both the audible and inaudible ranges are made accessible, and in the latter range there is the ability to cause the energy to radiate if desired.

But naturally the total amount of current issuing from the coil on the permanent magnet is exceedingly little. Its order of minuteness is almost comparable to the amount of energy that reaches one's antenna from a distant transmitting station. But, happily, this minute high-frequency current lends itself to amplification in just the same way as the receiving set amplifies what the antenna listens for.

The amplification arrangement is shown in Fig. 1, wherein the leads from the coil pass to the grid and filament respectively of the first tube, and wherein also the arrangement of tubes with relation to each other is the same as in any one-step amplifier with a detector. The results will be good whether the first tube be a detector or an amplifier, as amplification comes about in both cases.

For the sake of making the drawing clearer, the two batteries are shown separately for the two tubes, but in practice only one *A* and one *B* battery would be used. Let us say also that the use of more than two tubes is entirely permissible if larger output is wished. There is no problem of preventing distortion, as the machine is dealing with but one frequency at a time.

For many purposes a high-frequency pulsating current will do as well as a true alternating current. In such a case, the output of the last tube may be taken for use direct from the plate of that tube. If a true alternating current is desired, then one follows the drawing and draws the output from the secondary winding of the last audio-frequency transformer.

Operated within the audible range, the arrangement coupled to a loud speaker is a noise-making machine of the first order, and compares favorably with a steam siren. By starting the motor from rest with the tubes and loud speaker connected, a tone of increasing pitch and volume results. If, at the time of such a test, the belt is at the large end of the coned pulley, the pitch will go on out of the audible range, perhaps passing through a short period of hissing and then reaching silence.

With 400 teeth in the saw one has a range of from 12,000 to 36,000 cycles per second in the output, corresponding to wavelengths of from 25,000 down to 8,333. Naturally these wavelengths will radiate, being of the usual proportions used in long wave working. But there is an interesting field of research in the smaller frequencies, for, as Mr. Champreaux has said, "The long waves *do* radiate," and it is with rather long waves one has to deal when the frequencies get down into the realm of audition.

For radio telegraphic use, the arrangement may have the key inserted in the lead from the magnet coil to the grid, breaking the input at that point. For radio telephonic use, the magnet may be provided with an auxiliary absorption coil of one or two turns wound directly adjacent to the alternating winding, and having across the terminals of the auxiliary winding a microphone. A varying part of the output of the main coil will thus be absorbed while speech is going on, and the result will be a varied output at the end of the string of amplifying tubes. The relation of the two coils and the magnet is shown in Fig. 4.

By making the rotational speed proper, any desired frequency below the

maximum can be had from the device just described, but a simpler form may be desired, in which case the arrangement shown in Fig. 2 can be made. It

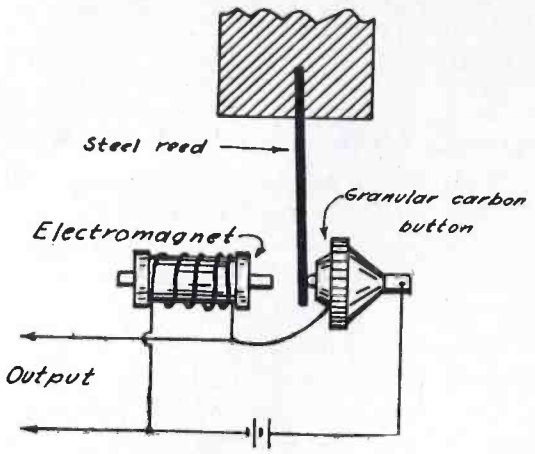

Fig. 2. Voice-Frequency Generator, 800 to 1000 Cycles per Second

has no rotating parts, its only moving part being a flat strip of steel acting as a reed. This reed bears against a granular carbon button of the type used in a microphone, and agitates the contents. The carbon button is connected in series with a battery and an electromagnet with a soft iron core. Thus the action is continuous as long as the connections remain as described and the source of current holds out. By taking a tap

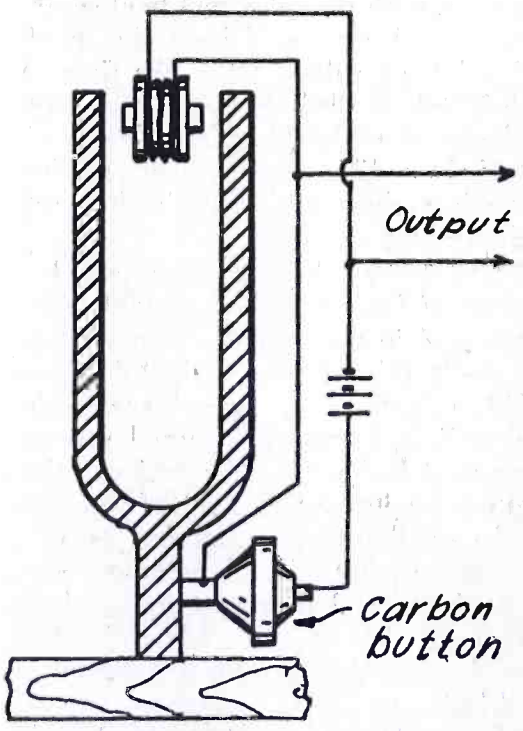

Fig. 3. Tuning Fork Generator

from each side of the electromagnet winding, pulsating current can be had of the pitch of the reed, and this may be made alternating by passing it through an audio-frequency transformer.

Such a device will not produce currents above the limit of human hearing, but is useful for investigations in the realm of human speech and music. For the former the frequency should be in the neighborhood of 800 cycles per second. Any desired frequency may be made with the device by changing reeds and testing them against tuning forks of known pitches. Minor adjustments of pitch are made by moving the reed in its block so as to change its free length.

The output of this simple generator has a usefulness as a substitute for a buzzer tone in modulating radio telegraph sending. Its tone is pure and often there is an advantage in that quality.

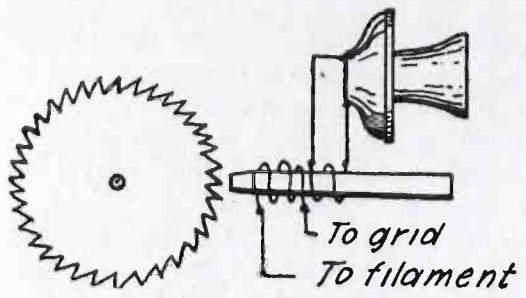

Fig. 4. Radiophone Transmission from a Mechanical Generator

The third type of generator is that shown in Fig. 3. Here the moving element is an actual tuning fork, of fixed pitch, and the driving coil is placed between the limbs of the fork near the end. The microphone button is attached to the base of the fork, where it will get the influence of the vibration but will not load either limb of the fork and so destroy its natural frequency. In other respects the device is like that of Fig. 2.

SUPPLYING THE OBVIOUS

By DR. A. E. BANKS

Although the text of most of the technical and semi-technical contributions on radio is definite and explicit, certain omissions or ambiguities do occur, especially in the accompanying diagrams. Many of these omissions are intentional as they are unnecessary to anyone able to read the article intelligently.

For instance when the neutrodyne was introduced Roy K. Freeman offered an alternative for Hazeltine's "neutrodons" in a coil which performed inductively the functions of Hazeltine's neutralizing capacity. Mr. Freeman was interviewed by the press and his circuit published. The "telephones" were not shown in the circuit and the postman labored under the burden of a never ending stream of queries as to where the telephones should go. Now is it not obvious that one would hestitate to put the phones in the filament circuit or in the grid circuit, in the antenna, or in the ground? Where could they go but one place? The diagram submitted was a basic one, descriptive of a circuit and Mr. Freeman took it for granted that the headset would be introduced into the *B* battery circuit.

In looking over the circuits published in RADIO many details which are obvious are found to be omitted in circuit reproduction. Grid condensers are shown and no values assigned. A grid leak appears yet it is not stated what value is used. Of course occasionally an incorrection is printed through the author inadvertently submitting an incorrect diagram or some other reason. In cases like this, magazines, as a rule, correct the circuit in the next issue.

The writer offered an article recently in these columns on a high capacity non-puncturing condenser for use with C. W. There have been letters from all parts of this continent, some enthusing, some complaining of scabs and other detritus on the aluminum pans, but most of them stating that the plates which the pans constituted would not "form," and that the condenser was useless, asking for further information. Of these letters received ninety per cent of them were not accompanied by return postage (which no doubt was an oversight).

Now in the case of this condenser, water was one of the important ingredients. Pure water exists theoretically only. The nearest thing we have to it is distilled water. The impurities contained in any local water supply contribute to inefficiency in chemical rectifiers or condensers. The ingredient water, means water, not impure water but relatively pure. Therefore in constructing a condenser of this type one should be sure that uncontaminated distilled water is used, just as one should determine the purity of the aluminum and the quality of sodium phosphate. That the condenser will function may be demonstrated. Incidentally it may be remarked that the condenser in use at the writer's station was recently cleaned and reassembled and was working satisfactorily three days later notwithstanding the fact that but a limited amount of time could be devoted to the "forming" process.

An article in February *Q. S. T.*, describes Low Loss Tuners for Amateurs. In checking up the diagrams Mr. Kruse slipped up on the amount of inductance contained in the 1BGF tuner. Practically all other details necessary for duplicating the set were contained. The information was forthcoming in the next issue, yet no doubt the postman was once more taxed as to this detail.

Approximately twelve months ago a noted B. C. L. approached the writer with a troubled countenance and abject mien. It appeared that a circuit had been published in RADIO showing a wonderful receiving apparatus and that he had proceeded with construction of the same. In fact he had it well under way, when a frightful omission was discovered in the circuit offered the reader. There was no *A* battery or rheostat for filament control. All that could be seen was a filament with two loose ends. One of them happened to be connected to the ground, the other was flying loose with no electrical function so far as Mr. B. C. L. was concerned. Now in order to make this gentleman happy it was necessary to ex-

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A Few Tips On Handling Panels

By Brainard Foote

These directions, written with special reference to Radion hard rubber panels, are especially complete in detail. They are illustrated from photographs taken by the author.

SINCE that comparatively ancient day when we used to wind our tuning coils on oatmeal boxes and make crystal detectors out of safety pins, the construction of a radio receiver has resolved itself into two distinct "steps"—whatever be the type of equipment we buy. First there is the selection of the circuit and the parts to go into it. Then comes an equally important operation—that of assembling and mounting these parts together.

We all strive to buy what we believe to be the very best of apparatus for the set we intend building because we know that the best of results are obtained from the best of units. The second part of our work must be carefully performed in order that there may be no erroneous connections, no jumbled-up assembly and no leakage to offset the good possibilities of the parts we have purchased.

There are two general methods by which the radio set may be assembled. In the first place should be mentioned "board" mounting. If this scheme is followed, the parts are fastened to a table or convenient wooden base in some simple fashion, and the connecting parts wired according to the printed diagram we are following. While easy of assembly, and successful in results where there is no electrical contact with the wood and where the parts carrying current are at least two inches away from the actual woodwork, the board mounted scheme has two serious drawbacks: First from the standpoint of results is the fact that the parts are continually exposed to dust and dampness. Dust gets between the condenser plates and forms leakage paths between binding posts on transformers or variometers.

The other objection to board assembly lies in the poor appearance of the completed "job"—and the "bread-board" receiver seldom finds warm welcome in the living-room or parlor alongside the piano and victrola. A real set always uses some sort of a panel upon which the tuning instruments are supported, and this panel has four important functions:

1. It must not conduct radio frequency or direct current in the slightest degree. In other words—NO leakage.

2. It must not absorb any moisture, or dust and dirt will be carried into the panel, dissolved in water, and leakage started in that way.

3. It must have a very low dielectric constant, so that there will be no current lost by capacitive conduction between adjacent binding posts, etc., between which the dielectric constant of the insulation material might cause a high capacity.

4. The phase angle difference must be low, or radio frequency loss will take place in a form known as "dielectric absorption."

Then, in addition to these essentials of electrical quality, the panel must have a beautiful appearance. The manufacturers of Radion have recognized all of these factors in its development from the older forms of hard rubber formerly considered standard "best" for electrical insulation. And since a lustrous, smooth surface prevents condensation of moisture because of the absence of convenient "pockets" for water to settle in, it is highly polished both front and rear.

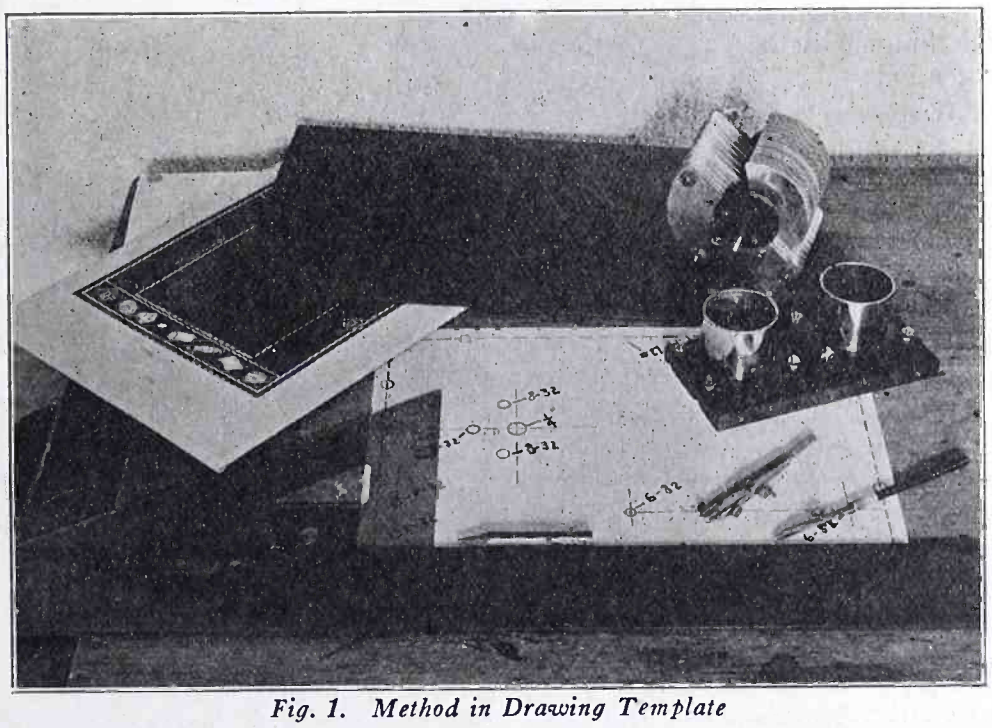

Fig. 1. Method in Drawing Template

The constructional data from which we work usually specifies a certain size of panel, and it is best to buy a stock size, since this insures a clean-cut edge. Most panel manufacturers supply a good many sizes—18 in the case of Radion. There are four stages in our work of assembling the radio receiver, and these, together with the tools needed in most cases, are as follows:

1. Laying out the mounting holes on a sheet of paper the same size as the panel. For this, we require:

- Drawing-board.
- T-square.
- Right-angled Triangle.
- Compass.
- Ruler.
- Pencil.

2. Marking and drilling the panel. Useful tools are:

- Small wheel brace.
- Center punch.
- Hammer.
- No. 1 drill for clearance of 3/16-in. shafts.
- 5/16-in. drill for clearance of ¼-in. shafts.
- No. 27 twist drill 6-32 screws.
- No. 18 twist drill for 8-32 screws.
- Small (10c) clamp for holding paper to panel.

3. Countersinking holes so that all screws appearing on the front of the panel are flush with the surface. We need:

- Countersink as used by carpenters with about 6 "flutes."
- Regular auger brace to hold countersink.

4. Assembly and mounting tools are:

- Side-cutting pliers or "Flats" and "Cutters."
- Small file.
- Large screwdriver.
- Small screwdriver.
- Knife.

Some of the tools suggested may not be necessary in case we decide to build a set for which the manufacturer furnishes a drilled panel or where the instructions include a marked sheet of paper or "template" for marking the panel directly. In most cases, however, the layout of the parts will be decided by the builder, because the physical proportions of various makes of the same apparatus differ so widely.

The template or "temporary plate," is a sheet of paper or pasteboard the exact size of the panel, upon which the positions of the various holes are to be penciled. It is like the plan from which the house is built, in this case the plan being full-size. Fig. 1 gives an idea of the method adopted in drawing the template. The sheet is thumb-tacked to the

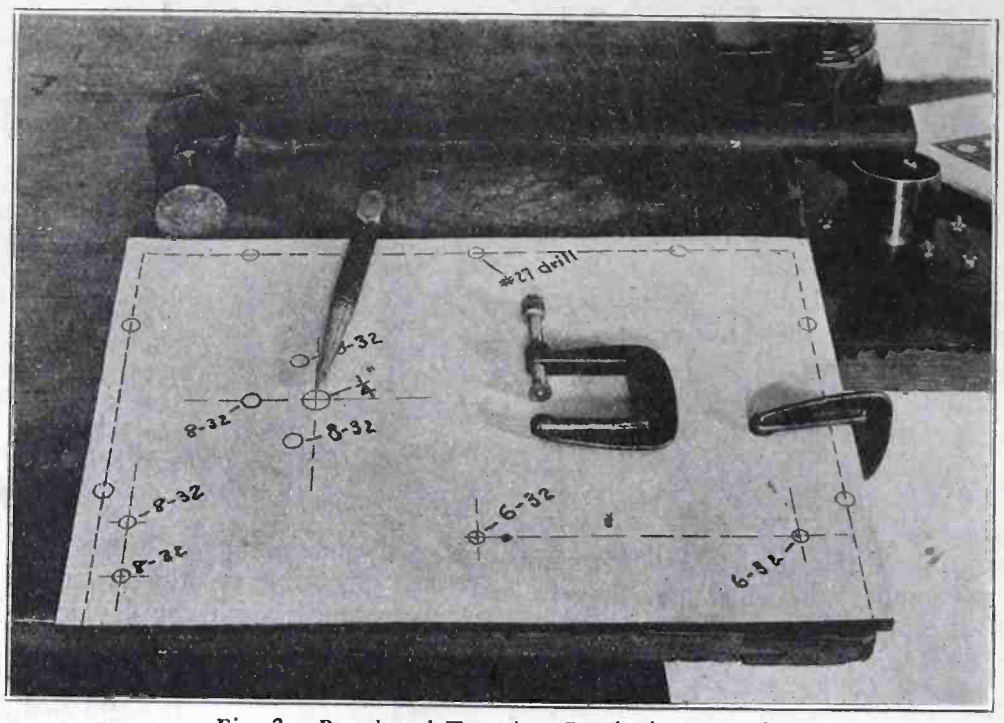

Fig. 2. Panel and Template Ready for Punching

drawing-board and the instruments which are to go into the outfit arranged on the paper in the order in which they are to be mounted. Several things must be kept in mind:

1. Arrange the front of the set in a symmetrical and pleasing manner.

2. Allow plenty of space between dials and endeavor to have the dials hide the mounting screws.

3. Figure on the space the unit will occupy behind the panel so that there will be about two inches clearance between each unit and its neighbor.

4. Allow clearance around the edge of the panel for the thickness of the cabinet walls, bottom and top, and allow holes for fastening the panel to the cabinet.

Very often instruments like rheostats and variable condensers come with a small template already marked for the positions of the mounting screws, and it is then only necessary to decide upon the placing of the shaft before this may be called into service to mark the template. The compass should be used to indicate the locations for the various screw-holes, and the size of screw or size of drill should be marked alongside each one. Radio apparatus employs 6-32 and 8-32 screws for the most part. A 6-32 machine screw is a No. 6 screw having 32 threads per in., while an 8-32 screw is a No. 8 screw with 32 threads per inch also. The No. 6 screw requires a No. 27 twist drill for clearance, and the No. 8 screw needs a No. 18 drill for clearance. These drills fit the small wheel brace—or, in a pinch, the regular carpenter's auger brace will do.

After carefully checking over the placing of the parts and noting whether there is plenty of room between them all in behind the panel and room enough for the insertion of the tubes, we are ready to "center-punch" the panel. The little clamp is used to hold the template securely to the panel front. Hold the punch straight up at each center point of the drilling circles, being careful to get the punch mark well into the panel and at the right point. Scan the template closely after you have finished to be sure that you haven't left out any of the centers.

Now comes the drilling job. Put the No. 27 drill in first and lay the panel upon a board to protect the table. Be sure there are no nails or splinters projecting to damage the surface. Hold the wheel brace vertically and look at it from two points to be sure you have it vertical. Then drill through slowly—do not try to "spin" the drill, as you may break it or make a rough opening at the other side. Radion is so easy to drill and to cut that no mechanical skill is necessary.

Then insert the No. 18 drill and make holes for the No. 8 screws. Get the instruments ready and

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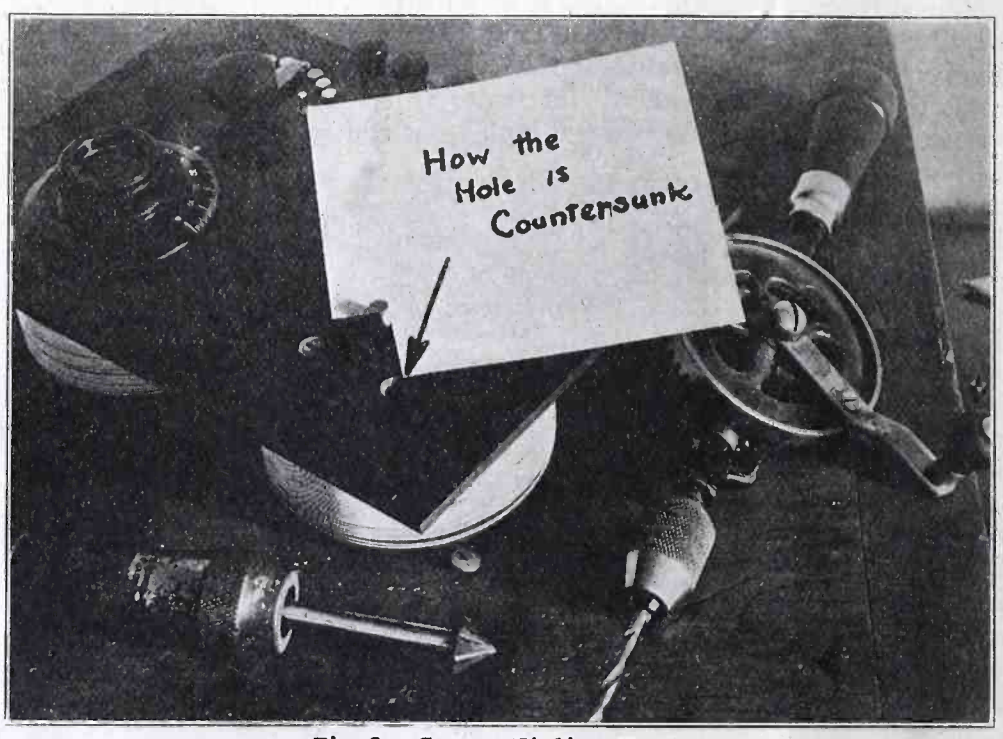

Fig. 3. Counter-Sinking Holes

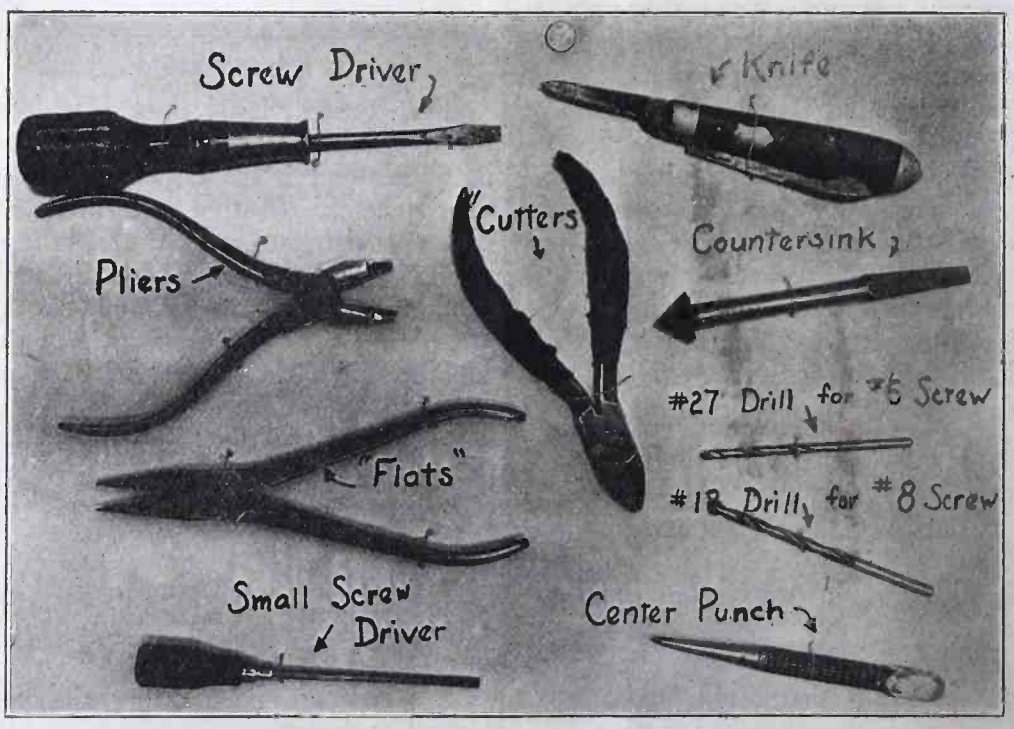

Fig. 4. Tools Needed for Panel Drilling

A Cheap and Efficient Dry Cell Tube Receiving Set

By H. A. Fischer

This is an unusually selective and economical one-tube set for receiving broadcast programs. It employs spiderweb coils which may be easily wound by the maker.

THE need for an easily controlled receiver which will cover all broadcasting wavelengths with a minimum number of controls at low cost is met by using a standard circuit with spiderweb coils. The approximate list of material needed for the set is as follows:

1 6-in. x 15-in. panel.
1 9-in. deep cabinet.
2 23-plate var. cond's.
½ lb. No. 24 SCC wire.
16 in. No. 8 round brass rod.
2 knobs and pointers.
2 3-in. dials.
1 rheostat with knob.
1 socket.
1 grid leak condenser.
1 phone condenser.
6 binding posts.
Bus-bar, nuts, washers, bolts, etc.
Tube and battery.

The forms for winding the coils are cut from stiff cardboard, 4 in. in diameter, into which are cut nine slots equally spaced and 1⅛ in. deep. This leaves enough space in the center to place the mounting and also for the binding posts; see Fig. 2. Into the slots is wound, zig-zagging, No. 24 S.C.C. wire as follows: Primary 65 turns, secondary 40 turns, and tickler 50 turns. No taps are taken, as tuning is done by variable condensers.

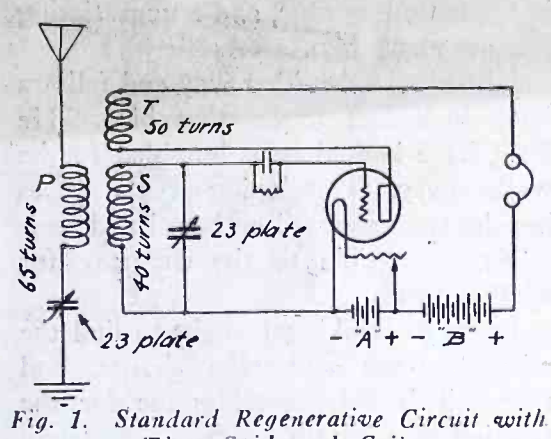

Fig. 1. Standard Regenerative Circuit with Three Spiderweb Coils

The secondary coil is mounted stationary in an upright position on a block of wood and the primary and tickler coils on either side, mounted on a special adjustable mounting so that the coupling may be varied. An idea of how this was done will be gained from the Figs. 2 and 3.

A wooden block was mounted on the primary and tickler coils at a 45 degree angle and a hole drilled through parallel to the horizontal diameter of the coils. A No. 8 brass rod was threaded on both ends, one end passing through the block and the other end through the panel, after which a knob is screwed on it. A ½-in. square brass post was mounted near the coils to act as supporting bearings. Set screws were placed through the tops of these posts so that a slight pressure from them would be sufficient to hold the coils in any position. As these coils are not varied much, there will be little wear on the shaft.

Flexible leads are used to connect the movable coils and a set of flexible leads are provided inside the set so that the *B* battery may be mounted directly inside. The cabinet must be made large enough to allow sufficient space for the coils to swing.

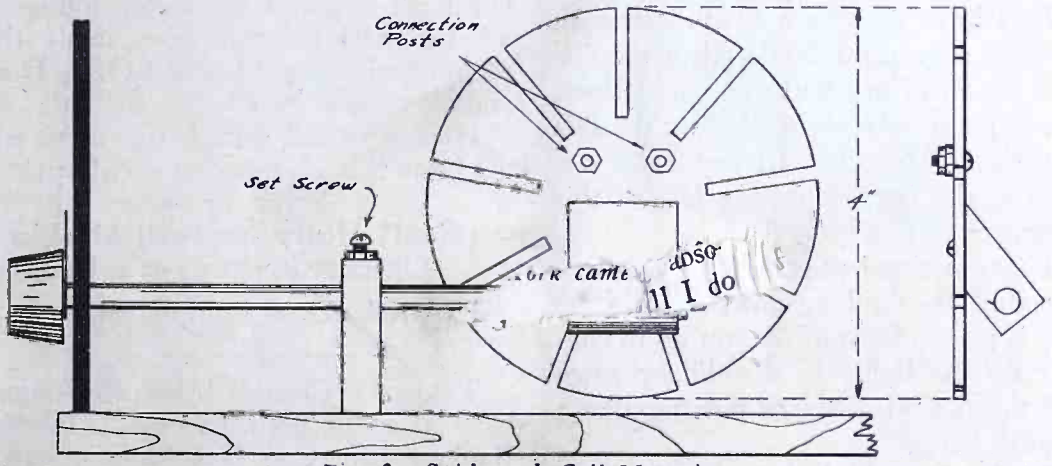

Fig. 2. Spiderweb Coil Mounting

The variable condensers are each 23 plates, which gives a wavelength range of from about 200 to 600 meters.

The panel should be shielded and the shield grounded to the ground binding post. The coupling control shafts are also grounded to this shield. The shield may be of tinfoil.

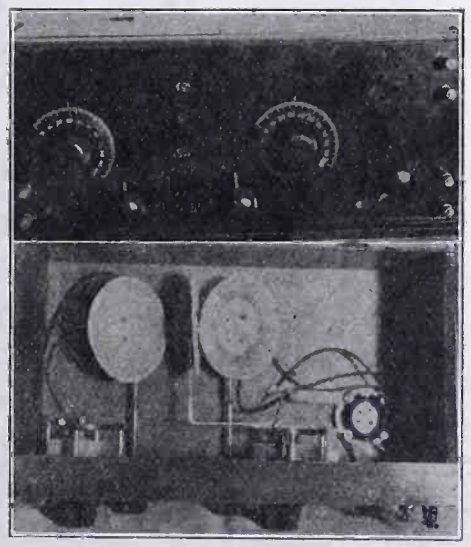

Fig. 3. Front and Rear View of Set

Any degree of coupling may be had by varying the distance between the primary and secondary. For instance, if interference is experienced, the primary is turned away from the secondary a bit and the condensers retuned to the wavelength to make up for the change in adjustment, and in all probability the interference will have disappeared.

This set was used with a WD-11 tube with 22½ volts on the plate and an antenna of 75 ft. long. Being only 10 miles from New York and only 3 miles from Newark, no difficulty was experienced in picking out a certain local station and entirely excluding the others. Also while the local stations were still going the following other stations were tuned in and the locals entirely excluded: WJAX, Cleveland, O.; WGY, Schenectady, N. Y.; KDKA, Pittsburgh, Pa.; WFI, Philadelphia, Pa.

It will be interesting to note that the coupling between the primary and secondary and between the secondary and tickler were left at about 45 degrees during these tests and tuning done only with the two condensers, the coupling being varied only slightly occassionally to clear up speech or stop oscillation of the tube.

SOLDERING ALUMINUM

By PHILIP W. EMIGH

To those who are interested in joining aluminum to aluminum, copper, brass, etc., the following may be of interest. Get a small quantity of scrap zinc and block tin, in the proportion, by weight, of four parts tin to one of zinc. Melt the zinc first, in an iron pot or crucible and when *just melted* add the tin, stirring constantly. When melted pour out in long thin strips ready for use.

From the nearest drug store get an ounce or two of stearic acid. This is a substance that looks and smells like tallow and comes in small cakes or lumps.

Get a small piece of sheet aluminum to practice on and proceed as follows: Scrape a few shavings of stearic acid onto the aluminum and with a torch, gas flame, or an ordinary soldering copper (or iron) apply enough heat to cause the acid to flow. While the acid is in a liquid state scrape the surface of the aluminum, where it is desired to solder, and apply the solder described above. The heat should be great enough to cause the solder to flow freely and "tin" the surface of the aluminum.

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LETTERS FROM A "LID" TO THE RADIO SCHOOL FELLOWS

Hello to all the bunch:

Well we reaches this port, or as the nauticle term frases it, we arrives at this port, and its sure some trip. In fact I been having a great time with one exception ever since I been on here. So you fellows can be able to gain by my experiences what I loses when you gets out and gets a ship all on your own I'll start from the bottom and narrate all of my adventures.

The day we sails I comes confidential like up to the head of the Pere with a new straw sachel in my key fist, and a old one of Aunt Henriettas in my left which dont look so bad and a red faced guy with cruel eyes stops me with a officous manner.

"Where you bound for young fellow?", he says.

I grasps right away hes a old sea dog himself by the hat hes wearing which is a regular seafarin mans cap, like I has right there with me in my new sachel.

I shows him my assignation papers, my license which Im proud of, and my passports, and Im right to the point to present my birthday certificate but by that time his officous manner is pretty well quenched and he passes me by without a word.

Theres a great number of ships at that Pere and its only after a great deal of needless questioning of dumb-bells that I finds mine.

And boys I craves to tell you she is some ship. Just to stand and survey the length of her over all gives you a thrill you wont soon forget.

Mabe a little d e s c r i p t i o n now wouldnt be above order. The part which is known among the seafarin profession as the hull is painted black. Above the hull the decks of the same material is red and the wood decks is naturle color. Going higher still, the houses etc. arent all white for they have a hip-high streak of bill board yellow around the bottom, probably as far as I can reduce for reasons of cleanness. To tip it all off in a naturle manner comes the smoke stack as gaudey as a barbers pole. Besides the stripes which is green and white colors theres two big letter Gs cut out of tin or some such material and solidley fastened to each side. Well I dont know what they stands for unless its go, and we sure goes, eight nots each hour Im told, and when I informs you a not is longer by far than a mile youll realize. Just imagine to yourself now walking that fast and then conjure up this giant ship of steel and beams going through water with such a speed.

I'm standing on the deck near my sachels observing things, you fellows know what keen a interest I takes in things when a fat, sourfaced guy approaches.

"Are you the new messboy?" he says in a questioning tone, and a ungratiating manner about him.

I just looks the other way and fellows its a look that settles that bird. He must have knowd he is humbled for he walks away. Developing events proves hes the chief steward on board and he is solely responsible to the company for what we eats.

I gets to thinking I ought to find the wireless room and take charge, and where it is only stumbles me for the fraction of a instant.

I figures and rightly that the leadin would lead me in to it and thats what happens.

But all punning aside she is sure some beauty. I got three rooms way up on top. Stating them cronilogikally they are: 1—Battery Repository. 2—Operating House. 3—Living etc. Room. The terms is my own.

I realizes its worse than useless to name in very much detale all of the distinct pieces of apparatus as you fellows knows them only too well from the sets you got up there but Ill just point out some of the features on the face of this outfit.

That starting box stuff is pretty [redacted] lute stuff Im thinking now, for a[redacted] here is press a button like you do to connect up the lights in a ordinary room and the old MG begins purring like a Angora Kitten.

At 1st I couldn't hear anything on the receiver and I gets to thinking thats the reason the other op is fired because he must be fired. He couldnt quit a swell job like this. And coupled also to that the transmitter wont give the aerial a single amp though it sparks beautfulley 'I catcha da suspish,' as our Wop friends ignorantly put it.

But do you know fellows, the laugh is against me after all. My prepossessor though I cant see any sense in him leaving has a sense of humor. (Pretty good Eh?) They is a ground switch tightly fastened to the ceiling and he leaves the aerial grounded through that or earthed to put it more genteeley.

I soon has things going and I takes control of the air and Im here to tell you I gets a thrill thats the buzzers attitude out of that taking charge. You fellows all knows what a snappy fist I got anyway I having sent to you all many times just practising, and I sure wakes those birds up what happens to be under a head-band at the time. The needles jumps around over those metric scales like they has locomotive-taxia. I dont pay much attention to the back reply. Its only a crowd of hams calling RTQ and TQR anyway but I gives em all the detales of the ship then I holds down the key for a half hour or so to see if the gaps gets hot easy but they dont. I wants to let em all know I got a license and belongs to the brotherhood of operating engineers.

About that time a quiet guy pokes his head, followed by himself into the doors opening and says hes the inspector.

Well Ill tell you more in my next but I got to go up town now and see if all the advertising matter about this town of wheels and beans is OK. Dont you envy me fellows?

Hoping you all get a license quick and get in on this adventuring life, I am

Yours Truly

(Sined) Henry Speedwell Mosdike

Operator in charge of ss Kekoskee

PS—Kekoskee is a old indian name.

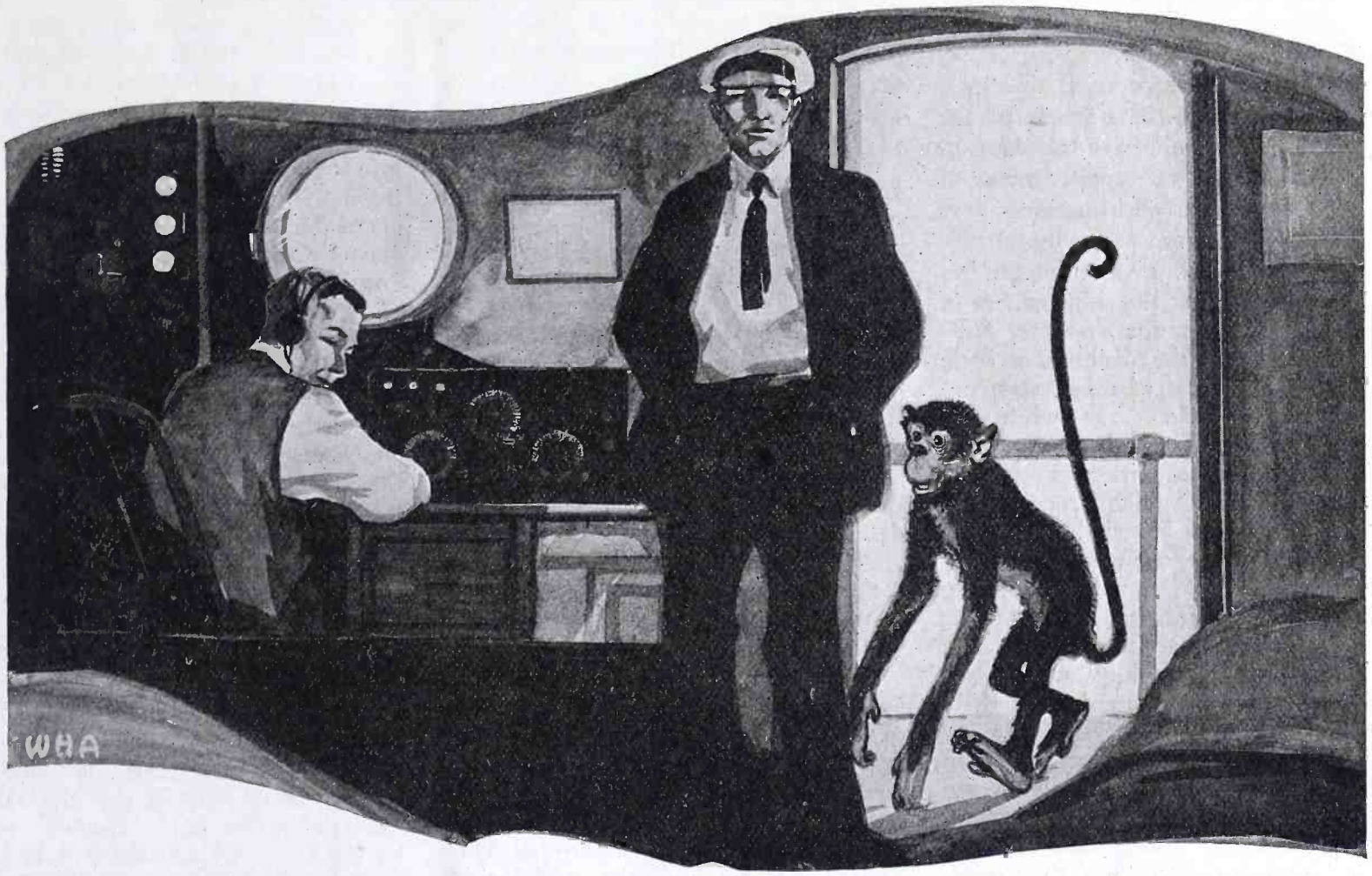
Two new Class B broadcast stations have recently been licensed: WHO, Bankers Life Co., Des Moines, Iowa, on a wavelength of 526 meters, and WLS, Sears, Roebuck & C., on 345 meters. Both are 500-watt stations.

Symmetrical and beautiful panel arrangement is not always compatible with maximum efficiency in a home-made set. When efficiency is wanted all leads should be as short as possible and grid and plate leads be as far apart as possible. A plate variometer, for example, should be placed close to the detector tube.

The Invisible Wire

By Erald A. Schivo

A difficulty and problem confronting a ship operator is here solved. The mysterious trouble is simple enough once you know the reason why.



"Kork came into the radio cabin followed by a monkey."

"MARTINDELL," said the little man who hired radio operators for many ships which sailed the great Pacific, "I'm going to give you a hard job."

"I will try to do my best at it," murmured Herbert Martindell, wondering what could be hard about a wireless operator's job. He had completed several long voyages and had found the work quite easy.

"Martindell," continued the little man thoughtfully, "I'm going to make you chief operator of the *S. S. President Harvard!*"

For a moment Martindell could not believe his ears. That he should be given such a position seemed improbable. He was quite capable to become the chief radio operator of the *President Harvard* provided there was no mystery to solve. Every radio man knew that something was the matter with the radio apparatus, and as yet the trouble had not been located. Sometimes it was very easy to transmit a few thousand miles, at other times not a signal could be heard a hundred miles from the ship.

"I expect you," said the little man as if he were talking about a trivial matter, "to locate the trouble."

"Yes, sir," responded Martindell too astonished to say more.

"Here," said the little radio man holding toward Martindell a sheet of paper, "is a note to the captain. I will say goodbye, as the ship is bound for New York."

An hour later Martindell was on board the ship and in the radio cabin. He marvelled at the glistening instruments, and wondered just where the trouble could be. Radio engineers had failed to find it, yet he, one of the youngest wireless operators in the company, had been given what seemed an impossible job.

"Gee!" muttered Martindell aloud. "If I find what's wrong with this set I'm doing good."

"I'll say you are," came a voice from behind him. "Who gave you permission to come in here?"

Martindell laughed quietly. "The captain gave me the key. I'm the chief wireless operator."

"Oh, I see." The older man looked over Martindell with apparent disgust. "I'm the second operator—John Kork."

"Pleased to make your acquaintance," said Martindell affably. "Herbert Martindell is my name. Have you been an operator on this ship long?"

"Three trips I've been second operator," grumbled Kork. "I concluded I was about due to become the chief. Do you expect to discover what's wrong here."

"I'll try my best."

"You'll have to. The last chief I had was a pretty good fellow, but he could no more solve the mystery of this set than I."

"So you tried yourself?" asked Martindell, interested.

"Oh, not any more than I'm being paid for."

"Well, Mr. Kork, I hear that the vessel sails within the hour. I hope we get along with each other."

Twenty-four hours later, when the great steamship was more than five hundred miles from shore, Martindell experienced his first difficulty with the wireless apparatus. He had just relieved Kork who had been on duty for four hours.

"Any trouble yet?" Martindell had asked when Kork was ready to leave the radio cabin.

"No occasion to transmit anything," Kork had replied, "but we are having a little stormy weather now and I shouldn't wonder if something came along. It generally does during a storm or just after one. That's why the radio engineers could not locate the trouble, I guess. In harbor the set always worked perfectly."

Kork mumbled something about getting a little food with coffee, thus leaving Martindell alone with the instruments. Although Kork had obeyed all orders given him by the chief operator he seemed to do everything with dislike. Martindell seldom received information about the radio apparatus unless he asked for it. There were, no doubt, many things which previous operators had done to locate the mystery of the set, which Kork could have told him of. As it was, Martindell repeated many of the tests which resulted in nothing more than a waste of time.

The captain had given him an important message for the ship owners in San Francisco. For the *President Harvard* to transmit the distance, a little more than five hundred miles, was considered very simple. Yet while the generator of the transmitter showed a high voltage, the hot wire ammeter read almost nothing. The San Francisco station could not hear Martindell's signals. Like several other operators, the same tests were gone through by the young chief radio operator, to arrive at the conclusion that the aerial was grounded.

"I've found the trouble!" cried Martindell when Kork showed himself in the doorway.

Kork came nto the radio cabin followed by a monkey. He smiled when he heard the chief operator's statement.

"So did every other fellow," said Kork half sneeringly, "but they never located it. You find, I suppose, that the aerial is grounded?"

"Why yes," replied Martindell with surprise, "but where did that big monkey come from."

"Pet of the crew," laughed Kork, "the old boy has been on this ship for more than a year."

The animal seemed to know that it was dangerous to fool with the radio apparatus, probably he had had bitter experience, for he waited patiently in an out-of-the-way corner.

"So the other fellows knew that something was the matter with the aerial," murmured Martindell thoughtfully. "Didn't they take a look at it, change the insulators or anything?"

"If you wished to take a look at it now how would you do it?" came from Kork the half sneer upon his face again.

"Why, just go out and look up. I might also take it down if necessary."

Kork laughed, this time with extreme amusement. "Why, my dear fellow, don't you know that you can't see your hand before your face without, unless you're under an electric light. It's night time. Guess you forgot being that you were so busy here. As for taking the aerial down in the dark, it is practically impossible. The last man tried and almost broke his neck. The morning with plenty of daylight will be quite sufficient. Ask the captain and he will tell you the same thing."

"Guess I'll have to wait for the set to get out of order in daylight then."

"It never happened yet," said Kork with a trace of puzzlement in his voice. "All the trouble comes during the night. If you were to take the aerial down tomorrow you'd find nothing the matter."

"That's strange."

"Yes, it is," granted Kork looking at Martindell through half closed eyes. "Well, Mr. Martindell, I'm going to get some sleep now. Want to keep the monk here for company?"

"No thank you," laughed Martindell, "the poor old fellow don't like this cabin."

"I'll say he don't. He tried to throw in a switch once that had a little too much current in it. Always trying stunts that he sees the crew do. Well, goodnight. Come on Jumbo."

Both Kork and the monkey left the radio cabin, the latter much to Martindell's satisfaction.

"Gee," muttered the chief operator, "why can't the crew select a dog or an animal with a little sense instead of a foolish looking monkey?"

Several times, before he was relieved by Kork, he tried the transmitter, only to fail to receive a reply from the powerful San Francisco station. He tested several pieces of apparatus each one seeming to function properly.

"I can't understand," muttered Martindell aloud. "If the aerial isn't grounded, which I think it is, then what can be the matter?" The question remained unanswered when Kork again made his appearance.

"Is it working yet?" inquired Kork.

"Haven't tried for about ten minutes, if it does later, get out this message as it's important and has been delayed almost four hours already."

"I'll try now," said Kork looking over the message and at the same time adjusting the head-set. He slipped something from a drawer into his pocket, making sure that Martindell did not note the action.

Soon the generator began its merry whirl, the meters jumped forward, and the set was ready for operation after one thrust of the aerial switch had been made. Kork pressed the key and the hot wire ammeter showed a maximum of current in the antenna.

"Working fine!" cried Kork, and called the San Francisco station. He delighted in noting the puzzled expression on Martindell's face.

Martindell was thinking. He had observed Kork looking at him, had turned his head away purposely, and had sensed rather than saw Kork open the drawer and take something from it. Now that the set worked, Martindell had a vague suspicion. He decided to look in the drawer when his watch came.

When his turn on duty came again, he opened the drawer, which he had a perfect right to do, but found nothing that could in any way affect the radio apparatus. His suspicions were just as strong, however, for the wireless set worked perfectly.

"Still work fine?" asked Kork when it came his time again. He said it as if he knew it all the time.

"Yes, but it's daylight now, remember, and you told me most of the trouble, in fact all, comes during the night. By the way, I looked at the aerial and it looks as if it was all right. I would say that the trouble to take it down would be quite a bit?"

"Yes," replied Kork quickly, "the chief operator tried twice on my first trip, when the insulators needed changing. He finally succeeded by having the crew help him and myself. I remember one man climbing the big steel mast in the center. He tied the aerial to the mast with difficulty by using a stout piece of wire, then it was slowly lowered. Some job. The last man wanted to take it down but the captain refused to give permission as the antenna had been gone over by the radio engineers, including the radio inspector."

"In other words the trouble we are having now did not begin until after you second trip," said Martindell slowly.

"No, at the end of the first trip we experienced the same trouble we are having now. In port the set was looked over but nothing out of the way was found. Well—Mr. Martindell—"

"I'm not particular about that mister business except in the presence of others," interrupted Martindell.

"You're a little different from the last man then. Well, old man, I'll try to tune in something now." He adjusted the head-set.

"Something funny about that man," thought Martindell. "I wonder—" He could not give the matter much thought but he determined, after he came on duty for the first night watch, that he would consider every angle of the case.

His period of rest passed quickly. He was awakened by Kork shortly before dark.

"I had more than my time, didn't I, old man?" asked Martindell as he saw that darkness was approaching.

"Well—I know that you must have been thinking quite a bit about this case lately," muttered Kork. "All the other fellows did at first but gave it up as a bad job."

Kork was about to go for his supper when he thought of something which made him accompany Martindell to the radio cabin.

"Forgot something," he said shortly, and preceded Martindell into the radio room. The latter was just in time to see him close a drawer, the same drawer

Continued on page 54

Comparison of Wire and Radio Telephony

By Carl Dreher

The mechanism of speech reproduction is here fully presented in most readable form. Not only can the reader gain an understanding of such technical devices as the microphone, but also as to why all sounds are not truly reproduced over the telephone and radio.

ALL branches of engineering react on each other. The vacuum tube has been a great and practically indispensable factor in the later progress of line telephony. But the telephone engineers had to wait for radio engineers to give them the vacuum tube amplifier. The radio men who developed the vacuum tube were interested in telegraphy; radio telephony, at that time, was a dream. But with the development of radio telephony, the radio experts have found it expedient, now and then, to take a leaf from the telephone brethren's notebooks, for, after two score years of handling speech, the telephone engineers know something of the art of making consonants and vowels behave.

The first instrument in this behavior treatment is the microphone. A microphone is simply a collection of carbon granules in back of a diaphragm, which is vibrated by sound waves, thereby varying the pressure between the granules, and their resistance, just as the resistance of a carbon rheostat is varied by changing the pressure on it by means of a screw—the only difference being that the forces involved in the latter instance are a few million times as great as those in the former.

It is always amusing to read, in the romantic radio supplements, of the enormously sensitive microphone of the broadcasting studio. That microphone, as a matter of fact, is just about one one-thousandth as sensitive as the humble microphone of the common telephone. The telephone does not deliver such pleasing speech, in fact, its attitude towards speech is that of a surly expressman towards a three hundred pound steamer trunk, and it treats it in the same way, but, beyond peradventure, it has the pep. It works alone and asks for no assistance. The aristocratic double-button duralumin transmitter, used in broadcasting stations gets by only with the help of a bank of amplifiers.

Letting Fig. 1 represent a commercial telephone microphone, the mouthpiece *M* conveys the sound waves to a diaphragm *D* which varies the pressure on the carbon granules *G* in the space between the two carbon disks C_1 and C_2. Thereby the resistance between the disks is varied proportionately, and the vibrations of the voice are transformed into an alternating current if the device is placed in a suitable telephone circuit with a steady current when speech is not impressed on the microphone. A spring *S* bears on the diaphragm and damps or limits its vibration.

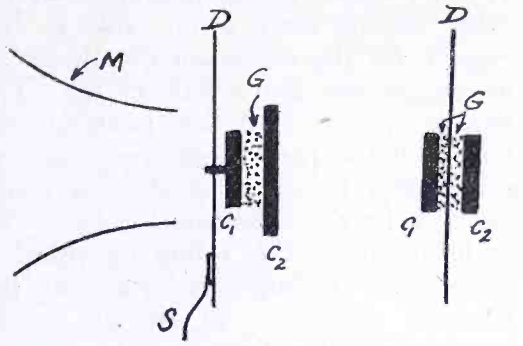


Fig. 1. Commercial Telephone Transmitter
Fig. 2. High Quality Telephone Transmitter

Fig. 2 is a sketch of the high quality microphone used in broadcasting studios. There is no mouthpiece, as it involves some distortion, and also because this type of transmitter is normally used for distant talking and pick-up, the source of sound being several feet from the microphone. The diaphragm is in the middle, with a carbon button on either side, and the carbon granules rest between the diaphragm and the disks. The diaphragm is the neutral point and is normally grounded and connected to the negative pole of the battery as shown in Fig. 3. The two buttons go to the terminals of the primary winding of a transformer, the secondary of which feeds the grid of the first amplifier tube. The primary winding has a mid-point tap connected to the positive side of the battery through a suitable resistance to regulate the flow of direct current through the microphone buttons.

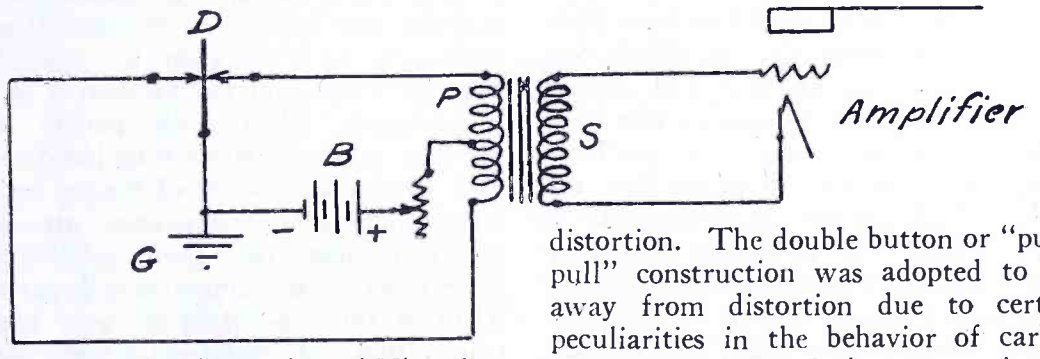


Fig. 3. Electrical Connections of Microphone

The usual microphone current is in the neighborhood of 20 milliamperes (0.02 ampere) per button. For alternating current it will be noticed that the two buttons are in series, and the two add up to give an impedance of about 200 ohms.

The high quality transmitters are carefully designed and built to minimize distortion. The double button or "push-pull" construction was adopted to get away from distortion due to certain peculiarities in the behavior of carbon under pressure, and the same principle has been adopted more recently in the construction of high quality amplifiers with tubes of limited capacity. The diaphragm is not a simple sheet of metal, but a stretched sheet of an aluminum alloy with a very high natural period—initially 7000 cycles, so that it will not respond with undue familiarity to any particular musical note. Of course any such crude damping device as a spring resting against the diaphragm is not to be thought of; air damping is used.

One of these transmitters weighs 2½ pounds without the housing. It costs about as much as a good receiving set or a second-hand Ford.

What is the upshot of all these elaborate precautions? Fig. 4 gives the answer. The commercial telephone transmitter, it will be seen, is tuned to

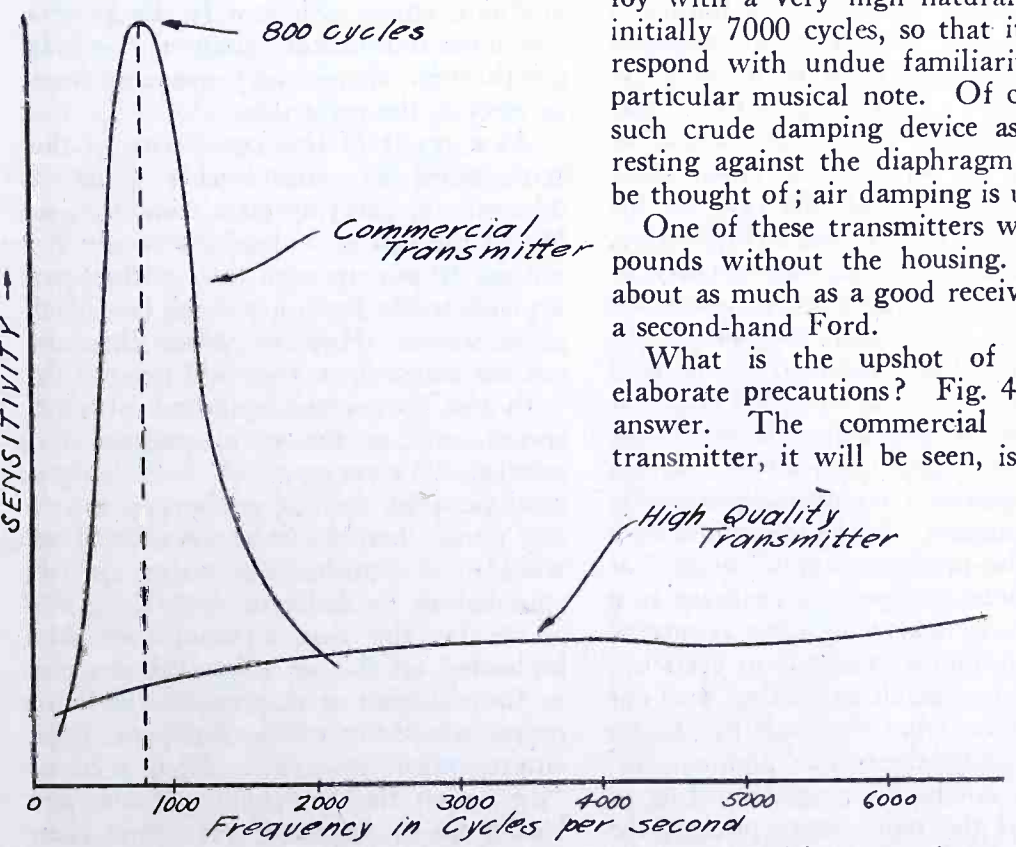


Fig. 4. Frequency Characteristics of Commercial and High Quality Transmitters

about 800 cycles, which telephone engineers have adopted as the mean speech frequency in their calculations. This is the reason for its superior sensitivity. It is grossly inhospitable, as the curve shows, to frequencies above 2000 cycles. The high quality microphone is far more tolerant; it takes the frequencies as they come to it, and is reasonably kind to all of them; it has a flat frequency characteristic, to put it scientifically. This means that in speech or music this microphone will not exaggerate one pitch at the expense of another, but will pass on the sound substantially as it comes to it, and that is the prime requisite of every piece of apparatus in a broadcasting station and in the audio-frequency portion of a good receiving set. But the full significance of these characteristic curves will appear in the discussion of frequency bands in line telephony and broadcasting.

The Meaning of Acoustic Frequency Bands

THE sounds of speech and music have a complicated make-up and it is no simple task to reproduce them electrically or mechanically. In speech, for example, we have to deal with highly transient explosive consonants like *p*, a letter which takes less than two hundredths of a second to pronounce, extremely high pitched consonants like *s*, and the longer vowel sounds with their more moderate fundamental frequencies. In acoustics a note consists of a fundamental frequency or pitch, and its harmonics, which are multiples of the fundamental frequency. If the predominating frequency is 500 cycles, for example, there are likely to be present frequencies of 1000, 2000, 4000 cycles, as well as higher and intermediate pitches. These are known to musicians as *partials* or *overtones,* while electrical engineers use the term *harmonics*. If the character of the tone is to be preserved faithfully this whole brood of notes must be permitted to troop along with the fundamental, the head of the family, for the characteristic ring, quality, brilliance, and individuality of both musical instruments and voices are tied up with these overtones. Hence, although the highest notes of the musical scale go up to only about 4000 cycles, it is necessary to transmit a band of frequencies up to about twice this value in order to take in a reasonable proportion of the harmonics. If the lower notes are missing, the product sounds "tinny," as the telephone engineers say; there is a lack of body and masculine resonance which is instantly apparent to even untrained observers, although they may not be able to say what the fault is. If, on the other hand, there is a "high cut-off" at a point not high enough, resulting in the loss of the more acute pitches, the result is "drummy," muffled, croaky speech, lacking clarity and naturalness. The only way to transmit natural speech is to take care of all the frequencies between say 100 and 7500 cycles, neglecting none and exaggerating none.

A good test for the presence of high frequencies is the prominence of sibilants. If the *s*-sounds are as prominent as the other sounds there is no fault in this respect, for this consonant has almost all its components above 4000 cycles. The sounds of *f* and *th* are, however, far higher, and at the present time, while all good radio broadcasting stations transmit healthy *s*'s, no station has *f*'s or *th*'s in its output. The following vowel is there, and, through the force of the habitual association of sounds, people imagine that they hear these consonants, but actually they are missing.

In contrast to a well designed and properly functioning broadcasting station, with its band of from about 40 to perhaps 10,000 cycles, telephone systems are built to pass only a comparatively narrow band of frequencies, from 200 to 2000 cycles. The aim in the latter case is to produce merely intelligible speech, without any pretension to naturalness. Although it is possible to recognize familiar voices and to carry on a rapid conversation when both parties are familiar with the subject under discussion, as soon as a series of figures has to be communicated, or a stranger attempts to give his name over the telephone, the limitations of the system are apparent. Most of the consonants are very badly transmitted. I recollect a prominent radio telephone engineer who amused his friends by calling numbers on the wire telephone with phrases like "Sick flies slew fleas" following the exchange, whereupon the operator would promptly connect him with 6523 without noticing anything amiss. Since only the vowels and some rudimentary consonant sounds got through, the wrong consonants were as good as the right ones.

As a result of this peculiarity of the wire telephony, considerable effort is necessary in carrying on a conversation, but in the course of business people are willing to put up with this, as they put up with traffic jams, hat check boys, and crime waves. However, when they are out for amusement, they will not put up with the commercial standard of wire speech, and so the radio stations, the product of a younger art, have had to produce a far higher quality of speech and music than the wire lines could or would. A broadcasting station which appealed to its audience with the voice of the familiar desk set would speedily be hooted off the air. Another element in the situation is that more and more people refuse to wear head phones; their entertainment must issue from a horn. Now, even the best loud speakers are harder on the extreme frequencies than a good pair of telephones, they tend to suppress everything below 300 and above 4000, and not to hold the balance perfectly true between these limits. Telephone speech which is understandable in an ear receiver would be quite unintelligible if amplified and sent out through a loud speaker. The broadcasting stations must be prepared to emit music and speech of such fine quality that it emerges triumphant after a certain amount of mauling in the receiving sets. None succeeds 100%—drums don't sound quite drummy, owing to the emasculation of the lower frequencies; applause is a rustling rather than a clapping noise, owing to the loss of the higher pitched components.

The reader may wish to know why the telephone companies do not provide a wider band of frequencies for their subscribers, since it is conceded that the wider the band the better the speech. There are several reasons. In the first place, telephone apparatus for public use must be robust and durable. The microphones of a broadcasting station are treated like spoiled children. Commercial telephone apparatus gets nothing but hard knocks. Naturally it cannot be expected to deal as gently with the sounds passing through it.

Another factor is found in the fact that a frequency band costs money. The 200-2000 cycle band devoted to speech toll purposes abuts, at the lower end, on the frequency band devoted to telegraphy. At the other end of the scale the speech band abuts on the territory of the multiplex carrier telegraph circuits. The capacity of the wire is thereby greatly increased, and the 200-2000 cycle non-carrier channel, while still representing the bulk of the toll business, no longer occupies a position of exclusiveness. This is another case where the telephone engineers have been glad to utilize a radio invention, for the carrier currents are generated by vacuum tubes, and the first successful application of the modulated carrier principle was in the radio field.

The carrier frequencies used on telephone lines are in general of an order of frequency much below that of radio. The reason for this is that these very high frequencies pass too readily across natural capacities such as those that exist inevitably between the wires of a cable or pole line, and thus, to avoid crosstalk between circuits, lower frequencies must be used. Crosstalk, or unintentional transference of speech from one circuit to another, is one of the chief bugaboos of the telephone engineers, and they are very careful to keep the power on their circuits at a level where it is not apt to spill over onto other lines or channels of communication; in the same way they wish to keep away from the higher frequencies with which it is inherently hard to guard against crosstalk. Furthermore, the electrical properties of space

and wires are opposite in this respect—space will transmit only very high frequencies (Dr. V. Bush points out that an antenna radiating 100 kilowatts at a frequency of 30,000 cycles per second, corresponding to a radio wavelength of 10,000 meters, would radiate only 1.6 *microwatts* if excited to the same potential at the commercial power frequency of 60 cycles), while a wire will transmit any frequency, but lower frequencies more efficiently than high ones. This is another practical consideration making for the use of moderate frequencies in wire carrier communication.

Distribution of Power and Amplification

THE fundamental difference between a radio telephone system and a wire telephone circuit is that in the former, one can do things to currents only at the ends of the circuit, namely at the transmitter and receiver; while on a line the energy is under control at intermediate points as well as at the terminals. It is about the same difference as that between walking and flying. Walk, and you can stop where you please—with some exceptions. Fly, and you have to make up your mind to stay in the air as far as the next aviation field.

Radio is simply a problem in amplification. Two kinds of amplification may be employed in order to get a given amount of energy at the terminal: transmitter amplification and receiver amplification. The latter is less expensive, but it suffers from the disadvantage that it is a general amplification, magnifying not only the desired signal, but parasitic noises and extraneous signals as well. In practice a compromise is employed, the transmitting power of the station being made high enough to get over the interfering noises (at least most of the time), with some further amplification at the receiver.

Since in a radio circuit the amplification is limited to the ends of the circuit, we might expect, even without knowing anything of the relative losses in the two methods, that a radio circuit starts off with more power than a wire circuit. The sounds of speech or music leave a 100-mile radio broadcasting station with an energy of about 500 watts. On a telephone line of the same or greater length, the speech leaving the transmitter may have a power of one one-thousandth of a watt, or 1,000 microwatts. The telephone unit of power measurement is one one-millionth that of a moderate sized radio station. But on the telephone line, by means of repeater or amplifier stations at suitable intervals along the line, the energy is kept from falling too far below the initial level, whereas in a radio system there is nothing but losses, losses, losses till the receiver is reached. A radio message goes on its way like a man making a long journey among strangers, where he must pay his way with the money he started with, while on a modern repeatered telephone line we have the case of one who has a source of income along the way, and can afford to start with a much smaller sum in consequence.

Fig. 5 is an attempt to show graphically the difference between transmission of energy along a radio circuit and a long distance telephone line. It is necessary to draw the curves on a logarithmic or foreshortened scale, the ratios involved being of astronomical magnitude. The ratio of the largest power shown, 100 kilowatts, to the smallest, one-tenth of a microwatt, is no less than one trillion.

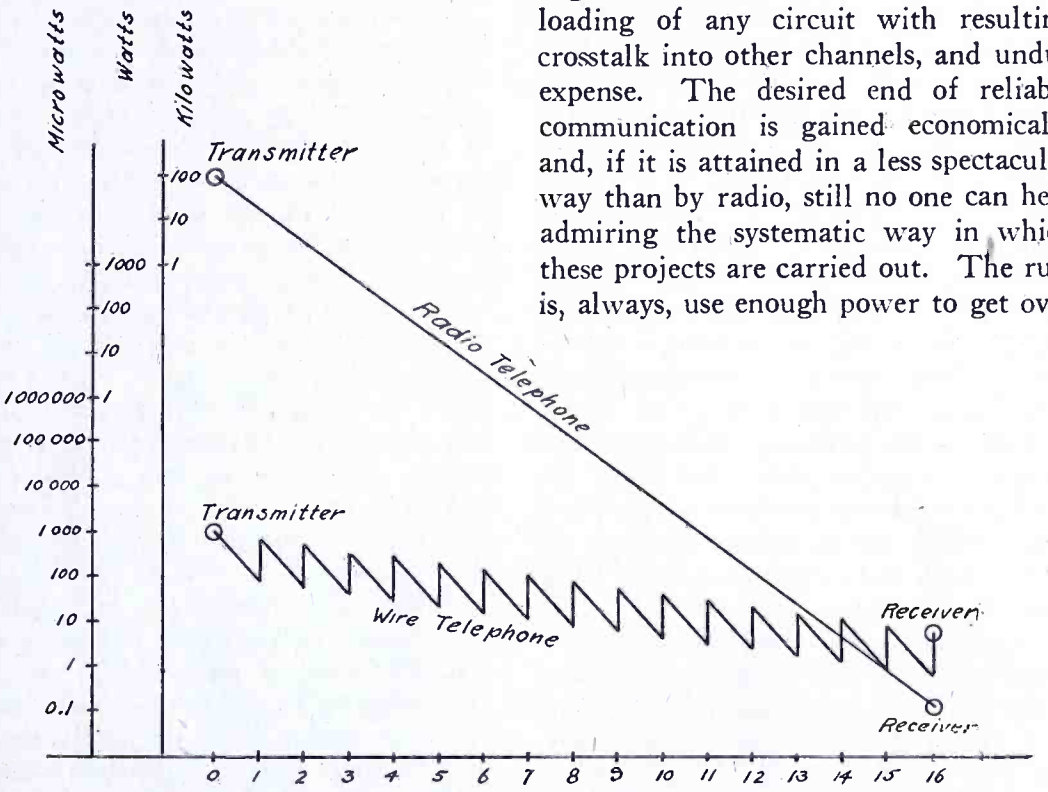
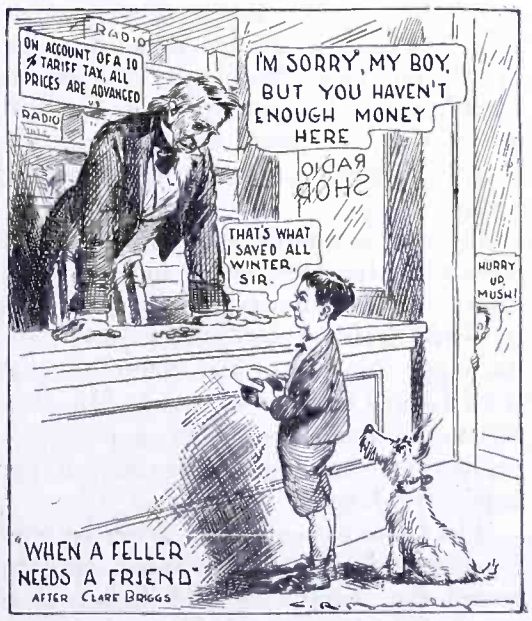


Fig. 5. Power Comparison of 1600-Mile Wire and Radio Circuits

The lower zigzag curve of Fig. 5 is an adaptation from a paper by H. W. Hitchcock, "Applications of Long Distance Telephony on the Pacific Coast." Starting with 1000 microwatts, the output of the desk set transmitter at Avalon, we see how the energy drops and is boosted by repeaters some sixteen times, 4 microwatts finally arriving at Deer Park, enough to operate the ordinary telephone receiver there. Actually, of course, the curve given by Hitchcock is not as regular as the idealized form here given. The circuit contains deep sea cable, aerial and underground cables, a carrier cable system, and open wire stretches, with varying attenuations and amplification characteristics.

If this same stretch had to be covered by radio, for equally reliable service we should probably require 100 kilowatt transmitter. This might deliver some two-tenths of a microwatt at the receiving end, which might then be amplified up as required. This figure corresponds to a field strength of 200 microvolts per meter, which Espenschied gives as a minimum for reliable radio communication, and a 10 meter receiving antenna. The upper line in Fig. 5 shows an assumed even variation of this power between the ends of the radio circuit.

Hitchcock points out that if all the amplification of this 1600 mile telephone line were to be concentrated at the transmitter, in order to get four microwatts at the receiver, about 30 billion kilowatts would be needed for transmitting power! If, on the other hand, all the amplification were to be affected at the receiver, the line noise, crosstalk, etc., would drown out all the speech. But, by distributing the amplification piecemeal along the line, the telephone engineers avoid excessive power, overloading of any circuit with resulting crosstalk into other channels, and undue expense. The desired end of reliable communication is gained economically and, if it is attained in a less spectacular way than by radio, still no one can help admiring the systematic way in which these projects are carried out. The rule is, always, use enough power to get over unavoidable line noise and residual crosstalk, don't go over this level, don't drop below it, and use your amplifiers to keep on the straight and narrow path of sufficient but never excessive power.



Prevent This Tax on the Boyhood of the Nation.

Joining the Radio Lodge

By Aaron Nadell

After telling of the joys to be had from learning the code, the author shows how it may best be studied. Nobody has ever regretted the time spent in learning the code.

IN that lost paradise, before the days of broadcasting, everyone in radio was a member of the radio lodge. Then, when you passed through "roaring streets unknown" and saw an antenna stretching above the housetops, your heart was warmed. For under that antenna was to be found a Brother; and you could, if in need of conversation, ring the doorbell and ask for "the wireless operator;" and presently exchange winged words with a fellow enthusiast concerning "sink gaps" and "five hundred cycle notes." But them days have gone forever. The last time I tried that I was ushered into a kitchen where a little man was bent over a would-be crystal set mounted on a cardboard panel; and the little man stared at me suspiciously and said: "Vell, vat you vant here?" In these days of superheterodyne receivers, unless I see a counterpoise, even a cage antenna means nothing in my young life.

But the old fraternity still exists and is going stronger than ever; and it's pleasant to listen in of nights and hear the "OM"s tossed to and fro, and the 73's bandied across a dozen states. OM, dear reader, means "old man," and 73 is the telegrapher's sign for "regards." And sometime, OM, when you tire of the limitations of broadcast receiving, and of being a stranger in Radioland, you will grit your teeth and go through the ordeal of initiation, and join the radio lodge.

Far be it from me to disparage the thrill to be had from listening to broadcasting, especially broadcasting from a distance. But—did you ever know that getting a postcard from the other coast could carry more kick than hearing a broadcast station on the other coast? It can, when you're doing some transmitting yourself, and the postcard is an acknowledgment that your station has been heard. Then the thrill of listening across the country is as nothing to the thrill of listening for the letter-carrier's whistle.

I know a young chap in California whose call has been heard in every radio district of the country, in Hawaii, and in New Zealand, and who is now going gunning for two-way communication with Leon Deloy in France! His outfit consumes about as much power as a parlor reading lamp, and it cost him perhaps fifty dollars.

Two-way communication between Europe and the Eastern states, and between the Northwest and Japan, is an accomplished fact; Alaska and Hawaii and the northern side of Greenland have been brought within the fold; this summer will see the pan-American tests, when the amateur fraternity will undertake to get in touch with our South American cousins, and the next subject for discussion is the need of an international language!—Here, by the way, is a development that may do more to prevent future wars than all the statesmen who ever saw the inside of Versailles.

This smashing of barrier after barrier by a few thousand amateurs is one of the most dramatic developments in the world today, unnoticed though it yet is. It offers the finest field of activity for those who, liking radio, are commencing to be bored by the limited possibilities in receiving broadcasts. Unfortunately, there is a preliminary test to be met before one is privileged to join the ranks of the amateurs—the "initiation" to the "radio lodge," so to speak. One must learn the code. Modern methods, however, based on the principle of onomatopoeia, have made this considerably less of a grind than it was formerly, and one can now qualify with less effort than it takes to qualify for the Masons. But having qualified, and received the government transmitting license as official certificate of membership, one not only acquires Brothers in distant states, but soon makes some of them friends, over the air. All the night then becomes full of meaning as one listens to friends chatting. Other wavelengths are alive with the voices of ships calling out of the sea; calling the United States on the long wavelengths of the trans-oceanic stations; and best of all with the friendly calls of transmitting citizens of other nations, shaking hands with us around the world!

How to Study Code

"From one to five we study code;
A harder row I've never hoed.
We've got to study to get by,
And, holy smoke, it sure is dry.

"To copy mile-long strings of talk
Would make old Job get up and balk—
Good night; and still long months of it!—
I often think I'd better quit.

"But when the harbor whistles blow
I think of places I could know
Had I the right to pitch my camp
Aboard some roving deep-sea tramp.

"Oh gee! To see, before I die
The Cuban palms against the sky,
Waikiki's beach, the Maelstrom's coil,
Were worth a century of toil!

L' Envoi

"And so, to gain the open road,
I sit me down and—study code."

This poem, printed some years ago in the Radio Corporation of America's little bulletin, was written by a student at a radio school in New York City. I never knew him, and I've forgotten his name, but I couldn't forget his verses. They breathe half the spirit that prompts men to face the drudgery of mastering elusive dots and dashes.

But the drudgery need no longer be nearly so great as it was for him—and for myself. While the pleasures of amateurs, if not of commercial operating, are much greater now than they were then.

Starting right is the most important factor in learning the code. Not that it is possible to start so wrong that you'll never learn it, but it is possible to start so wrong that learning it will be considerably more difficult.

The first point is not to memorize the code as it looks to the eye. You go down your chart and you say: "R—dot dash dot." That's wrong. That's the way it looks. But the way it will sound, when you actually have to receive it, is: "R—d' dah dt." If you memorize it as it looks your mental process when you receive will be something like this—"D' dah dt—that's dot dash dot—that's R." It will take long practice to establish in your mind the direct "d' dah dt—R" association that you could have established easily by memorizing the code that way in the first place. If you have already started wrong, but haven't gone very far, go back and spend your next practice period re-memorizing the code according to the principles set forth above, repeating the syllables aloud. Give every dot not final the value of "d' ", call every final dot "dt" or dit", and every dash "dah."

A—d' dah	N—dah dt
B—dah d' d' dt	O—dah dah dah
C—dah d' dah dt	P—d' dah dah dt
D—dah d' dt	Q—dah dah d' dah
E—dit	R—d' dah dt
F—d' d' dah dt	S—d' d' dt
G—dah dah dt	T—dah
H—d' d' d' dt	U—d' d' dah
I—d' dt	V—d' d' d' dah
J—d' dah dah dah	W—d' dah dah
K—dah d' dah	X—dah d' d' dah
L—d' dah d' dt	Y—dah d' dah dah
M—dah dah	Z—dah dah d' dt

Once again, don't read those syllables to yourself, pronounce them out loud, and forget all about dots and dashes for the time being.

The next principle is—never listen to code without attempting to copy it. No matter if it is far too fast for you—try, or cut it off. If you haven't a pencil handy, try to read it in your head.

Continued on page 62

Radio Construction Pointers

By Paul Oard

This month's suggestions include a handy combination switch, a use for scrap bakelite, a source of clips, and a good insulating compound.

Eliminating the Plug and Jack

WHILE the plug and jack method of controlling detector and amplifiers in audio-frequency amplifying circuits is by far the most used method in radio construction practice, many would prefer some switching arrangement to serve the same purpose and yet eliminate some of the complication of arrangement, and also do away with the necessity of removing the plug from the jack, and inserting another jack to decrease or increase amplification.

The method described here serves to eliminate the plug and jack method of control in audio-frequency circuits, and serves three purposes: (1) controls multistage operation; (2) breaks filament circuit; (3) breaks plate circuit. All this is automatically taken care of in one rotary control.

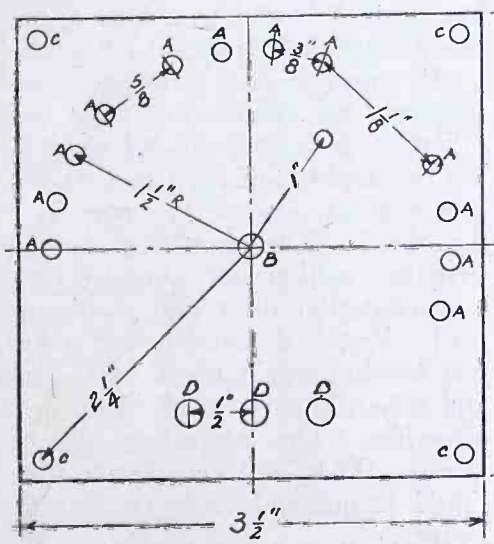


Fig. 1. Drilling Layout for Base

A for switch points 6/32 clearance holes, B for switch shaft 8/32 clearance hole, C for fastening lugs 6/32 clearance holes, D for binding posts 8/32 clearance holes, E for blade stop.

Materials needed for the construction of the combination switch for this arrangement are as follows:

1 base for switch, bakelite, ⅛x3½x3½.
1 Bakelite supporting washer, 1⅜ in. diameter x ¼ in. thick.
12 switch points with small hexagon nuts.
6 switch blades, 1¼ in. long.
1 steel or brass rod, 3 in. long x ¼ in. diameter, for blade shaft.
1 star or spring washer, about ¾ in. diameter, for lock nut bearing.
1 8/32 hexagon machine nut, for lock nut.
4 fastening lugs, ¾ in. x ¼ in. diameter.
3 small binding posts.
4 6/32 flat head machine screws ½ in. long, for fastening lugs.
1 6/32 round head machine screw ¾ in. long, for blade stop.
2 6/32 hexagon machine nuts, to lock stop.

The base for the switch is drilled as indicated in Fig. 1, with the exception of hole E, which is drilled later, as below, and the switch points are put in position. The bakelite supporting washer is next drilled and tapped, and the switch blades are fastened on this washer as shown in Fig. 2. The filament fan switch *A* is formed by placing four blades one over the other, and then separating them so that, when in proper position, each blade will rest on a switch point. These switch blades are carried in stock by most radio supply houses. To properly arrange the blades so that they will cover the proper points in order of rotation, the blades *B* and *C* should be on the 8th and 12th points, reading from the left, when the four blades of the filament switch cover the first four points.

The shaft is 3 in. long, with ⅝ in. at one end threaded 8/32. The threaded end is slipped through the supporting washer and the base and fastened on the back side of the base with an 8/32 machine nut, with a spring washer between the nut and the bakelite to prevent the nut from cutting into the bakelite. The shaft thread should make a driving fit through the supporting washer, so that it will insure the washer turning with the shaft. The hexagon nut is soldered to the shaft after the adjustment is fixed, so that it will not loosen.

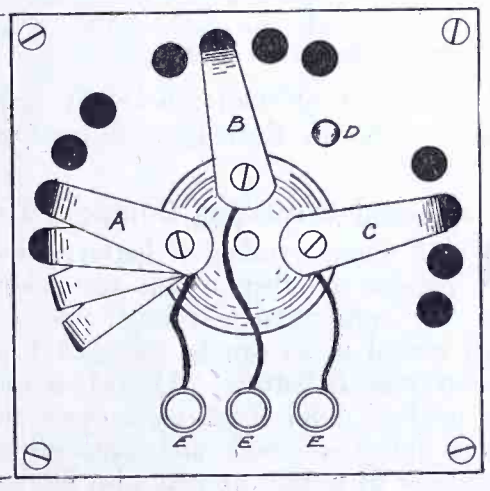


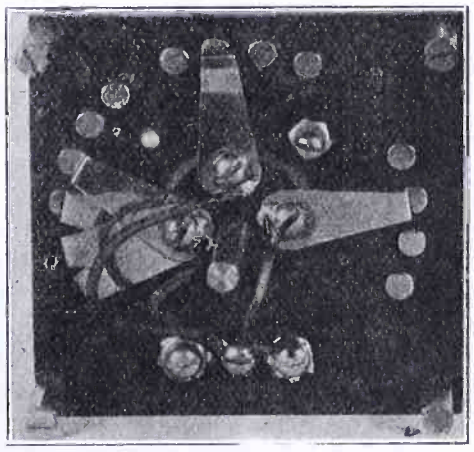
Fig. 2. Method of Fastening Switch Points

A filament control for switch, B stage-to-stage switch, C detector plate voltage and amplifier plate voltage control, D stop, E binding posts.

Now that the switch blades are in position, place the blades so that they rest on points *1, 5* and *9* respectively, and "spot" the hole to be drilled for the blade stop, indicated at *E*, Fig. 1, and *D*, Fig. 2. This stop is 7/16 in. from the center of the base, and should be so placed with respect to blade *C*, Fig. 2, that it will serve to stop the blades as they leave the points when turned to the extreme left. When turned to the extreme right, blade *B*, Fig. 2, will strike the stop as the blades cover points *1, 2, 3, 4, 8* and *12*. The ¾-in. 6/32 screw is used as the stop, with a nut on each side to act as a lock.

The three binding posts, *EEE*, Fig. 2, are placed on the back side of the panel. The four fastening lugs are fastened with round head 6/32 screws to the front side of the panel. The flat head 6/32 screws serve to hold the fastening lugs to the radio panel proper. Three short lengths of flexible cord are soldered to the binding posts and the switch blades.

The completed switch will take care of detector and three stages of audio amplification on the amplifying side.



Completed Combination Switch

The fan switch controls filaments, the blade *B* the stage-to-stage, and the blade *C* the detector and amplifier plate voltages. In the circuit diagram, it will be noted that the last three points are connected together, as the voltage is the same for the three amplifiers. If de-

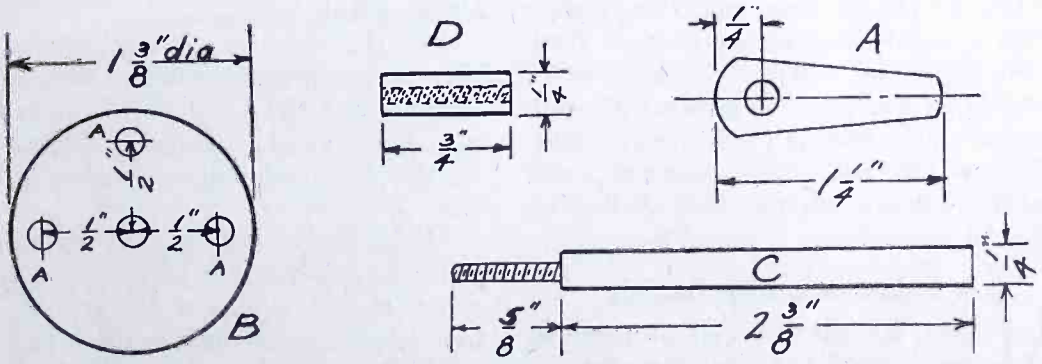


Fig. 3. Details of Combination Switch

A switch blade, (6), B bakelite supporting washer, C switch shaft, D fastening lugs (4).

sired to tap off different voltages for the amplifiers, the taps are disconnected from each other and run to the desired voltage tap on the *B* battery.

In the arrangement as presented, on detector, one and two stages, the primary of one of the transformers is in shunt around the receivers or loud speakers. This is no disadvantage, while on the last tube the circuit is just as though the usual plug and jack arrangement were used. If only two stages is desired in actual construction of the arrangement one point is left off on each blade.

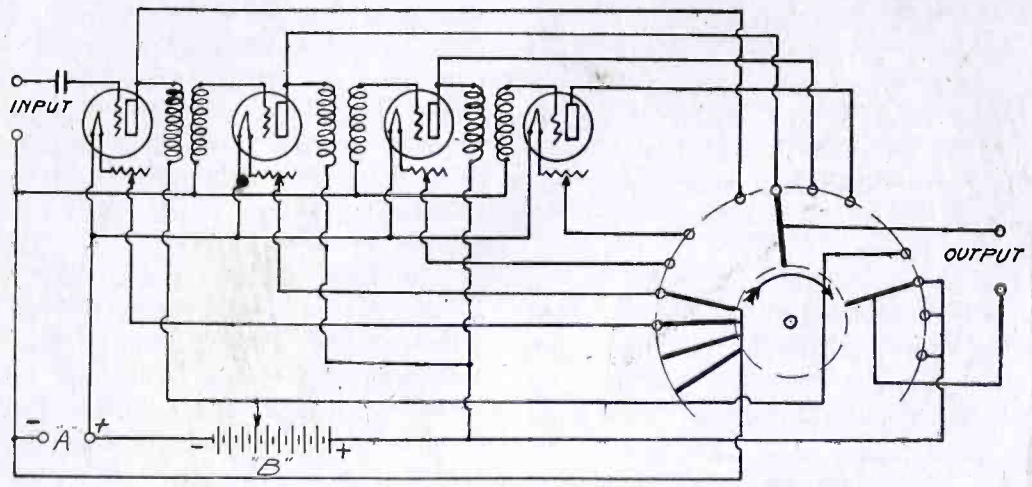


Fig. 4. Circuit Diagram for Combination Switch

Where both detector and amplifying tubes operate on the same voltage throughout, blade *C* may be eliminated. Its purpose is to prevent shorting of part of the *B* battery current through the receivers, and also to allow different voltages to be used on the amplifying side if desired. Where, for instance, 199 tubes are used, it is possible to work all tubes on one commonplate voltage of 45, in which case the blade *C* may be eliminated.

Several variations of the arrangement are possible, and will suggest themselves to the constructor upon a little study. After assembly, the completed unit is mounted behind the main radio panel, with the shaft projecting through and controlled by a knob.

A Use For Scrap Bakelite

SOME enthusiastic constructors make up several instruments on bakelite panels, and later wreck them, finding themselves with several useless panels on hand. To salvage them merely melt the material from an old "moulded mud" control knob into the holes, using a hot soldering iron and compressing with a small piece of wood until flush with the panel. After the holes have been filled, the panel is finished off with emery cloth and oil. Properly done, such a job will defy detection, and panels that are not too well drilled up may be given a new lease on life.

A Faenstock Clip Supply

MANY of the dry cell *B* batteries are provided with a number of Faenstock clips for the purpose of varying the voltage in steps of from 1½ to 4 volts. These Faenstock clips, which are a patented form of binding post, are unusually long where they are imbedded in the wax compound at the top of the battery. They are of value for many purposes in radio construction. Most constructors have dead *B* batteries in their "junk" piles, and these will prove a prolific source of supply for the clips. After detaching them from the dead cells, holes may be drilled in the ends for mounting purposes. If a batch of them are collected at one time, they may be sent to the plating works and given a coat of white nickel at small expense and to their general improvement.

A Good Insulating Compound

THE same wrecked *B* batteries will provide another useful commodity for the constructor—sealing wax. A half pound or so can be salvaged from the average *B* battery. Melted, it may be used to bind fixed condensers and some forms of coil and transformer windings in place. It may also be used to fill up countersunk holes for fastening screws in baseboard mountings. A number of purposes will suggest themselves to the busy constructor.

WOOD FINISHING

By D. B. McGOWN

The primary objects of wood finishing are to preserve the surface and to bring out the natural beauty of the wood. The finishing of rough articles can be done easily and simply with a coat of cheap paint or varnish. Battery boxes, for example, must be proof against chemicals, so the wood is covered with black asphalt paint.

For the finer classes of radio work, there is no difference in the preparation of the wood than will be found in high grade furniture. Radio cabinets are usually made of walnut, mahogany, or oak.

Wood is usually planed smooth in a machine planer, which leaves small ridges at right angles to the grain. The first process is to remove these by carefully planing with a "smoothing plane." This plane should be sharpened to as keen an edge as possible, and set so it barely cuts off the "high-spots."

After the whole surface has been planed smooth, medium grade sandpaper should be applied, and the possible rough spots should be removed. For most smoothing the sandpaper should be about No. ½, and should be held on a small wooden block. Always rub the sandpaper *with* the grain of the wood, and *never* across it. Otherwise crosswise scratches will result. After a complete sanding with the coarser grade, the whole thing should again be gone over with a finer grade, about No. 0, or 00, and the work is ready for finishing.

It may be found that some kinds of wood cannot be planed smooth no matter how small a cut is taken off, and that in certain positions it seems that any direction is "against the grain." This characteristic is particularly noticeable with some of the best mahogany, and the only way to smooth such a surface is with a steel scraper, which, owing to its shape, does not dig in. A steel scraper will cut nearly as fast as a plane, if it is properly sharpened and set up, but is much harder to use, as it requires much more skill to obtain a true surface.

As wood is porous by nature, it is necessary to fill up the pores with a "filler." A proper colored stain should also be applied, as very few woods, except walnut, are of any popular color unstained. The stain may be applied first, and a filler later, or vice versa, or a combination filler and stain may be used. Prepared liquid fillers and stains may be obtained in all colors and shades, and it hardly pays to mix them in small quantities. Dry stains may also be obtained. They will keep better than the liquid forms, and often are more satisfactory.

A good filler can be made by mixing enough turpentine and linseed oil to common cornstarch to make a thin paste. This is applied by rubbing on with a soft rag, allowing to set for a half hour, or more, and then wiping the surplus off. After this has dried for 24 hours, the stain may be applied, or the stain may be combined with the filler, and all put on at once. The wood may, on the other hand, be stained first, and then filled by being given several thin coats of white shellac. Care must be taken to have the shellac thin, and to apply it evenly. It must then be allowed to dry hard, and rubbed down with very fine sandpaper, and another coat put on. About two coats of shellac makes a good filler job.

The work is now ready for the final, and longest process,—that of varnishing. A clean brush and a quantity of the best grade rubbing varnish should be obtained. A clean brush does not mean a new one, which usually contains a great deal of dust, but one which has

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A Plate Current Supply Set

By G. M. Best

Herein is detailed the construction of the simple and inexpensive equipment necessary to use 110 volts alternating current as the source for the direct current plate supply of vacuum tubes. All parts specified are standard equipment or can be made up in accordance with the directions given. A slight modification also cares for a.c. filament supply for the second tube of an a.f. amplifier.

THE problem of plate current supply for the vacuum tube is never ending and with the increased use of multi-tube receiving sets, such as the Neutrodyne, the problem is serious, due to the large *B* battery drain, with resultant expense. Storage *B* batteries are used by many to good advantage, but there is always the necessity of re-charging. It is the purpose of the writer to describe a method of obtaining plate potential from the 110 volt alternating current house lighting circuit, at a relatively small initial cost and an extremely low upkeep.

The reader may already be familiar with various types of rectifier sets now on the market, such as the Tungar rectifier, for charging storage batteries, where a gas filled tube rectifies one-half of the alternating current wave and supplies a pulsating direct current to the battery. The Western Electric 2-A current supply set is an example of a rectifier set for furnishing filament and plate current for three vacuum tubes in a power amplifier, from the 110 volt line, but it is designed to accompany a particular type of amplifier and is not well adapted for other receiving sets. It employs two vacuum tubes of the two element type, having a filament and plate only, rectifies both halves of the alternating current wave and then filters the pulsating D. C. output before delivering it to the receiving set.

It is this type of rectifier that is pictured in Fig. 1, which shows a complete homemade outfit mounted on a hardwood board, and in convenient shape to be placed in a closet or other out of the way place where it will not be seen or occupy space around the radio set. The apparatus required is all standard with the exception of the power transformer, which can be made from specifications to be given later. The following list of materials, with approximate list prices, will give the reader an idea of the cost of building such a set:

2 C-301-A or UV-201-A Vacuum tubes @ $5.00	$10.00
5 Federal No. 134 or Western Electric No. 21-D 2 M. F. condensers @ $1.25	6.25
1 G. E. Wayne No. 179,541 Bell Ringing Transformer @ $1.75	1.75
2 Western Electric No. 38-A 12000 ohm Resistances @ $1.00	2.00
2 Any good make Sockets @ 75c	1.50
¼ lb. No. 18 D.C.C. Wire	.25
½ lb. No. 26 D.C.C. Wire	.50
1½ lb. No. 30 D.C.C. Wire	2.00
Necessary core iron for transformer	2.00
Total	$26.25

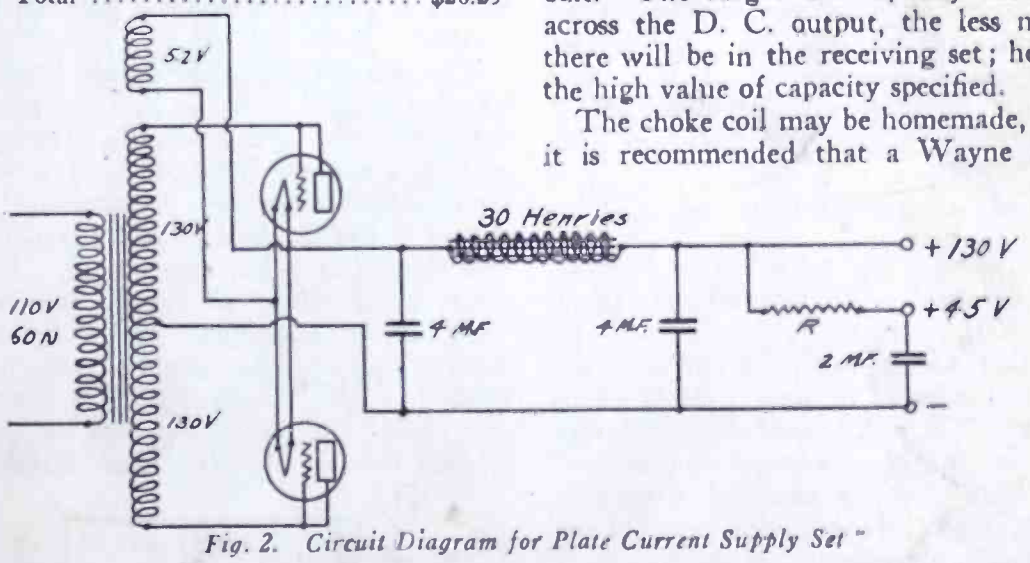

Fig. 2. Circuit Diagram for Plate Current Supply Set

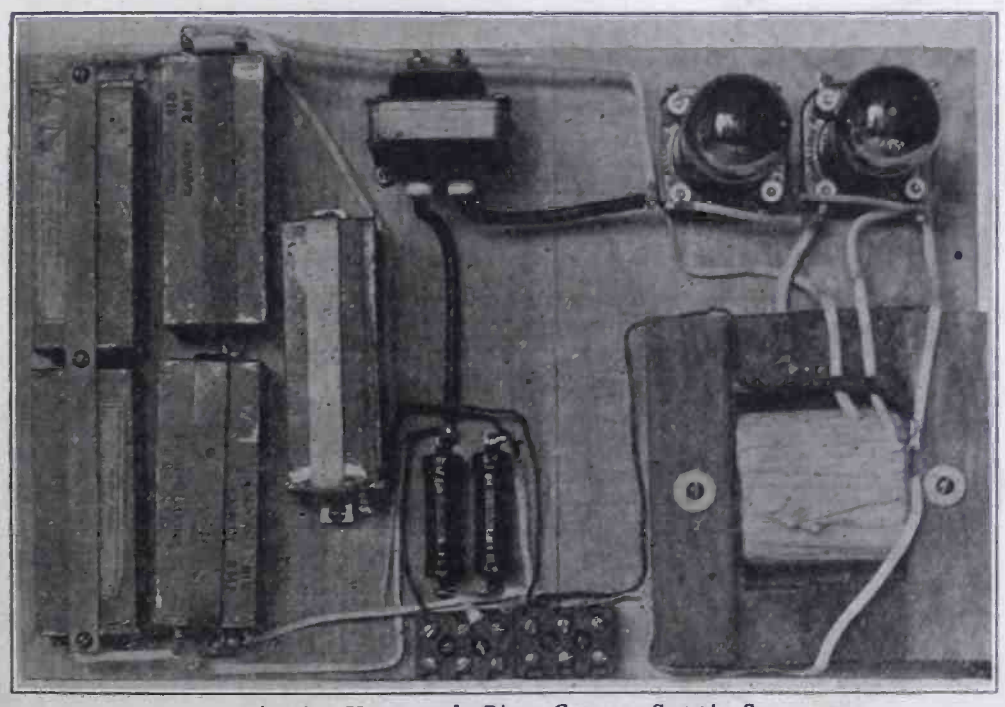

Fig. 1. Homemade Plate Current Supply Set

Fig. 2 is a schematic circuit diagram of the set, and shows all the connections required. The filaments of the rectifier tubes are operated from the 5.2 volt secondary winding of the transformer and each tube receives 130 volts A. C. from its half of the high voltage secondary, which is wound to a total of 260 volts. The grids of the tubes are connected to the plates, the connection being made at the socket terminals. The center tap of the transformer is the positive terminal of the pulsating direct current output and the negative D. C. terminal is taken from a common filament lead to the two rectifier tubes. The filter consists of a choke coil of high inductance, 10 henrys or more, and preferably as high as 25 henrys, with two 2 mfd. condensers bridged across the line on each side of the choke coil, making a total of 8 microfarads in the filter circuit. The larger the capacity bridged across the D. C. output, the less noise there will be in the receiving set; hence the high value of capacity specified.

The choke coil may be homemade, but it is recommended that a Wayne No. 179,541 bell ringing transformer be used, as it has about the right inductance, is conveniently mounted, and is not expensive. However, for those who wish to build their own choke, the following figures will be useful. Out of silicon steel core pieces 1 in. wide and 3 in. long build up a square core 4x4 in. outside dimensions, until the core is 1 in. high. This will give a core cross section of 1 sq. in. Wind two coils of 1500 turns each, using No. 34 D.C.C. or enameled wire, and place one coil on each leg of the core, connecting the coils so that they will be series aiding. The assembled choke will look much like the transformer pictured in Fig. 4.

If a G. E. bell ringing transformer is used for the choke, the primary winding only should be used, the secondary winding being of very small inductance, and not needed. The output of the filter

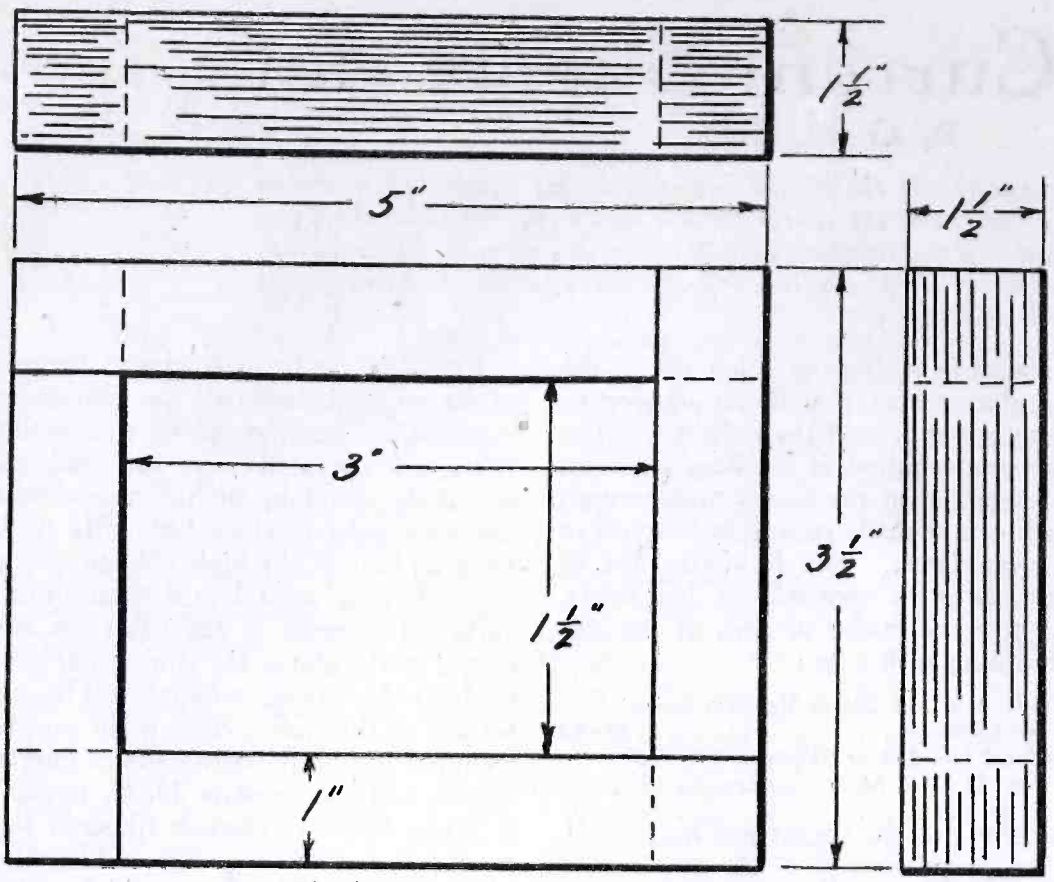

Fig. 3. Transformer Core Construction

when connected to the rectifier tubes will give 130 volts direct current, which will supply the power stages of the receiving set directly, without any other apparatus.

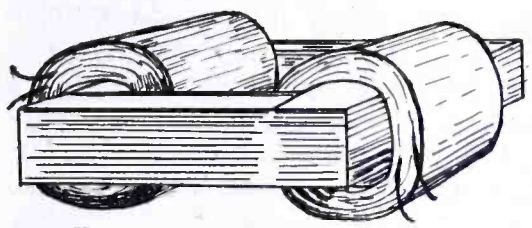

Fig. 4. Assembled Transformer

As many of the tubes in the receiver are operated on 45 and 90 volt plate potential, a set of resistances will be necessary to cut down the voltage from 130 to the lower values. Two Western Electric No. 38-A 12,000 ohm resistances in series furnish a convenient resistance unit, and may be obtained from any radio supply store having a stock of transmitting apparatus. If the No. 38-A resistances are not obtainable, there are several types of Ward-Leonard 10,000 and 15,000 ohm transmitting grid leak resistances available, and will serve the purpose equally well, although they may be more expensive. The resistances are connected to the positive terminal of the filter output, as shown in the diagram. A tap taken off between the two resistances will give approximately 80 volts, and the entire 24000 ohms will furnish 45 volts with a current drain of 5 or 6 milliamperes.

The negative terminal of the filter is common to all the tubes, no matter what their plate voltage may be. A 2 mfd. condenser is shunted between the 45 volt positive terminal and the negative lead, in order to prevent howling in the receiving set. This condenser is very important and singing or howling of some sort in the receiver is sure to result if it is left out of the circuit. It may also be necessary to add another 1 or 2 mfd. condenser between the 45 and 90 volt positive terminals, in case the receiving set sings when connected to the current supply set, but as a rule this will not be needed.

The power transformer should be constructed of good materials, the core being made of silicon steel if possible, although soft iron will do if silicon steel is not obtainable. The core construction is shown in Fig. 3, the core pieces being of two sizes, 1x2½ in., and 1x4 in. The pieces are piled up to form a window 1½x3 in. inside diameter and 3½x5 in. outside diameter, the height of the core being 1½ in. This will provide a core of 1½ sq. in. cross section, and the following data are for that cross sectional area: Primary winding 550 turns No. 26 D. C. C. wire, wound on one leg of the core. Over the primary wind 26 turns No. 18 D. C. C. wire, insulating this winding from the primary with empire cloth or other insulating material. The high voltage secondary consists of 1300 turns of No. 30 D. C. C. wire, with a center tap at the 650th turn, wound on the other leg of the core. It is very important that the core be thoroughly wrapped with empire cloth so that there will be no chance of the primary or secondary coils coming in contact with the core. The data given above are on the basis of silicon steel for the core material; if soft iron is used, it is recommended that the core be made ½ in. higher, making a total height of 2 in., in order to have sufficient flux density. After the coils are wound and placed on the assembled core, the core should be clamped as tightly as possible and fastened securely to the baseboard, so that there will be no vibration when the transformer is in operation.

A switch in the 110 volt primary circuit should be provided for convenience. No switch or filament rheostat is necessary in the filament secondary circuit, as the filament voltage is of the proper value, and is not critical. With a current drain of 24 milliamperes, two C-301-A tubes have been in operation in the writer's set for over 750 hours and show no signs of deterioration. If, however, the tubes should lose their filament activity, it would be a good plan to burn the filaments at the normal current for a few hours without applying the plate voltage, and it is quite probable that the filament activity will thus be restored. It is not advisable to use dry battery tubes in the rectifier set, as they are not designed to stand such a high plate voltage and would quickly burn out or flash over between the elements. Vacuum

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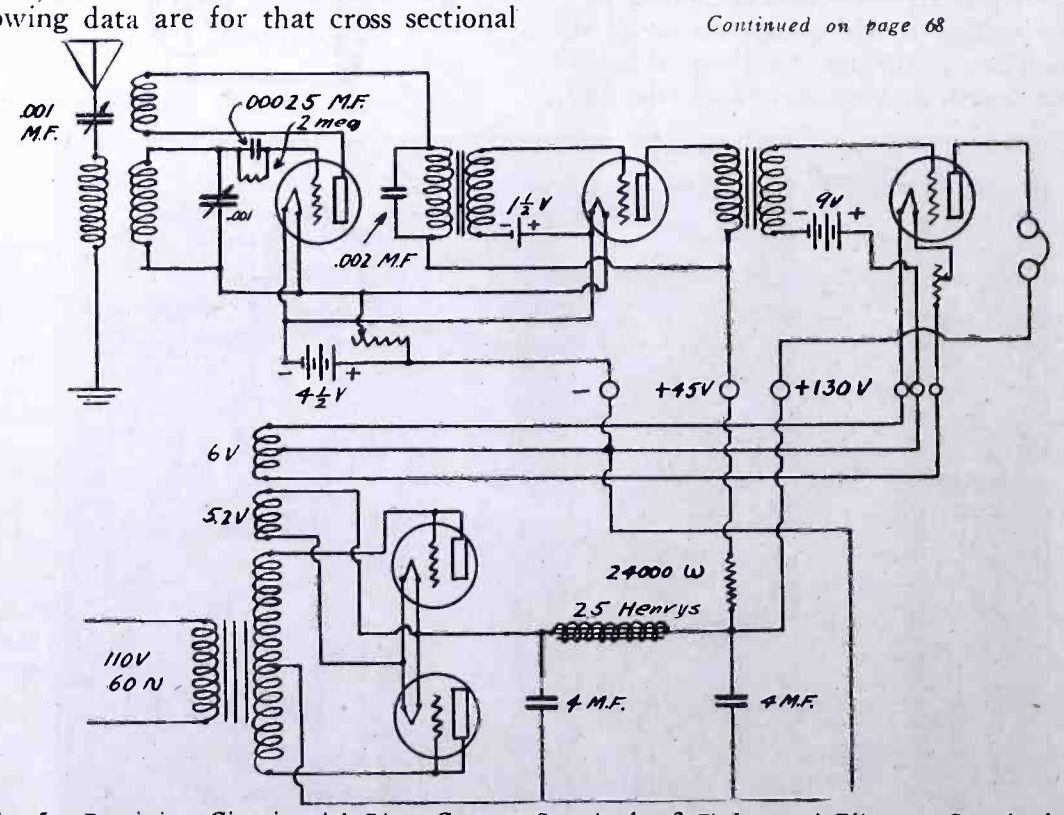

Fig. 5. Receiving Circuit with Plate Current Supply for 3 Tubes and Filament Supply from Transformer for 1 Tube

Theory of Super-Heterodyne Circuit

By L. R. Felder

Anyone contemplating the construction or operation of a super-heterodyne receiver may well study this article. In simple terms it explains the "reason why" of the circuit and its application. It will be found especially helpful to those making up Best's 45,000-cycle super-heterodyne.

THE super-heterodyne circuit was a development of the Great War, and was the direct outgrowth of the need for a good radio-frequency amplifier for low wavelengths. The ordinary methods for radio-frequency amplification of low wavelengths which were available at that time were unsatisfactory for a number of reasons. It will be very instructive to consider the reasons for this.

The principal methods for amplifying low wavelengths at radio-frequency were tuned radio-frequency amplification, untuned transformer-coupled amplification and resistance-coupled amplification. All of these proved unsatisfactory. Fig. 1 illustrates the first plan, namely tuned radio-frequency amplification. Two stages are shown before the detector, but any number may be used. However, one or two stages of such a method offer sufficient difficulties. Such an amplifier is extremely selective. If any one of the tuned circuits is not exactly in resonance, amplification will be destroyed and, in fact, the signal may be completely lost. It will be observed that in the entire radio-frequency circuit there are some half dozen circuits to tune and hence an equal number of controls. To tune all of these circuits to resonance requires the skill of an expert, and the possibility of an expert missing a single circuit is great.

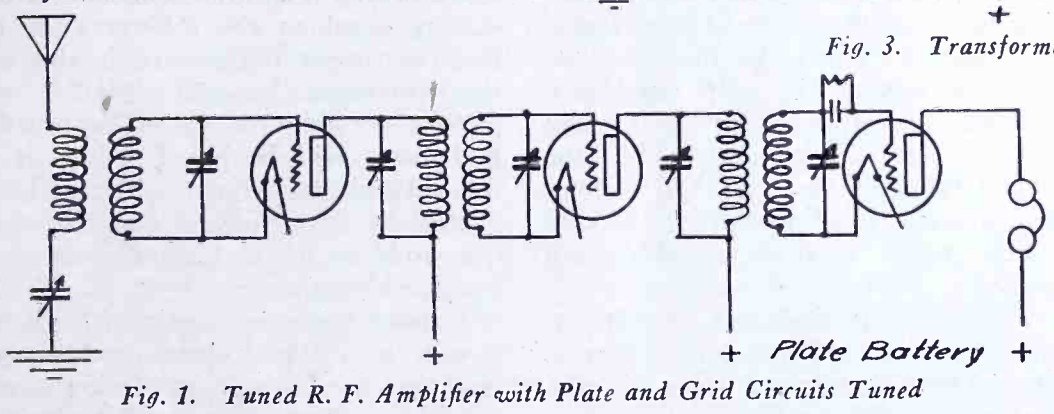

Fig. 1. Tuned R. F. Amplifier with Plate and Grid Circuits Tuned

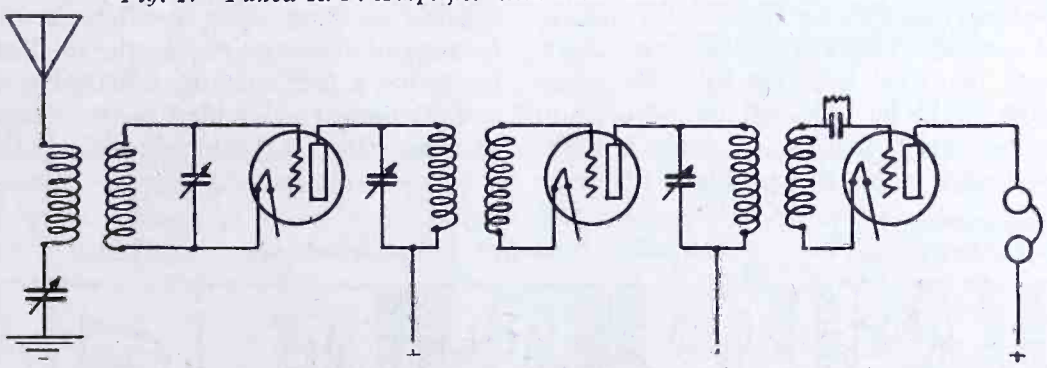

Fig. 2. Tuned R. F. Amplifier with Plate Circuit Tuned

Of course the circuit may be arranged as in Fig. 2, which shows only two inter-tube circuits which are tuned. This reduces the number of controls from six to four, but even four are too many. However, even if it were possible to tune all of these circuits and realize the full amplification from each tube, there is another difficulty in the way. The internal capacity of the tube produces feed-back between the plate and grid circuits which is sufficient to produce radio-frequency howling. In other words, we have here the same limitation to radio-frequency amplification at low wavelengths as was described in last month's issue of RADIO in the article on "Neutrodyne," and for which the Neutrodyne circuit is a solution. Tuned radio-frequency amplification thus presents two essential difficulties: (1) Tuning controls are too many for such an ultra-selective circuit, which makes tuning too difficult, and (2) it is almost impossible to avoid regeneration at such high frequencies without introducing some neutralizing force. Regeneration

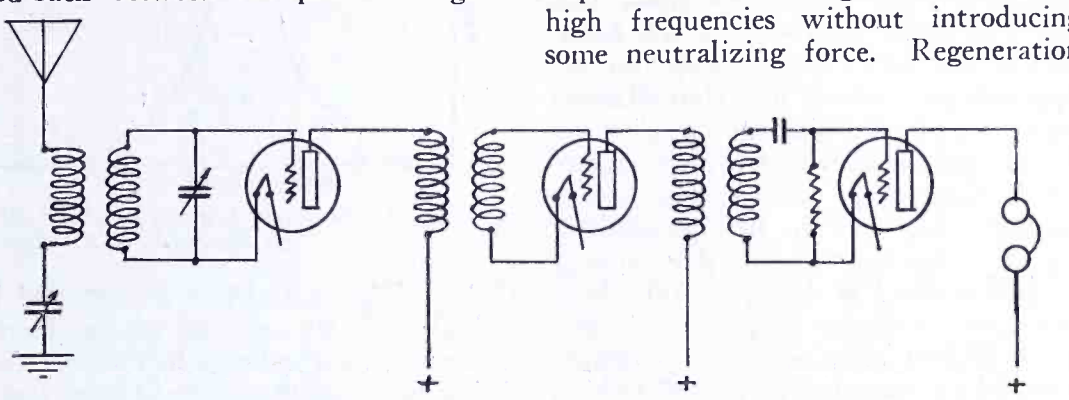

Fig. 3. Transformer Coupled R. F. Amplifier

results in oscillations which spoil quality of signals and reduce over-all amplification. Tuned r. f. amplification was therefore abandoned.

The next plan was to employ straight r. f. transformer coupling as in Fig. 3. Even such a system has a tendency to regenerate and produce radio-frequency howling. But, even if it did not oscillate, it has one disadvantage. Radio-frequency coupling transformers will give amplification only over a very narrow band of wavelengths. Maximum amplification is secured at one wavelength, and then falls off as this wavelength is departed from. With this system we therefore cannot avail ourselves of the full amplification of the tube at all wavelengths.

The third alternative method of radio-frequency amplification is straight resistance coupling as in Fig. 4. But at very high frequencies corresponding to the low wavelengths this has one very great disadvantage: it does not amplify. The reason a resistance-coupled amplifier does not amplify at very high radio-frequencies is that the capacity of the tubes

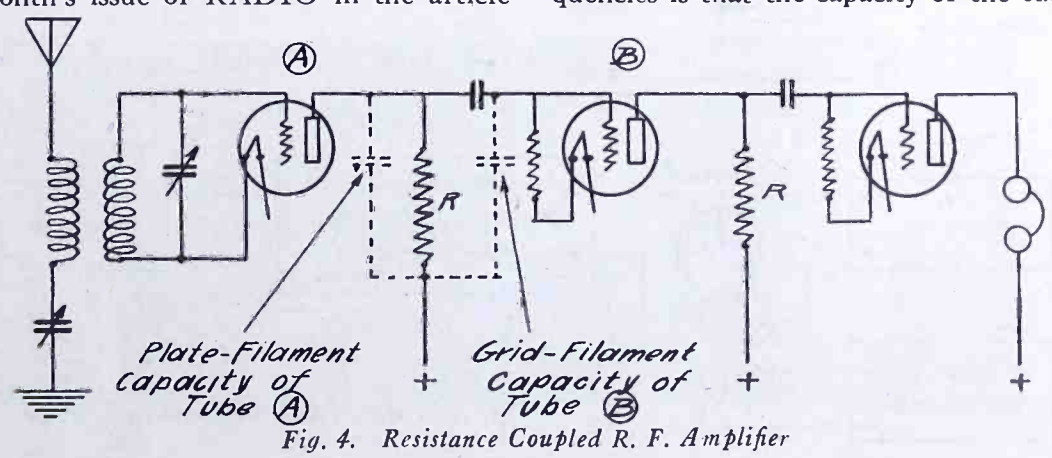

Fig. 4. Resistance Coupled R. F. Amplifier

from plate to filament and from grid to filament short-circuits the amplified voltage. Thus in Fig. 4 consider the coupling resistance *R*, which is of the order of 50,000 ohms. The amplified voltage is developed across this resistance and applied to the grid of the succeeding tube, *provided* there is nothing to annul this voltage. But actually we have in parallel with this resistance *R* two capacities: (1) the plate-filament capacity of tube *A*, and the grid-filament capacity of tube *B*. These capacities have no influence on the voltage across *R* at direct currents or audio-frequency currents because their reactance is so great. However, at radio-frequencies, their reactances become so small that they practically short-circuit the resistance *R* and hence destroy amplification. Approximate values for plate-filament capacity and grid-filament capacity are 4 micro-microfarads and 6 micro-microfarads respectively. Since they are in parallel, the total is 10 micro-microfarads. The reactance of this capacity at 200 meters is about 10,000 ohms. In other words our coupling resistance *R* of 50,000 ohms or more is short-circuited by a reactance of 10,000 ohms, which is very much less than the internal impedance of the tube. Hence no amplification at radio-frequencies can be secured. Amateurs who have wondered why resistance-coupled r. f. amplification at low waves is impossible will now see the reason for it, and will also understand why it is possible at very long waves, for at very long waves the reactance of the tube capacity is high compared to the coupling resistance *R*, and hence does not short-circuit the voltage.

We now readily see the obstacles which were in the way of radio-frequency amplification at low wavelengths. The Neutrodyne Circuit described in May RADIO is one solution, but in 1917 this was not yet possible. Numerous attempts at a solution were made all over the world, and some of these are both of importance and interest. One of these solutions attempted to broaden the band of wavelengths received and amplified by making a radio-frequency transformer wound with resistance wire. The effect of the resistance winding was to change the amplification curve from that of Fig. 5(a) to that of 5(b). The same effect was secured by using radio-frequency transformers with an iron core, the losses in the iron core being equivalent to resistance losses. This resistance effect also prevented regenerative action in the amplifiers. However, selectivity was thus lost. Another solution attempted by the English struck at the root of the trouble; they directed their energy to making vacuum tubes with extremely small capacity.

Armstrong attacked the problem of short wave radio-frequency amplification from an entirely different angle. Radio-frequency amplification at long waves had proved very successful; at short waves it was unsuccessful. If some means could be obtained of converting the incoming low wave into a high wavelength then the problem of r. f. amplification would be solved. This means a conversion of a high frequency into a low frequency.

Such conversion of frequency had been practiced for a long time in C. W. heterodyne reception, in which the phenomenon of beats is used. If a continuous wave oscillation of frequency 100,000 cycles per second is combined with another of 99,000 cycles per second, then the well-known phenomenon of beats is produced, and the result of these two oscillations is another oscillation whose amplitude varies at a frequency equal to the difference of the two component frequencies, in this case the difference between 100,000 and 99,000, or 1000 cycles. Thus a 1000-cycle note will be heard. This is an old principle in radio reception and was applied by Armstrong in his solution to the problem of r. f. amplification at low wavelengths.

Suppose the incoming signal has a frequency of 700,000 cycles, and suppose also that we have an oscillating circuit capable of generating oscillations over a range of frequencies. If the oscillator is set for a frequency of 650,000 cycles and its output is coupled to the receiver carrying the 700,000-cycle signal, then

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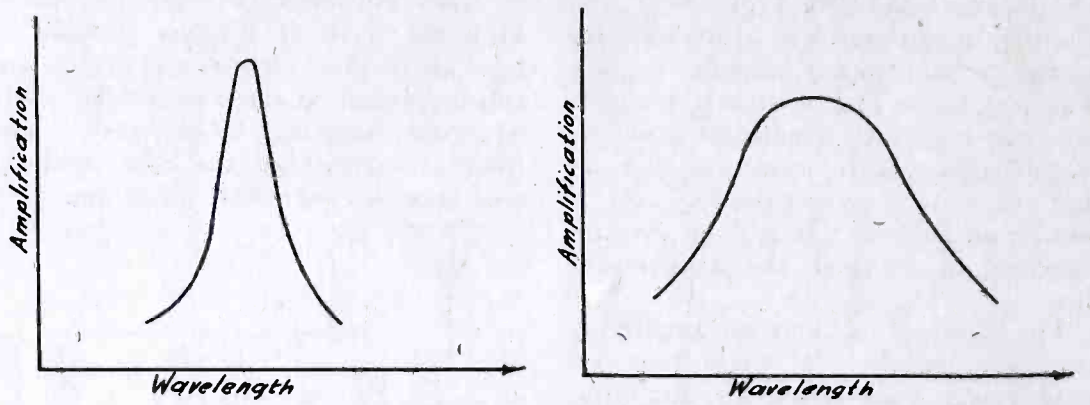


Fig. 5. Amplification Curves, (a) with Ordinary R. F. Transformers, (b) with Transformers Wound with Resistance Wire or Having Iron Cores

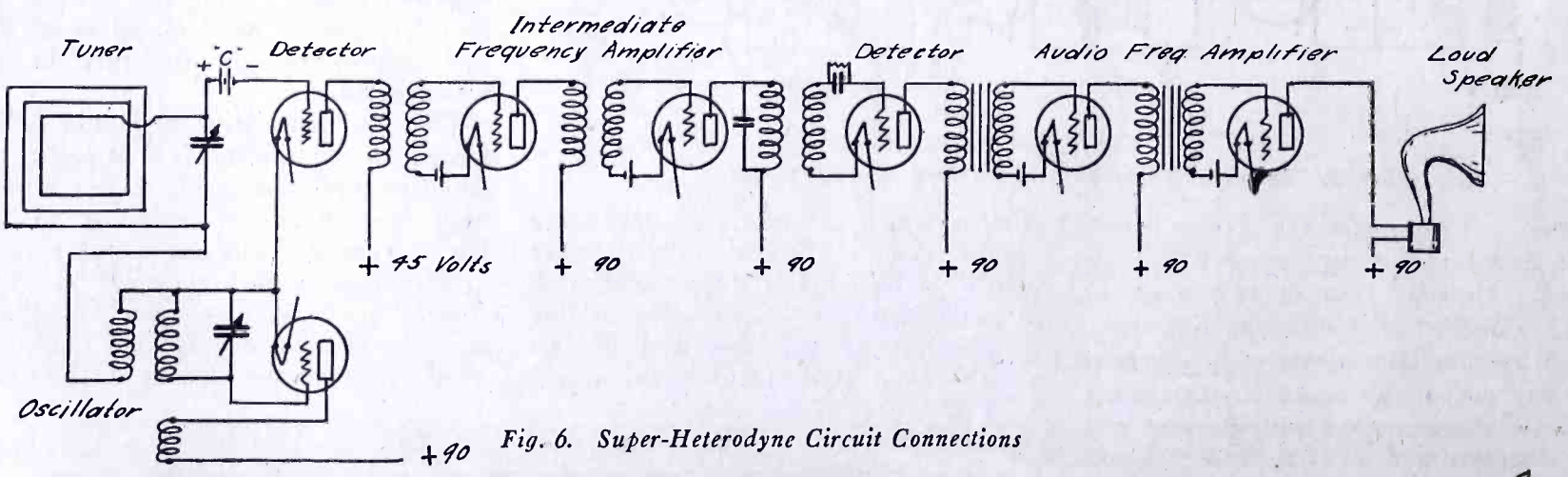


Fig. 6. Super-Heterodyne Circuit Connections

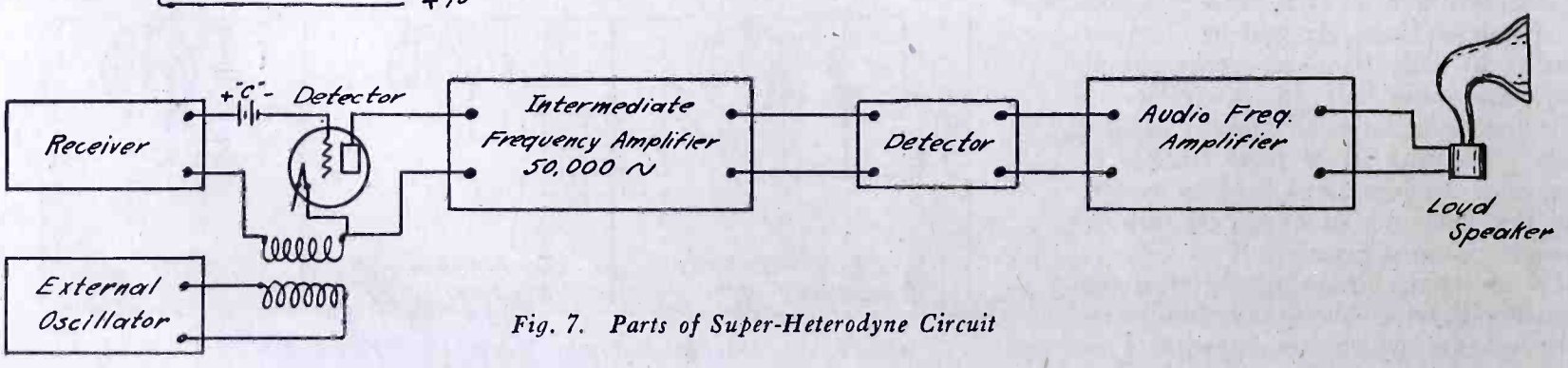


Fig. 7. Parts of Super-Heterodyne Circuit

Additional Data and Improvements in Best's 45,000 Cycle Super-Heterodyne

By G. M. Best

This material supplements the original article in May RADIO. It will be followed up each month hereafter with the best of the suggestions submitted in the prize contest for improvements. A reprint of the first article has been made for those unable to secure the May number. It will be sent postpaid by the publishers for 25 cents.

Cabinet Construction and Shielding

IT has been found that a shielded panel and cabinet improve the selectivity when the set is operated within a radius of a mile or two of a high-powered broadcasting station and also greatly reduce the "man-made static," such as is caused by high tension transmission lines, street cars, automobile ignition systems, elevator motors, etc. Tests show that a great part of the disturbances are picked up directly in the wiring of the set when it is not completely shielded. In the same manner, waves from nearby high-powered broadcasting stations are picked up by the oscillator coil system and much of the selectivity generally expected from the use of a loop is lost.

The complete shielding of the panel and cabinet will not be necessary except in cases where the set is to be operated under the conditions just described. In locations where there is very little "man-made" static, and no high-powered broadcasting station within a few miles, shielding is not necessary and the directions given for building the cabinet may be followed with the metal lining omitted. A view of the bakelite panel, with the brass shield in place, the instruments mounted and part of the wiring installed is shown in Fig. 1.

Fig. 2 is an inside view of the cabinet showing the shielding of all sides, the top and bottom. It is very important that if shielding be undertaken at all that it be complete, as otherwise its advantages cannot be realized at all times.

It is recommended that the cabinet be made to order in some woodwork shop. The expense is nominal and worth while, in view of the cost of material and the labor expended in building a cabinet. The cabinet shown in the illustration is made of mahogany and was built to order at a cost of $8.00.

For those who prefer to build their own cabinet, the following dimensions and instructions are given: Overall outside dimensions—26 1/16 in. long, 7 1/16 in. high and 10 in. deep. Inside dimensions 25 1/16 in. long, 6 1/16 in. high and 9½ in. deep. Material of ½ in. mahogany or oak. The extra 1/16 in. given in some of the dimensions is to allow for shielding the cabinet and to permit an easy fit. The top of the cabinet should be made in two sections, one 2 in. wide and the other 8 in. wide. The 8 in. section should be hinged from the back so that it may be raised to insert tubes and make adjustments on the Chelten Midget condenser and oscillator coupler unit.

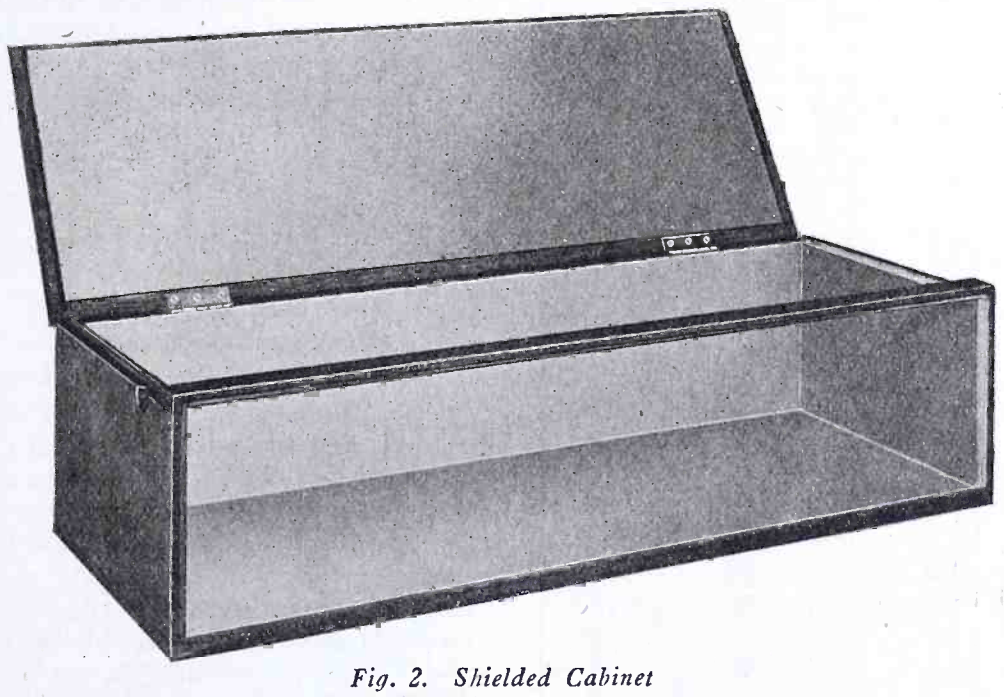


Fig. 2. Shielded Cabinet

The cabinet shielding may be of about No. 34 gauge brass or copper. The shield material should be cut in sections of a size that will just cover the bottom, top and three sides, and tacked into place with small flat headed brads or brass tacks. After the shielding is completed, three wood strips ½ in. square, two 5½ in. long, and one 26 in. long should be tacked to the two sides and top of the cabinet, ¼ in. from the front edge, or 3/16 in., if a 3/16 in. bakelite panel was used. These strips form a stop for the panel when it is fitted into the cabinet and a means for screwing it into place. In the template, Fig. 3, drillings for screw holes along the top and sides are shown. Corresponding screw holes will have to be drilled in the bakelite panel, as they were not shown in the panel template given in last month's article.

A ½ in. hole should be drilled in the back of the cabinet, 4 in. from the bottom and 1 in. from the left end, for the purpose of bringing out the four battery leads from the terminal block mounted on the baseboard of the set. These leads may be conveniently made from two sections of twisted pair lamp cord.

Although the use of a shielding cabinet will improve the selectivity of the set and reduce stray interference without affecting it's efficiency, it will change the

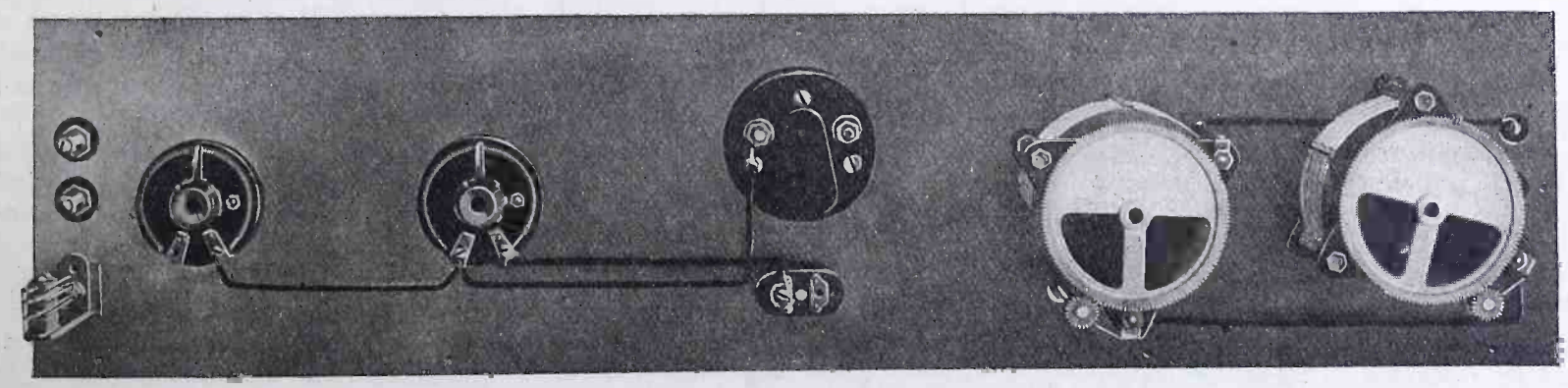


Fig. 1. Shielded Panel

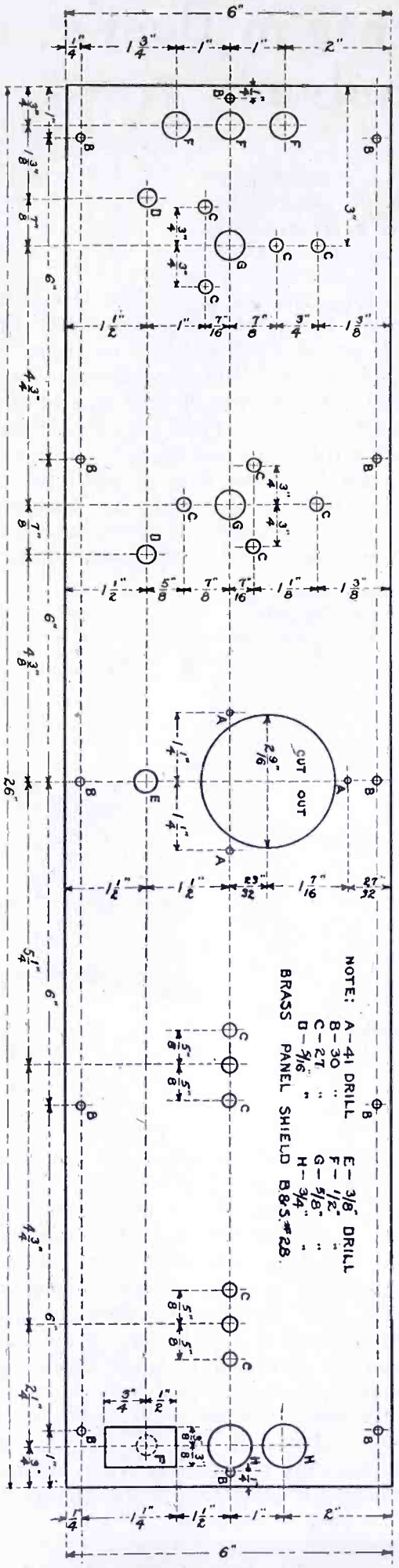


Fig. 3. Template for Panel Shield

calibration of the set and will necessitate a re-adjustment of the Midget feed back condenser and the oscillator coupling unit. The procedure for making these adjustments is the same as outlined in the original article.

Fig. 3 is a template for drilling the brass panel shield which may be of any gauge or thickness of brass or copper that is conveniently obtainable. No. 28 gauge brass was used in constructing the shield shown in the illustration, and is recommended as being of a weight that is convenient for cutting and drilling. Sheet tinplate may be used where brass is not available. The template is made to conform with the panel drillings of the set as illustrated in Fig. 5, of May RADIO. If the reader has made any substitution in the parts that mount on the panel, it will be necessary to change the shielding template accordingly.

Since the brass shield is connected to the negative *A* and *B* battery terminals, it is important that extreme care be taken to insulate all parts of the mounted apparatus, that are common to any part of the circuit, other than the negative battery leads, below the rheostats. This is most easily done by cutting the holes in the shield sufficiently large to clear the condenser and rheostat shafts and any other parts that would cause short circuits. It will be noted that in the template in Fig. 2, a large rectangular portion is marked to be cut out for the phone jack. It was found to be more convenient to drill a ½ in. hole through the phone jack and insulate it from the shield with a thin fiber washer as shown in Fig. 3.

Intermediate Frequency Transformers

IN case the intermediate frequency transformers are difficult to obtain, or their expense is too great, many constructors may desire to build their own transformers. While it is not probable that the results obtained with the home-made product will be as good as with the commercial types of transformers, no doubt some readers would like to try their hand at building a set of the 45,000-cycle transformers, and the following data will be of assistance in their construction.

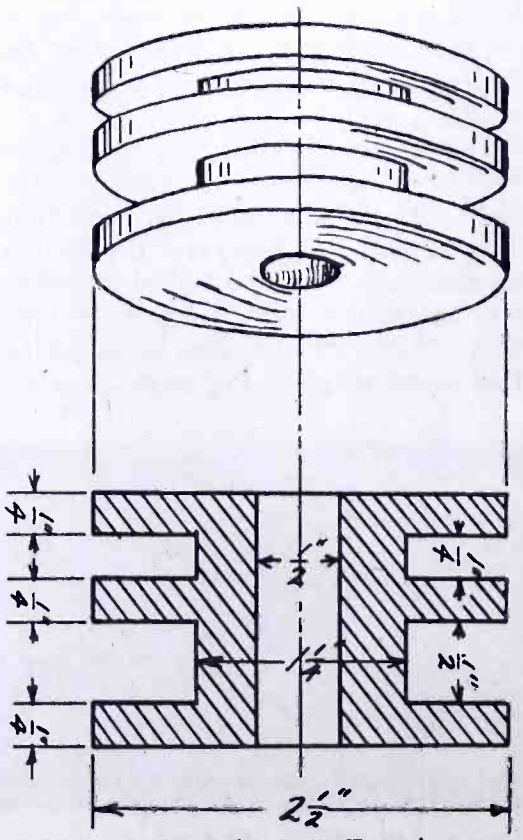


Fig. 4. Spool for I. F. Transformer

The spools on which the coils are wound should be turned out of seasoned hardwood, with two slots for the windings, one slot being ¼ in. wide, and the other ½ in. in width. The principal dimensions of the spool are shown in Fig. 4. A hole ½ in. in diameter should be bored in the center of the spool, for the core.

The primary winding should consist of 450 turns of No. 30 Double Silk wire, wound in the ¼-in. slot. No particular order should be observed in winding the coil, the wire being placed in a haphazard manner to reduce the distributed capacity effect. The secondary winding should be 2100 turns of No. 36 Single Silk wire, wound in the ½-in. slot. For the core material, use either a bundle of fine iron wires, such as No. 36 gauge, or a bundle of flat strips of silicon steel, not over three thousandths of an inch in thickness. Ordinary heavy transformer iron or silicon steel will not do, and the thinner the laminations the better the transformer. Small lugs should be provided for terminals, the inside primary lead going to the plate, outside primary to the *B* battery, inside secondary to the filament and outside secondary to the grid, in each transformer.

HOOVER PLANS RADIO CONFERENCE

By CARL H. BUTMAN

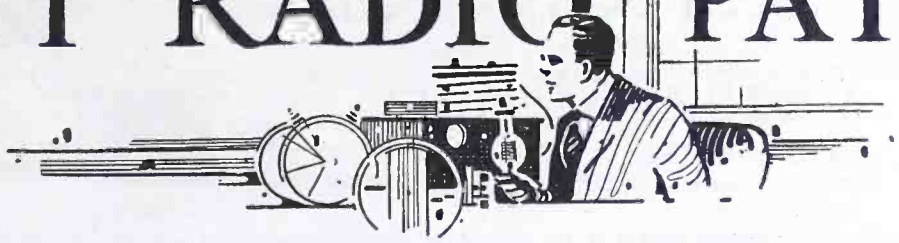
Secretary of Commerce Hoover will call a general radio conference in Washington soon after the adjournment of Congress in an effort to secure co-operation of all radio interests in clearing up the ether and solving the problem of distributing wavelengths. A conference will be called whether or not new legislation is enacted.

The conference will be similar to those in the springs of 1922 and 1923, at which representatives of the manufacturers, broadcasters, engineers, amateurs, commercial operators, and broadcast listeners aided in drawing up voluntary regulations under which radio has been supervised ever since. It was in this manner that the distribution of wavelengths for broadcasters and other interests was developed.

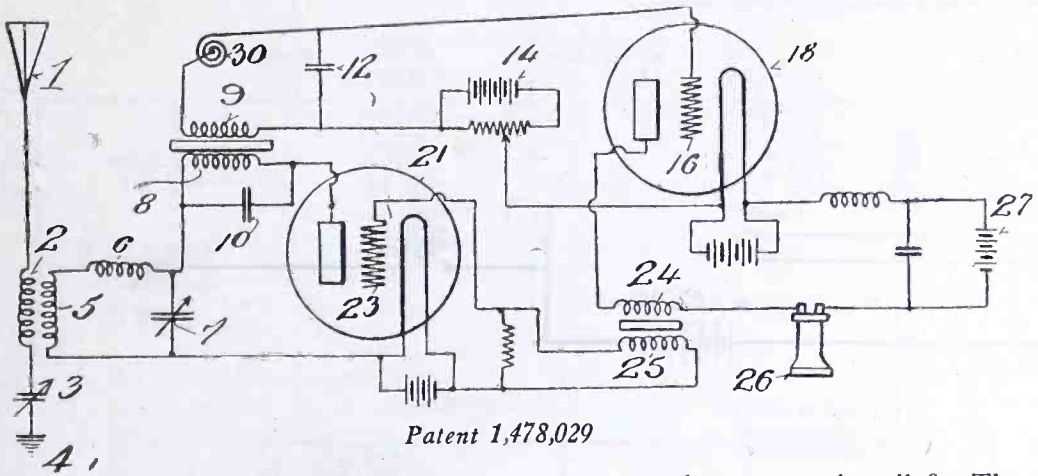
Present indications are that broadcasting stations will continue to increase although wavelengths available for this use are practically exhausted and stations are doubling up. Even time allotments in congested sections are becoming difficult to make.

Secretary Hoover believes congested conditions and interference are getting worse. If present conditions continue, he is unable to see how we could operate five years from now, and as a consequence he intends taking advantage of such suggestions from representatives of the allied radio art and industry as may be made.

DIGEST OF RECENT RADIO PATENTS



Prepared by White, Prost & Evans, patent attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below. These patents are selected especially with reference to their possible application and use by the radio amateur.



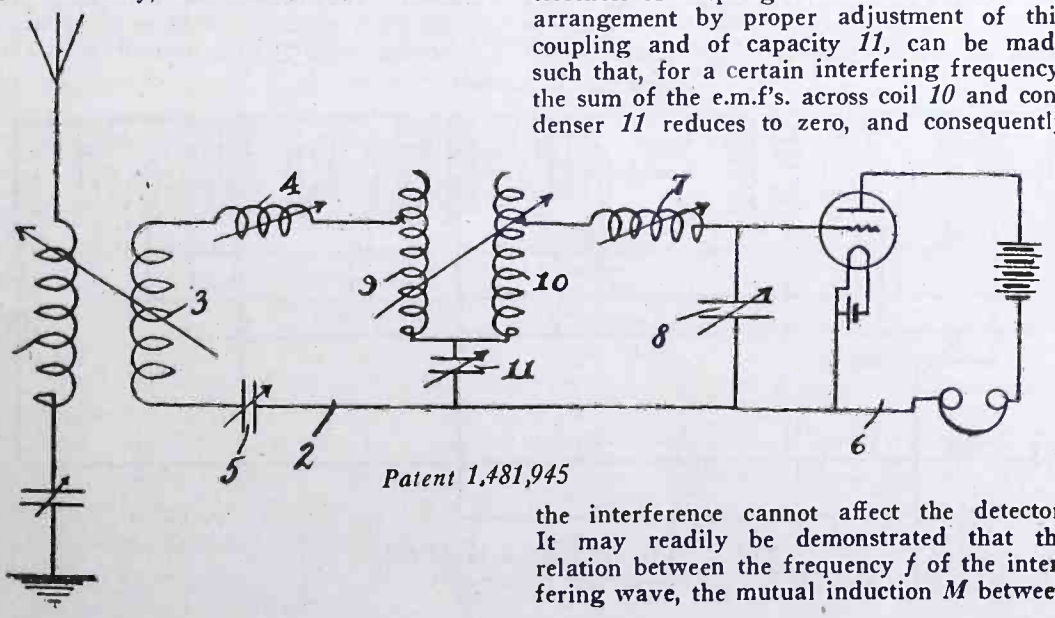
Patent 1,478,029

L. De Forest, Pat. No. 1,478,029; Dec. 18, 1923. Radio Receiving System.

This patent describes a very ingenious way of receiving constant wave signals without the aid of heterodyning or of a chopper. The apparatus is so arranged that periodic pulses of current are produced automatically, by the flow of the current impulses. The tuned circuit *5-6-7* is coupled as usual to the absorbing circuit *1-2-3-4*. The inductance *5-6* is purposely made high so that the growth of current therein is slow. A tube *21* is so arranged as to rectify the signals, the plate and filament being connected directly across this resonant circuit. If no other apparatus were provided, the flow of rectified current in the form of radio-frequency half-waves could not influence a telephone; therefore to split up this train of half-waves into groups of audio-frequency, the grid *23* is used, which, as described later, periodically varies, at audio-frequency, the resistance of the electron path between plate and filament of tube *21*, and thus serves to modulate the train of half-waves with an audio-frequency current. For this purpose, use is made of another tube *18*, serving as a three-electrode amplifier, the input circuit of which is inductively coupled, as by coils *8-9*, to the rectifier circuit. When the signal impulse first comes in, it gradually rises in intensity, and causes the induction of a corresponding current in coil *9*. The grid *23* is supplied with an amplified potential, due to coupling *24-25*, between the output circuit of tube *18* and the grid-filament circuit of tube *21*. This potential is of such sign that the rectified current flow is reduced. This reduction in turn affects the amplifier *18* by the aid of coupling *8-9*, so as to change the potential of grid *23* to permit another impulse to pass. This process is repeated for the duration of the dot or dash. A telephone *26* in the output circuit of tube *18* is operated by the surges of current therein. The tone of the signals can be varied by varying the circuit constants, as by the use of inductances *30*.

J. Weinberger, Pat. No. 1,481,945; Jan. 29, 1924. Radio Receiving System.

This patent describes an interesting form of wave trap that is intended to eliminate strong interference of a certain frequency. The antenna circuit *1* conducts its received energy across a coil *9* and condenser *11* in series. Another coil *10* variably coupled with *9* is also in series with the condenser *11*, and across the coil *10* and condenser *11* the usual detector circuit *6* is connected. An e.m.f. impressed across coil *9* and condenser *11* in series, from the antenna has its counterpart across coil *10*, its value depending upon the closeness of coupling between the coils. The arrangement by proper adjustment of this coupling and of capacity *11*, can be made such that, for a certain interfering frequency, the sum of the e.m.f's. across coil *10* and condenser *11* reduces to zero, and consequently



Patent 1,481,945

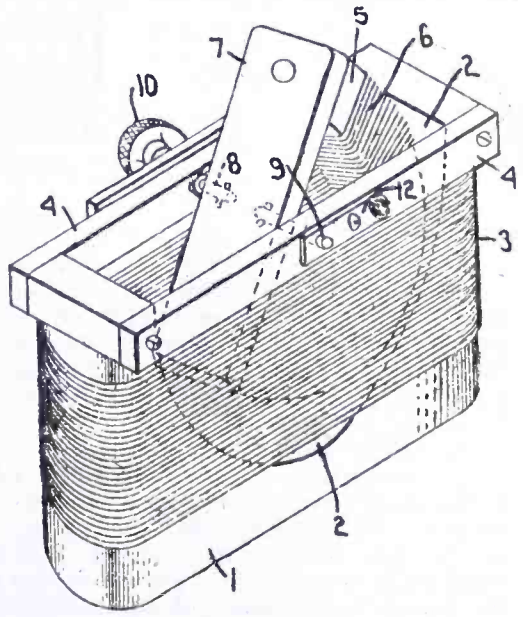
the interference cannot affect the detector. It may readily be demonstrated that the relation between the frequency f of the interfering wave, the mutual induction M between coils *9* and *10*, and the capacity C of condenser *11* must fulfill the following equation in order to reduce the effect to zero:

$$4\pi^2 f^2 = \frac{1}{M C}$$

The explanation of this action rests on the fact that whatever e.m.f. is induced in coil *10* by the mutual coupling is opposed by the potential drop across condenser *11* due to the flow of current therein set up in circuit *9, 11* by the interfering energy. By the proper choice of the circuit characteristics in accordance with the formula given above, these two opposing e.m.f's. cancel each other.

Ernest M. Reynolds, Pat. No. 1,478,579; Dec. 25, 1923. Coupler for Radio Reception.

A coupler of unique construction is described, in which the attempt is made to secure linear variation of inductance instead



Patent 1,478,579

of sinusoidal. For this purpose, a flat hollow rectangular coil *3* is formed, in which a coil *6* is movable. The coil *6* is wound on a circular non-magnetic core *5* in the form of a torus, and is pivoted near the top of the coil *3*. Furthermore, this latter coil is just wide enough to permit the coil *6* to swing freely therein. The arrangement may be used either as a variocoupler or as a variable inductance.

"How Long Will My *B* Batteries Last?" is the subject of a helpful 16-page pamphlet by W. B. Schulte issued by the Burgess Battery Co. This report presents the shelf life, discharge and capacity characteristics of plate batteries classified according to battery weight in pounds. Examples of how approximate service-hours may be computed are shown for all standard combinations of tubes and batteries.. Plate currents with various grid bias voltages are indicated by curves. The effects of the number and size of *B* batteries, the number and type of tubes, and the grid bias voltage, are clearly presented.

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.

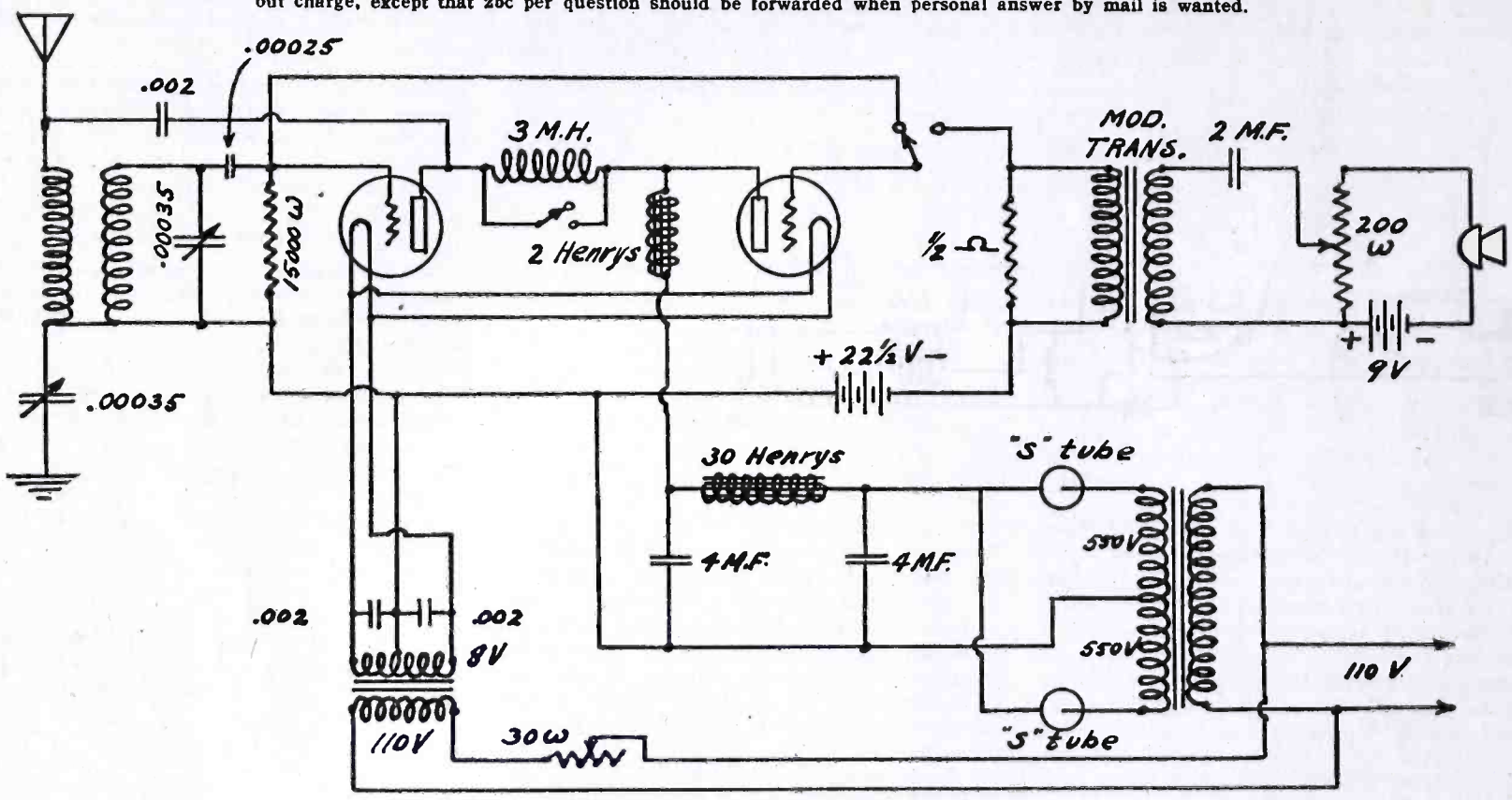


Fig. 1. 10-Watt C. W. Transmitter

Please publish a circuit for a 10-watt C. W. transmitter, for use either with buzzer, straight C. W. or phone, using "S" tube rectifier, filter, separate filament transformer and Heising modulation.—T. C. H., Redlands, Calif.

The circuit you wish is shown in Fig. 1. It will be necessary to have two single-pole, double-throw switches to convert the set from C. W. telegraph to radiophone. A double, pole, double-throw switch will be necessary to connect either the microphone or the buzzer to the input of the modulation transformer. The potentiometer and 2 mfd. condenser are for the purpose of controlling the amount of a.c. input into the modulator tube.

Please tell me how to make a simple microphone transmitter.—G. S., Los Angeles, Calif.

To build a successful carbon grain transmitter is a difficult task unless you are thoroughly familiar with tool making, and I would not advise your attempting to build such an article when it may be obtained at any radio store for a relatively small amount, and will be infinitely better than anything you could possibly construct at home.

Which is more efficient, an "S" tube rectifier or one of the commercial types of synchronous rectifiers?—F. J. P., Chicago, Ill.

From the standpoint of initial expense, the "S" tube rectifier is the best. However, the output of the "S" tube outfit is rather limited, and for those who desire to operate a number of 50-watt tubes, or several 250-watt tubes, either a motor-generator, or a synchronous rectifier will be necessary. Whether you use a synchronous rectifier or the "S" tubes, you will require a step-up transformer. So for small installations, up to 50 watts, the "S" tubes would be the most economical.

Please publish the circuit diagram of the Murad MA-13 receiver.—F. Y., Oakland, Calif., and W. H. B., Bellefonte, Pa.

The circuit shown in Fig. 2 is similar to the MA-13 circuit.

Please publish a circuit diagram for a one-tube transmitting set, with list of parts. Will a 150-ft. antenna work with this set?—W. E. L., Clem, Oregon.

The circuit you wish is shown in Fig. 3. I assume you have alternating current available. You will require the following apparatus for constructing the set: One antenna inductance, made of 20 turns of copper strip or heavy copper wire wound into a helix,

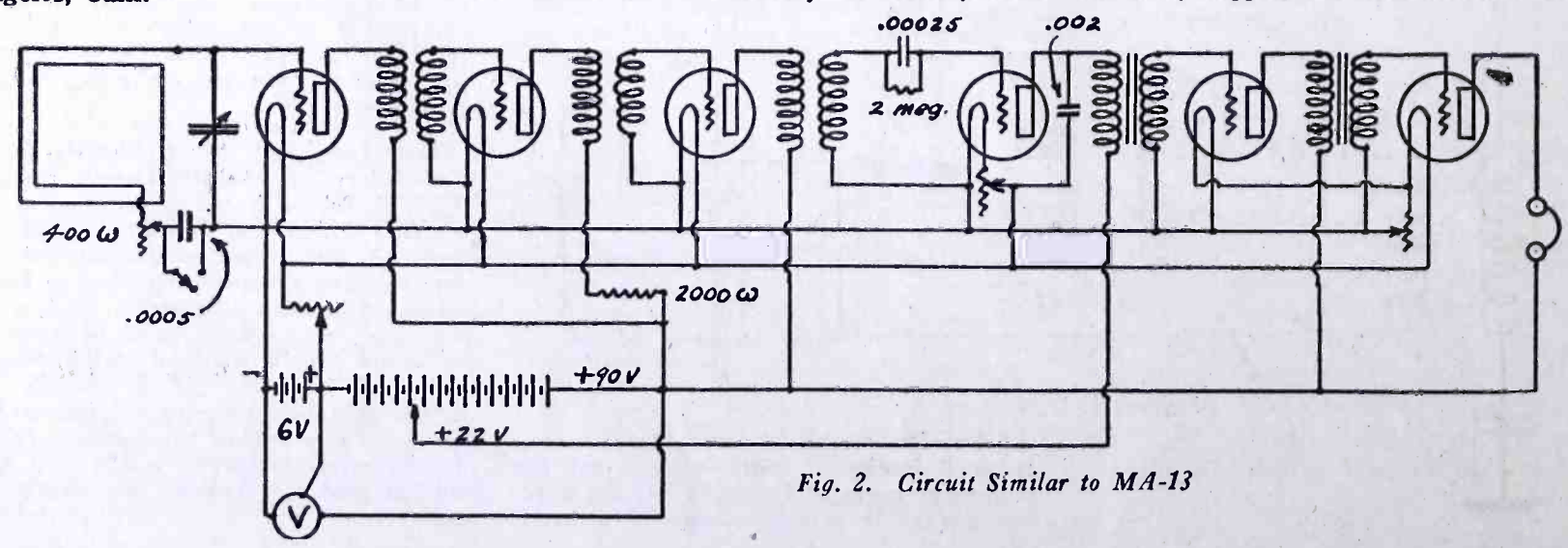


Fig. 2. Circuit Similar to MA-13

6 in. in diameter; one .002 mfd. mica condenser, one 5-watt vacuum tube and socket, one 250-turn honeycomb coil, unmounted; one telegraph key; one filament rheostat capable of carrying 2.5 amperes; one power transformer; one set of clips for variable connections on the helix. The power transformer you can build yourself from the following dimensions: core made up of silicon steel strips, 1½ in. wide and 4½ in. long, piled so as to form a square window, 1½ in. high. This will give you a cross sectional area of 2.25 sq. in. On one leg of the core, wind 365 turns of No. 18 D.C.C. wire for the primary. Over the primary winding place 27 turns of No. 12 D.C.C. wire, with a center tap at the 13.5th turn. On the other leg of the core wind 1825 turns of No. 28 or No. 30 D.C.C. wire, for the 550-volt secondary. The transformer is connected as shown in the circuit diagram, Fig. 3.

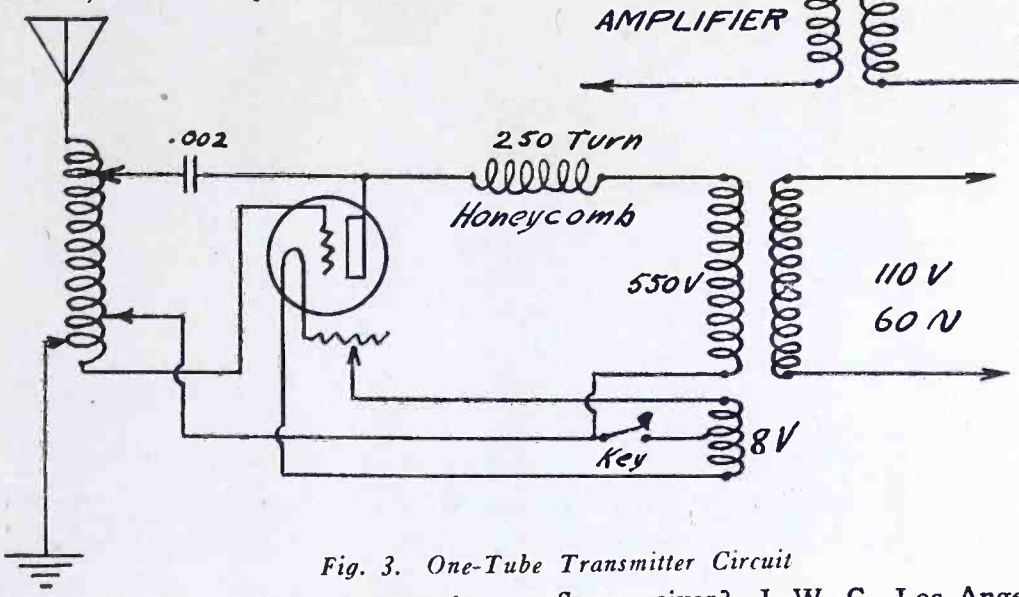


Fig. 3. One-Tube Transmitter Circuit

In April RADIO, page 15, a two-crystal receiver is described. Will this idea work out in connection with a Harkness reflex receiver?—J. W. C., Los Angeles, Calif.

There is no reason why this method should not work in a Harkness reflex circuit, or any other reflex circuit for that matter. Fig. 4 shows how this method may be applied to the crystal detector unit of a reflex set. Only the detector unit is shown, the rest of the circuit being independent of the crystal unit.

Please publish the circuit diagram of the Radiola super-heterodyne receiver.—C. H. J., Allentown, Pa.

The schematic circuit of the Radiola Super-Heterodyne is shown in Fig. 5. This is not a detailed wiring diagram of the set, but shows the general layout of a second harmonic type of super-heterodyne receiver.

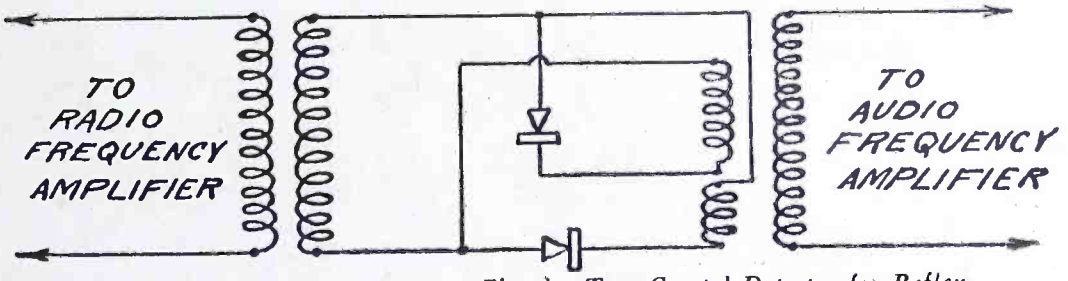


Fig. 4. Two-Crystal Detector for Reflex

Please correct circuit diagram of my receiving set, so that I can add one stage of radio-frequency to the present set, and retain the wave trap in the antenna circuit, which I find improves the results considerably.—S. S. H., Berkeley, Calif.

A corrected circuit diagram of your receiver appears in Fig. 6. It would greatly improve your set to add a *C* battery of 4½ volts as shown, and increase the *B* battery to 90 volts. The extra stage of radio-frequency amplification can be cut out when desired by means of the switch shown in the diagram. It would be preferable to use either C-299 or UV-199 tubes in the above circuit.

Please publish a circuit adding one stage of audio-frequency to my present circuit. Give data on how to construct a 330-ohm choke.—S. H. N.

Your circuit has so many errors in it that it is impossible for me to make out just what kind of a circuit you have. It appears that the circuit shown in Fig. 6 is about what you want, and I suggest that you use it. Apparently what you want is data on how to build a 330-ohm resistance. Choke coils are rated according to their inductance in henrys, and not as to their resistance, while resistance coils are rated in ohms. The only practicable method of winding a resistance coil is to obtain a coil of insulated resistance wire, measure off 330 ohms with a resistance bridge, commonly known as a Wheatstone

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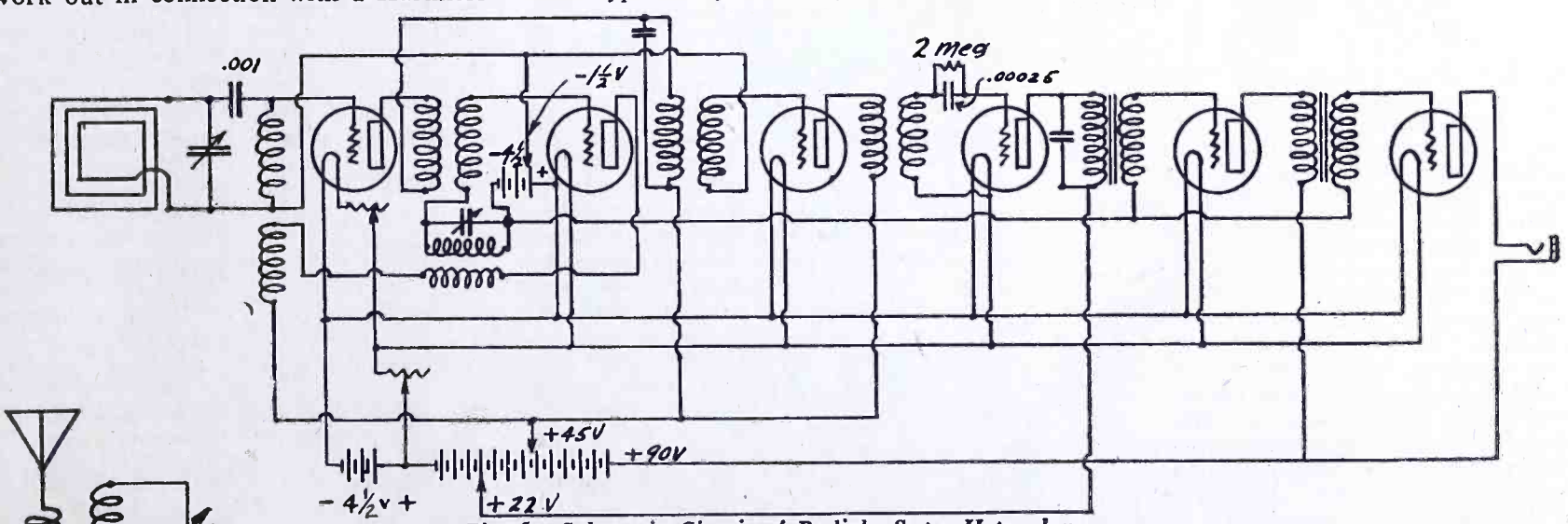


Fig. 5. Schematic Circuit of Radiola Super-Heterodyne

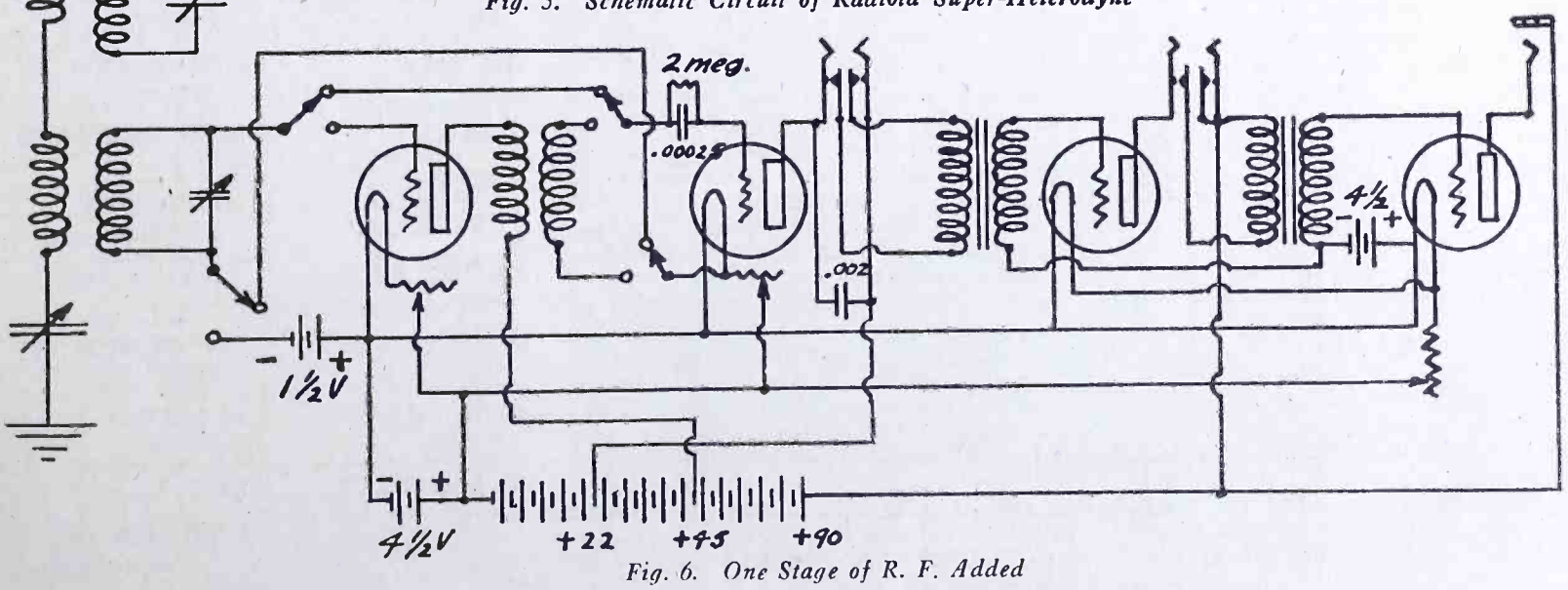


Fig. 6. One Stage of R. F. Added

EXPERIMENTS WITH 100 METERS

By D. B. McGOWN

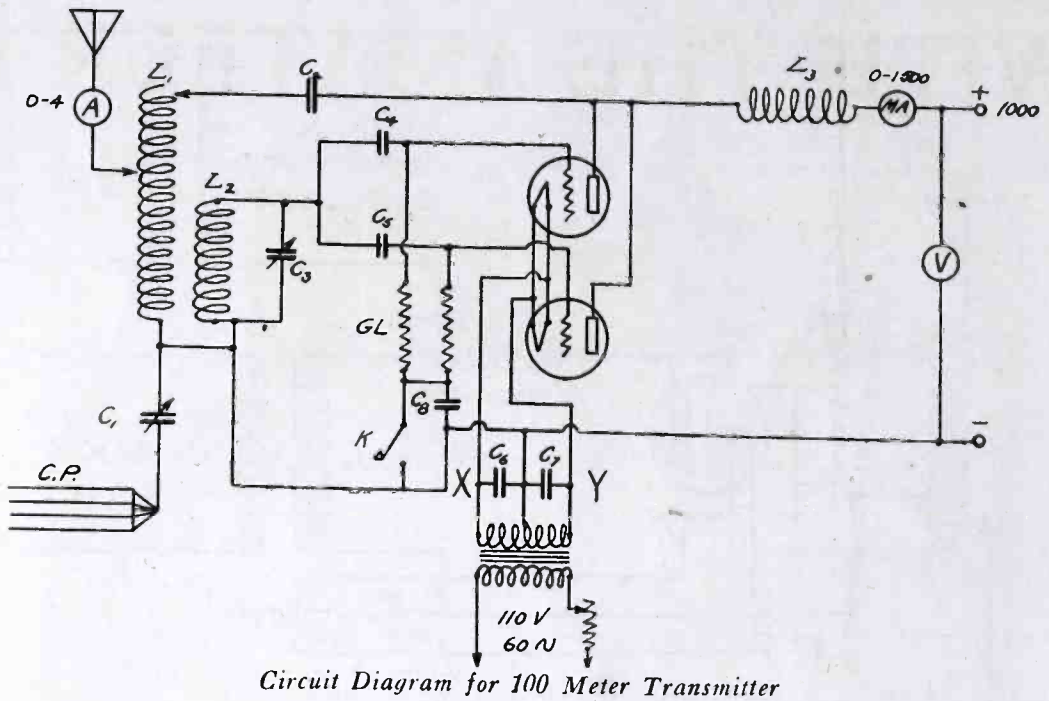
THE wavelengths around 100 meters, and below, bid fair to become the most useful of all. They were used to a small extent by the Naval Service during the latter part of the war, for inter-fleet communication with using spark apparatus. The Signal Corps Laboratory at Camp Vail furthered the development of the short waves, and finally the Westinghouse Company started operations on a wave a trifle below 100 meters, which was used to broadcast from KDKA at East Pittsburgh for re-broadcasting from their other stations on longer waves. The first amateur two way transmission across the Atlantic was accomplished and carried out on about 100 meters between the station of F. H. Schnell, of Hartford, Conn., traffic manager of the American Radio Relay League, and the prominent French amateur, M. Deloy, at Nice, France.

These short waves are so valuable that no stations are permitted to operate anywhere below 150 meters, except by special authority from the Department of Commerce. This authority usually takes the form of an experimental license, which, unfortunately, is not generally available to amateurs. It is hoped that some arrangements can be made whereby some small band of short wavelengths can be assigned for amateur and private experimentation.

The chief problem in short wave work is to so reduce the wavelength of the antenna, without seriously reducing its radiating qualities, so that reasonable amounts of energy may be radiated from it. We can, of course, use a very short antenna, which has a low natural period. But much better results seem to be obtained by using a series condenser to reduce the wavelength.

The writer has used the circuit known variously as the "reversed feedback," "Stanley," "British Aircraft," etc., as shown herewith the antenna was composed of four No. 10 solid copper wires, each 50 ft. long, on 15 ft. spreaders, with 10 in. Ohio Brass porcelain rod insulators at each end. The lead-in was taken off the middle, making a T, and all four wires were brought down some 10 ft. from the middle, and thence led to two wires, which formed the leadin. This antenna was suspended from two 50 ft. poles, giving a total length of 75 ft. from the leadin to either end of the antenna. The counterpoise was made up of ten wires, each 65 ft. long, separated evenly across the width of 25 ft., supported about 8 ft. above ground. The station was located near the middle of the antenna, and beneath the counterpoise, so the antenna lead passes right through the latter. This doubtless causes a reduction in the effective height, but was the best that could be done under the circumstances. The natural period of this antenna to counterpoise was 145 meters, with a capacitance of 0.0008 mfd.

The antenna ammeter was an O-4 ampere Weston thermo-couple instrument. Inductance L_1 was made up of 40 turns of No. 10 copper wire, with taps every third turn, wound in threads cut in a bakelite tube ¼ in. thick, the adjacent turns of wire being separated just enough so they would not short-circuit. L_2 is composed of 9 turns of No. 16 DCC wire on a 3.75-in. tube. L_2 was placed at the end of L_1, and is, therefore, closely coupled to it. L_2 is shunted by the 0.001 mfd. condenser C_3. Condenser C_2 was of 0.01 mfd. capacity, and was built to withstand 6000 volts. This condenser must be of good quality and of high breakdown values, as it is required to stand the full potential of the plate supply, which will short-circuit if C_2 fails. Grid condensers C_4 and C_5 are ordinary Dubilier transmitting condensers, and are of 0.001 mfd. capacity each. Condensers C_6 and C_7 are of the same type, but are of 0.004



Circuit Diagram for 100 Meter Transmitter

mfd. capacity each. The grid leaks G_L were standard R. C. A. units, of 5000 ohms rated value.

The set was intended for direct current plate supply, and alternating current filament supply. The first procedure in setting up such a transmitter is to mount the plate and grid inductances. The grid inductance should be so arranged that it can be turned through an angle of 180 degrees, as when first set up it may be of reversed "polarity" and no oscillations will be obtained. The various other instruments should be grouped as close together as possible, although not too close for convenient manipulation. The negative plate lead is led to the center tap of the filament transformer, while the positive connection is made through choke coil L_3 to the plates of the tubes. L_3 is an unmounted honeycomb coil of 200 turns, and its function is to prevent the high frequency from getting back into the d.c. supply system. Filament control is accomplished by inserting a variable resistance in the transformer primary circuit. Keying is accomplished by breaking the grid leak, which permits the grids to charge up, and "block" the tube, thus preventing oscillation when the key is open. The key is shunted by condenser C_8 of 1 mfd. capacity, which eliminates howling at audio-frequency, which sometimes takes place when the key is open. A chopper could be inserted here in series with the key to produce "ICW" if desired.

The wavelength of the antenna, with but a few turns of L_1 connected in circuit, with condenser C_1 omitted, was in the neighborhood of 175 meters. This was reduced to 100 meters by the series condenser C_1, a variable air condenser made up of 101 plates separated by ¼-in. washers so as to give ⅛ in. air space between plates. Its capacity varied between .0009 and 0.0011 mfd. After it had been adjusted to the desired wavelength it was locked in position.

The first experiments were with one 50-watt tube which gave a radiation of 1.5 amp. with 1000 volts and 200 milliamps on the plate. With two tubes the radiation was 2.2 amp. with a.c. filament supply and 2.5 amp. with 10 volt d.c. The radiation increases rapidly on higher wavelengths, being 2.9 on 103 meters and 3.5 on 110 meters.

With this set the writer has carried on tests with numerous distant stations from San Francisco, Calif. For example, station 4XC, at Atlanta, Ga., was worked, with no trouble and without repeating, as if he were twenty miles distant. This is something that could not be done, except with great difficulty, on 200 meters. Various nearer stations were also worked in the Middle West and Canada.

The field between 150 and 175 meters offers almost as interesting a field for amateur research, and practically the same set could be used. The longer wave would require that the inductance L_2 be increased to about 15 turns, and, if a small antenna is used, C_1 might be cut out. Or, if a large antenna is used, a series condenser can be used, and the advantage of the greater height and capacity of the large antenna made use of and still the wavelength kept within the law.

Abstract from an English newspaper dated March 27, 1924

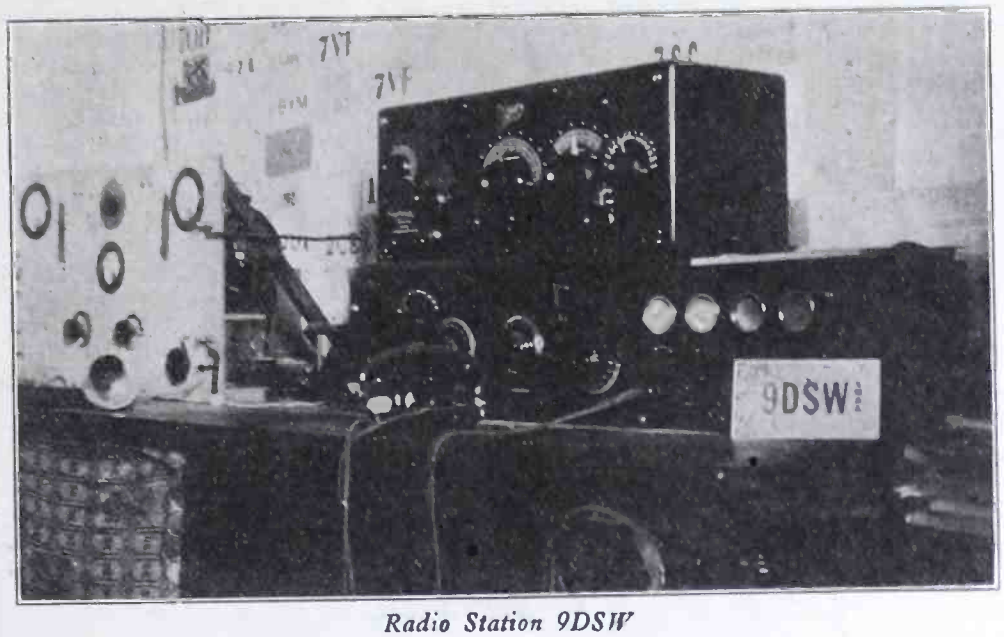
SHIPOWNER FINED $1000.00

"For not providing wireless on the steamer *El Kahira,* which sank in the English Channel with all hands, Ernest Olivier, 67, was fined $1000.00 at the Old Bailey. He was also ordered to pay a sum not exceeding $250.00 as costs. The Recorder observed this was apparently the first case of its kind to come before a Court of Assize. Olivier would be sentenced not because of the shipwreck, but because, to save his own pocket, he failed to comply with the regulations.

IT SEEMS to me.
* * *
AN AWFUL thing.
* * *
THAT THIS should happen.
* * *
BUT ANYWAY.
* * *
I CANNOT weep.
* * *
AND FEEL blue.
* * *
ABOUT ERNEST.
* * *
WHO LET his steamer.
* * *
GO TO sea.
* * *
WITHOUT RADIO.
* * *
BUT I do.
* * *
FEEL BAD.
* * *
ABOUT THE men.
* * *
WHO LOST their lives.
* * *
AND THE lonely wives.
* * *
AND LITTLE kids.
* * *
THAT ARE left alone.
* * *
TO MOURN their dad.
* * *
WHO NEVER came.
* * *
AND IT seems to me.
* * *
THAT LITTLE Ernest.
* * *
GOT SLIPPED.
* * *
A BIG piece of Justice.
* * *
AND A good lesson.
* * *
AND PERHAPS now.
* * *
HE UNDERSTANDS.
* * *
THAT A radio set.
* * *
ON BOARD a ship.
* * *
IS NOT a liability.
* * *
BUT A safe bet.
* * *
I THANK you.

H. BUNCH

WITH THE AMATEUR OPERATORS



Radio Station 9DSW

RADIO STATION 9DSW

9DSW is owned and operated by Gordon M. Larson at 856 Park St., Fairmont, Minnesota. 9DSW got into the transmitting game early in 1921 in time to own a half kilowatt spark set. After this came 5 and then 10 watts c.w. until the present set was constructed.

The transmitter consists of one 50-watt tube in the Hartley tuned grid circuit. The set is panel mounted to save space. A homemade transformer supplies 1500 volts to a 32 pint jar borax rectifier. A filter system consisting of four 1 mfd. condensers and a choke of 6 pounds of No. 22 wire smooth the pulsating d.c. and give this station the d.c. note for which it is noted, ICW and fone are used at times, the ICW through heavy QRM and the fone for local work. Good ICW is secured by modulating the grid circuit with an inductive coupled buzzer circuit as described some time ago in QST. This type of ICW insures a clean cut note. A thermo couple radiation meter, 0-500 milliammeter, and 0-15 voltmeter control the operation of the transmitter at all times. Under normal working conditions the antenna current is 3.9TC amperes with a plate current of 155 milliamps. The tube remains perfectly cool.

The receiver is at the right of the transmitter with the one control switch in between. The switch throws the power to the transformers and connects the aerial to the transmitter. The counterpoise is connected permanently to the transmitter and is used as ground for the receiver. The receiver is a three-circuit tuner with 3 steps of audio-frequency amplification available. A Zenith and a small 100 meter set are also used. Baldwin fones exclusively.

The antenna consists of a six wire fan suspended 58 ft. high at the far end and 45 ft. high at the near end. Porcelain insulators are used. The counterpoise consists of 14 copper ribbons each 45 ft. long fanned a distance of 55 ft. at the far end and 8 ft. above the earth.

The present set has been in continuous operation since early in 1923 and excellent results have been attained with both transmitter and receiver. 46 states and all districts both American and Canadian have been worked. 9DSW has been reported from Hawaii, Panama, Porto Rico, Alaska, Prince Rupert, B. C., Mexico, twice by WNP and by ships west of Panama and east of NYC. Best work is to 6XAD and Canadian 1DD of Nova Scotia. Fone has been reported from 16 states and from a distance of 1000 miles.

9DSW was one of the first to log WNP who was heard fourteen different times. Canadian 9BP, Mexican BX, Porto Rican 4OI, Australian 2CDM while west of Hawaii and several others equally distant have been logged. 500 cards since Sept. 1st testify as to the results of 9DSW on the air. 9DSW—"The Whistle From the Gopher State"—would appreciate hearing comments on this station.

NEWS OF THE AMATEUR OPERATORS

Call 1BX is R. B. Hodskin's, 24 Converse St., Longmeadow, Mass.

Call 2FO has been assigned to J. V. Settle, 32 Dodd St., E. Orange, N. J., who is using four 5-watters.

Call 3AW has been re-assigned to Dwight M. Williams, 40 Jefferson Ave., Haddonfield, N. J.

6ADM has moved his 50-watt set from Santa Rosa, Calif., to 112 Austin St., San Francisco.

Several experimental amateur stations are now using the waves between 100 and 150 meters with surprising success. The current radiated at these high frequencies is often a very small amount, but the radiated energy is often greater than on 200 meters. It is also gratifying to know that so many amateurs have tuned their transmitters down to the waves between 150 and 180 meters.

7IT has been heard all over North America and reported Q.S.A. in England.

7LH has recently heard one of the French amateurs. A station card from France confirming the reception has been received.

7SH of Aberdeen, Wash., is a very active station. His 10-watt transmitter has been reported heard in New Zealand several times.

7BJ of Vancouver, Wash., works the east coast nearly every night. He uses 5 watts on a wavelength of 150 meters.

It is reported that there are no more amateur spark transmitters in the state of Washington. It is hoped that the neighboring states can soon make the same boast.

7FQ of Tokoa, Wash., is heard on the air every night. He has worked 383 different stations in two months. His operating hours are from 11:00 p.m. until 6 a.m. every night.

7ZJ is now owned by Geo. C. Stocking of 4132 N. Beattie St., Helena, Montana.

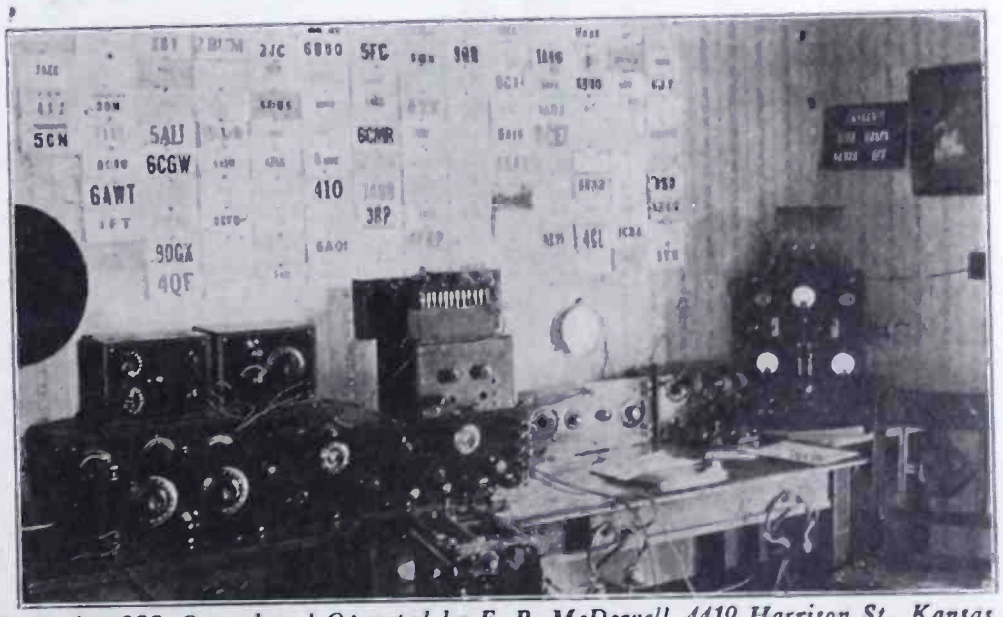
6ACW, owned by Mr. Y. Ito, has heard Australian 3BD. This record reception has been confirmed by the Australian amateur.

The Seventh District Radio Convention was held in Seattle April 11-12. Representatives from every state in the district except Wyoming were present. A real hamfest was enjoyed by all.

7FD, one of the best stations in Seattle, has been off the air lately and 7ADP has filled the vacancy.

WNP, the Macmillan expeditionary ship *Bowdoin*, has at last been heard after a silence of two months. Both 7LR and 7AIB report having heard him sending a blind broadcast message to the effect that all on board are well. The many friends of Dr. Macmillan and his crew will be glad to hear this bit of news from the icebound *Bowdoin*. It is reported that 7JD worked WNP on April 13th, at which time several messages were exchanged.

7CO of Glendive, Mont., is heard relaying



Radio Station 9SS, Owned and Operated by E. B. McDowell, 4419 Harrison St., Kansas City, Mo. 100 Watts Modified Hartley, 1500 Volts on Plate, 2 Amps Radiation, 100 Ft. Steel Tower Aerial with Cage Lead-in and 14-wire Radial Counterpoise.

messages every night. This station seems to be a gateway for amateur messages both east and west bound.

7ABB of Everett, Wash., has installed one of the new 203 A tubes and is heard regularly now. He sends press to WNP each Monday night.

7AIF has quit the amateur game and is planning to go to sea. He has just earned a first-class commercial operator's license.

Amateurs in Tacoma, Wash., are having a great deal of QRM from the local smelter works. There seems to be no way to overcome interference from this source.

The Dial, a small publication put out by The Gray's Harbor Radio Association of Gray's Harbor, Wash., has been selected as the official organ of the Seventh District Executive Council. Items of interest to Seventh District amateurs may be found in this little radio magazine.

7RY of Walla Walla, Wash., is one of the most consistent stations in the state. He is heard handling messages nearly every night.

7MN of Ketchikan, Alaska, has been heard recently by several stations in the states. WNP is heard at 7MN quite often, but two-way communication is almost impossible on account of the mush from NVH, the powerful arc station located there.

7AGF of Troy, Mont., and 7ZU of Polytechnic, Mont., were the only two amateurs from Montana to attend the recent convention in Seattle.

7KZ is a new station on the air. He is located in Lewistown, Mont.

7EL of Stevensville, Mont., uses a Ford coil to supply the plate of his five-watt tube. He works 1000 miles consistently.

Call 5WC has been re-assigned to J. Boyce Gaines, 724 So. Winnetka, Dallas, Tex., 10 watt, C. W. and phone. QSL's ans.

DX AT 6XAD-6ZW

(From March 31st to May 1st.)

A rather feeble showing this month, as I have touched key but seldom. QRN most annoying and fishing splendid!

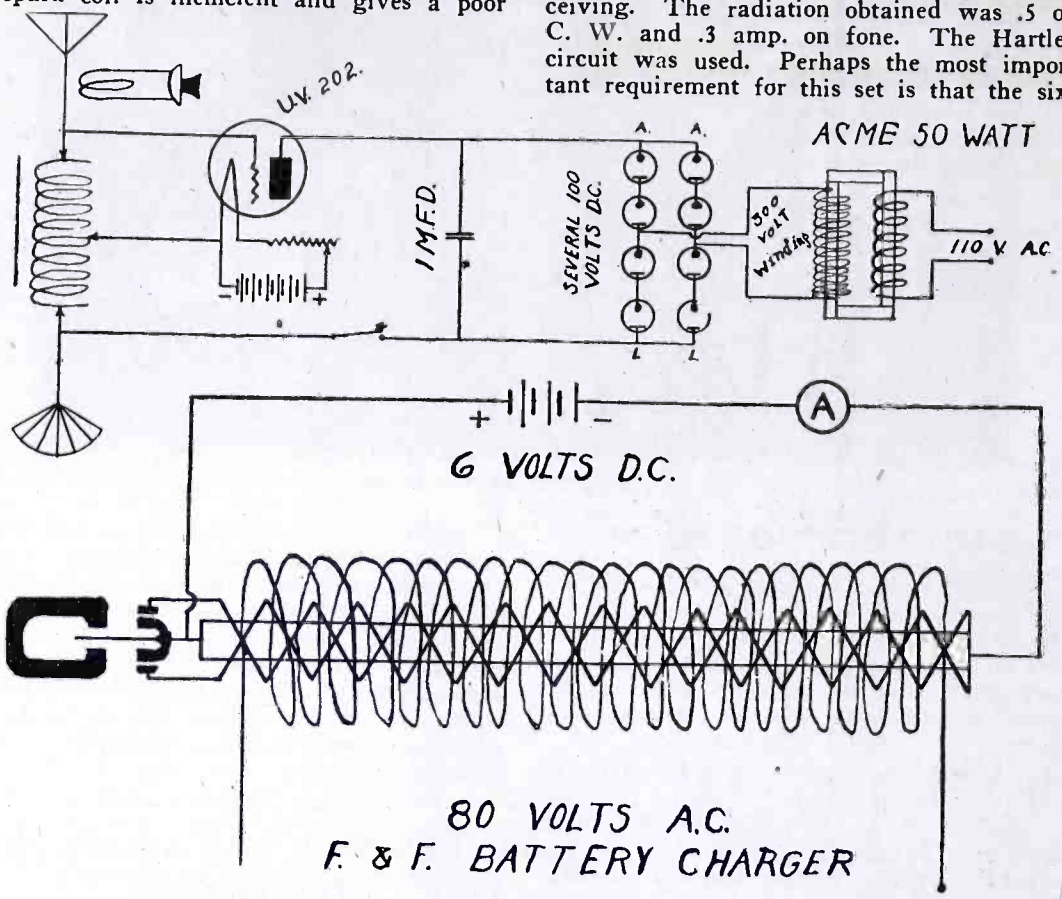
Stations worked—Zagb, 2atf, 4dx, 5aiu, 5ahd, 7aek, 8dgn, 8end, 8bnh, 8cei, 9lb, 9efz, 9dyi, 9awg, 9mbfi, 9dp, C4fy, C4cb.

Stations reporting 6XAD-6ZW—1lia, 1bal, 1 ban, 2aen, aey, 2cm, 3can, 3bhv, 5ua, 5kc, 5ade, 8bkd, 8wu, 8cwr, 8dnl, 8bzy, 8cap, 8bwb, 8arg, 9cpm, 9bmd, 9er, 9drs, C4aa.

A PORTABLE TRANSMITTER

By S. W. TOWNSEND, *8WY and Port. 8ATK.*

With the advent of the vacation season comes renewed interest in portable transmitters. These are thoroughly practicable in every way except as regards a source of high voltage power for the plate of the vacuum tube. *B* batteries are expensive and heavy, a spark coil is inefficient and gives a poor tone, and a.c. mains for a transformer or motor-generator are seldom available out in the woods.



Don Warden, ex-8BW, my partner in these experiments, found that a France battery charger could be operated backward from a six-volt storage battery so as to furnish about 90 volts a.c. (The diagram shows the connections.) Then, by using an Acme 400-volt step-up transformer, a regular electrolytic rectifier, and a filter consisting of an audio-frequency choke coil and a 2 mfd. filter condenser, a very satisfactory plate supply was obtained. This current was then used on the plate of a so-called 5-watt tube, and an 8-volt storage battery furnished the filament current.

We have had splendid results with this set, working up to 30 miles at noon in summer, on C. W. and 10 miles on fone, and we were reported as d.c. This was done on a single-wire T type aerial 100 ft. long and 30 ft. high, with a three-wire triangular counterpoise used for both sending and receiving. The radiation obtained was .5 on C. W. and .3 amp. on fone. The Hartley circuit was used. Perhaps the most important requirement for this set is that the six-volt battery used on the battery charger be of fairly high ampere-hour capacity, as this system requires quite high amperage to operate the charger in this manner.

Super-Heterodyne in Use for Broadcast Reception on Moving Train.

POSSIBILITIES OF RADIO FOR TRAINS IN MOTION

Reviewing the possibilities of radio when installed on moving trains, we find that, before the vacuum tube was perfected, telegraphic communications had been carried on between high-powered stations and trains. With the recent perfection of the radio receiver and the high-powered broadcasting stations in all the principal cities, we again look towards the day when radio will serve some of the many features for which it is capable, "that of furnishing entertainment while we travel."

There have been many reasons why a radio receiver could not be put to practical use on moving trains; and in this respect it might be stated that generator noise, mountains, land cuts, wheel noises of the cars, low-powered broadcast stations, and low antennae were some of the elements which receivers of the past were unable to overcome. With the recently-perfected super-heterodyne receiver, it is now possible to pick up broadcast stations on moving trains from five hundred to a thousand miles with a very small antenna, and, in view of the great number of broadcast stations, it is now possible to give entertainment to passengers of moving trains.

On a recent trans-continental trip of the Paramount Pictures executives, a Radiola Super-VIII installed in their special car gave satisfactory loud speaker operation from stations 1000 miles away. While in eastern Nevada KFSG, KFI, KHJ and KGW were heard. Out of Chicago WTAS, WOC, KSD, WOU, WEAF and WDAF were heard. An outside antenna was used for these experiments.

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

At 3BVA, 40 S. Beaver St., York, Pa.

4af, 4ad, 4ba, (4cs), 4db, 4dl, 4dp, (4dv), 4dy, 4eb, (4er), 4eq, 4fs, (4fz), (4gh), 4hw, (4io), (4iu), (4iz), (4je), 4jr, 4li, 4ll, (4mi), 4my, 4na, 4oe, (4og), 4oh, (4ou), 4pk, (4qy), 4rd, (4sh), (4si), 4sn, (4su), 4sx, (4xc), 4xe, 4xr, (4xv), 4ww, 5aa, 5aac, 5aaq, (5aas), (5aat), 5aaw, 5aaz, (5abn), 5adb, 5aek, 5agh, (5agl), (5agv), 5air, (5aic), 5aiu, 5aiy, 5ajb, 5ajh, 5ajj, 5ajm, 5ajt, 5akc, 5akn, 5alo, 5alv, 5amh, 5amo, 5anf, (5aom), 5ap. 5be, (5bx), 5ce, 5cn, 5co, (5da), 5dm, (5dq), 5dw, 5ek, 5ex, 5ez, 5gf, (5gj), (5ht), 5ik, 5ja, 5jf, 5jl, 5ka, (5kc), 5kq, 5lp, (5lr), 5mi, 5ml, 5nk, (5nn), 5nt, (5nw), (5om), (5ov), 5oq, (5ph), 5pv, 5qf, 5qh, (5ql), 5rb, 5rc, 5rg, 5ua, 5uk, 5vc, 5vv, 5wg, 5xa, (5xat), 5xaw, (5xau), (5xar), 5xbh, 5xd, 5zav, 5zk, 6aao, 6aan, 6abk, 6adt. 6afc, 6agk, (6ahp), 6aja, (6ajd), 6akw, 6akz, 6alk, 6ame, 6aol, 6apw, (6arb), 6arf, (6aru), 6auu, 6avr, 6avv, 6awq, 6bau, 6bbc, 6bbh, 6bbw, 6bez, 6bic, 6bkb, 6blw, 6bmb, 6bpm, (6bql), 6brf, (6bui), 6bur, (6buo), (6buy), 6cc, 6ccy, 6cdg, 6cdj, 6cee, 6cef, 6cej, 6ceu, 6cgw, 6cie, 6cjv, 6ckr, 6cmu, (6ea), 6eb, 6fh, 6fp, 6gt, 6hp, 6ka, 6lc, 6lv, 6nb, 6no, 6pl, 6tu, (6tv), 6xad, 6xau, 6xbc, 6xe, 6xn, (6zar), 6zcd, 6zdd, 6zh, 6zp, 7abb, 7abh, 7adf, 7adq, (7ael), 7af, 7afn, 7ahv, 7ajd, 7akk, (7bj), 7co, 7em, 7ey, 7fd, 7fq, 7fr, 7fy, (7gq), 7gr, 7qc, 7ip, 7it, (7iw), 7kj, 7lp, 7ln, 7ly, 7mx, 7ob, 7ot, 7ry, 7pf, 7qc, 7to, 7tq, 7wp, 7xba, 7ya, 7zu, 7zv, 9aal, (9aau), 9abc, (9abf), (9acx), 9ada, (9aec), 9aed, (9aem), 9aep, 9afy, (9agl), 9agz, 9ahs, 9aii, (ajw), (9aks), (9amb), (9aju), (9amx), 9amf, 9and, 9ap, 9apf, (9aqc), 9aqd, 9aqg, (9aqq). 9aqv, 9aru, 9arr, 9atm, 9atn, 9aus, 9awg, 9axt, (9ayj), (9ayx), 9azg, 9azp, 9azx, 9ba, (9bab), 9bbb, (9bbr), (9bbs), 9bcc, (9bce), (9bdj), 9bed, 9bel, (9bez), 9bfp, 9bfx, 9bgh, 9bhk, (9bhw), 9bhx, 9bis, 9biz, (9bjk), 9bko, 9bkv, 9bmo, 9bmq, (9bmu), 9bmx, (9bna), 9bof, 9bop, (9boz), (9bpw), (9bpv), 9bqx, (9brb), (9bre), 9brk, 9brx, (9bsi), 9btr, (9btl), 9buh, bun, (9bvn), 9bvz, (9bwc), 9bwo, 9bwq, 9bxm, 9bxq, (9bxw), (9byc), 9caa, (9ca), (9caj), (9ccd), 9ccw, (9cdb), (9cea), (9cfk), (9cfl), (9cfs), 9cga, 9cgu, 9cho, 9cit, (9cim), 9cin, 9cir, 9cip, (9cjc), (9cjm), 9cjt, (9cjy), 9cka, 9ckj, (9cko), (9clq), (9cme), (9cmk), (9cno), (9cow), 9cpu, 9cpz, (9csj), 9cte, (9cto), (9cvo), 9cvn, 9cvs, (9cwf), 9cxo, (9cxp), 9cy, (9cyb), 9cyd. (9cyq), 9cyy, 9czg, 9czu, (9dap), 9day, 9db. (9dcj), (9dct), 9dcw, (9ddp), 9dds, 9dfh, (9dfq), 9dga. (9dhk), 9dip, 9djz, (9dkb), 9dlb, (9dlf), (9dlm), 9dlw, (9dly), (9dnp), (9dr), 9dro, 9dte, (9dub), 9dwa, (9dwb), 9dwn, 9dxn, 9dxu, (9dxy), 9dyr, 9dyt, (9dyz), 9dzg, 9dzx, 9eac, (9eak), 9edo, 9eea, 9eg, (9egw), (9ehq), 9ehn, 9eht, (9ei), 9eib, 9ekf, 9eky, (9elb), 9eld, 9elj. 9elv, (9elw), (9elz), 9em, 9eq, (9er), 9gs, (9gz), 9hg, (9hm), (9kd), 9ks, (9lb). 9le, (9lz), 9ln. 9mc, 9mf, 9my, 9nc, 9nu, 9rc, 9ny, 9ry, 9rt. 9ss, (9tm), 9ta, 9vc, 9wm, (9xax), (9xbd), (9xbe), 9xi, (9yau), 9yx, 9zt.

Canadian—cw: 1af, 1ar, (1bq), 1bv, (1dd), (1dq), (1dt), 1eb, (1ef), 1ei, 2az, (2be), 2bg, (2bn), (2cg), 2ei, 2fu, 2hg, (3bq), (3he), (3ly), (3vh), (3wg), (3xx), 4bk, (4cb), 4co, (4cr), (4dq), 4eo, (4fz), 4hh, 4io, 5cn, 5gf, 9ak, 9al, (9bl), 9bx.

English: 2kf, 2sz, 2yt, 2nm.
French: 8ab.
Dutch: pcii.
Cuba: 2ww.
Porto Rico: (4je).
Mexico: bx, 1b.
Hawaii: 6ceu.

P.S.—3BVa makes a habit of answering all cards and letters. This dx is the result of one month's operation of 3BVA. One op and a 5-watt bottle hr. 1BGF "low loss" tuner.

By 5AEE and 5ADE 14th and Young's Bvld., Oklahoma City, Oklahoma

1agh, 1are, 1arw, 1bcr, 1bes, 1chq, 1jz, 1yj, 1xa (v), 1xt, 2adk (v), 2ani, 2bc, 2caw (v), 2cla (v), 2cpd, 2cyb, 2jd, 2rm, 2ww (v), 3dt (v), 3oi, 3tb, 3wc, 3zo, 4ai, 4af, 4cb, 4cn (v), 4co (v), 4dp, 4dv, 4eq, 4io (vv), 4ii (at 3oi), 4jr, 4lj, 4mb, 4rr, 4xc, 5aar, 5ac, 5adh, 5adv, 5aes, 5afq, 5agh, 5agl (v), 5ags, 5ajj, 5ajt, 5alj, 5alm (v), 5alo, 5alr (v), 5alz (v), 5amb, 5amg (v), 5be, 5bh, 5cn, 5dc, 5ek (v), 5ez (v), 5fv, 5ko, (5lp), 5lz (v), 5nk, (5nw), (5ph, vv), (5qd vv), 5qh (v), 5qv, 5qx, (5rq), 5sd (v), 5sj, (to, v), 5ts (v), 5vc, 5vo (v), 5vu, 5za, 6aja, 6cgw, 6fp, 7ajt, 7qc, 7zu (vv), 8agm, 8agp, 8ah, 8aig, 8ajs, 8ak, 8alw, 8att (v), 8bcf (v), 8bdm, 8bhg, 8bpa, 8bqi, 8btl, 8bw, 8bzi (v), 8cci, 8cmv, 8cpu, 8cqj, 8cta, 8cwc, 8cwp, 8cxg, 8czz, 8dbm, 8dcl, 8bdl, 8bdt (v), 8dem, 8dgo, 8dgp, 8dhs, 8eh, 8es, 8fm, 8kc, 8kg (vv), 8pv, 8rj, 8rn (v), 8vt (v), 8yv, 8zz, 9ado, 9aem (v), 9aev, 9afy (v), 9agb, 9agl, (9ahz, vv), 9aiz, 9al qra?, 9alc (v), 9amp (v), 9amx (v) qra?, 9ape, 9aqo, (9arj), 9arv, 9atu, 9awv, 9azx, 9bbg, 9bcb, 9bhd (v), 9bhh, 9bis, 9bna (v), 9bnv qra?, 9bpa, 9brk, 9buf, 9bun (v), 9byc, 9bzv, 9bzx, 9ccj, 9ced, 9chh (v), 9cic, 9cih, 9cjm, (9cny), 9cpm (v) qra?, 9ctc, 9ctg (v), 9cyn qra?, 9cyw (v), 9czg, 9dbf (v), 9dbp (v), 9dec, 9del, 9dfh, 9dgt, 9dhk, 9djp (v), 9dll, 9dlr, 9dmw, 9dqj, 9drs, 9dsw, 9dvo, 9dxk, 9dyr, (9eak v), 9efh, 9eja, 9ejy, 9elj, 9ell (v), 9er, 9hm (v), 9hw, 9jv qra?, 9mi qra?, 9ry.

Mexican—(bx) (using only 5 watts).
French—8ab (using 11-tube super-het).

By 2ZB, 10 Beecher Street, Newark, N. J.

1adn, (1aqm) fone, 1axz, (1ayb), 1ayt, 1azr, 1bbh, 1bbp, (1bid), 1biz, 1boa, 1bth, 1bzp, 1cg, 1cit, 1cmx, 1fh, 1kc, 1ml, (1xu), 1zo, (1zt), (4ab), 4ajs, 4bz, 4cd, 4er, (4ft), 4fz, 4hs, 4it, 4jr, 4ll, 4my, 4oa, (4og), 4pk, (4rr), (4sh), 4xc, 5abn, 5aeq, 5agn, (5aiu), 5ajb, 5alo, 5alv, (5amh), 5bm, 5cc, 5cg, 5ka, 5kr, 5lp, 5nw, 5pk, (5ql), (5rg), 5rh, 5ua, 5wk, (5xa), 6aao, (6adt), (6ahp), 6avj, 6bbr, (6bbc), (6bnt), 6cb, (6cdg), 6cgw, 6ck, 6cyw, 6gt, 6hi, 6jh, 6py, 6xad, 6dp, 7ads, (7co), 7ih, 7kz, 7xd, (8aeg), (8aig), (8alx), 8aoi, 8aol, (8aon), (8aq), 8aqo, 8aaj, 8atr, 8avj, 8axf, 8axk, 8bay, 8bdv, 8bfz, (8bwk), 8bvr, 8bvv, 8cdi, 8cei, 8cej, 8cjd, 8ck, 8cke, 8cun, 8cur, 8cuu, (8cwp), (8cwu), (8dgp), 8dhp, 8dhq, 8dia, 8dii, 8dm, 8eb, 8hx, (8ii) fone, 8na, 8nf, (8qb), 8rj, 8tj, 8tt, 8tx, 8vn, 8xe, 8zc, 9aal, 9ach, 9adp, 9ago, 9ahh, 9aia fone, 9aid, 9ajw, 9amu, (9aox), 9apf, 9aqf, 9aqg, 9aqz, 9ash, 9asw, 9ato, 9awv, 9awy, 9axu, (9azj), 9bal, 9bbg, 9bcs, 9bez, 9bfg, 9bgx, 9bhy, 9bkk, 9biw, (9bkh), 9bks, 9bky, 9bn, 9bnu (9bof), (9bqp), 9bqy, 9brk. 9brl, 9bvn, 9bya, 9cga, (9cgu), 9chf, 9chk, 9cju, (9ckh), (9cko), (9clx), 9cur, 9cvh, 9cyw, 9czj, 9czn, 9dbf, 9deq, 9dfb, 9dgy, 9dfb, 9dgy, 9dhr, 9dpr, 9dro, (9dtn), 9dwa, 9dxu, (9dvy), 9dzc, 9er, 9eji, 9ep, 9eld, 9ely, 9en, 9jc, 9lb, 9qi, 9ry, 9ty, 9xbe, 9xaw fone.

Can.—2be, 3kg, (3ms), 3ub, 3wg, 3zt, (4co), 4er, 4fz, oct calling 7id, wnp.

By 2BIR, 288 Prospect St., Nutley, New Jersey

(1aap), (1alj), (1asu), (1azr), (3abf), (3ahp), (3bcj), (3ek), (3zo), 4af, 4ag, 4az, 4bg, 4cp, 4eq, 4ft, 4ia, 4it, (4jr), 4ll, (4rf), 4rh, 4sh, 4su, 4xc, (5aiu), 5amh, 5amu, 5cs, 5ek, 5fv, 5lr, 5mo, 5om, 5pm, (5ql), 5rg, 5sg, 5tt, 5un, 5xa, 5yw, 5zr, 7ajd, (8cyi), (8ic), 9aaq, 9aau, 9abe, 9aef, 9ahj, 9aic, 9ami, 9amq, 9aom, 9ato, 9avb, 9awg, 9azj, 9baz, 9bcc, 9bdb, 9bgc, 9biw, 9bjk, 9bjl, (9bna), 9bpy, 9brk, (9bvz), (9bwu), 9caa, 9cco, 9cii, 9cjc, 9cko, (9cnb), 9crm, 9csn, 9ctg, 9cvo, 9cyp, 9czq, 9day, 9dbf, 9ddp, (9dhr), 9dmj, (9dro), 9dvw, 9dww, 9dwx, 9dyy, 9eer, 9efz, 9ehq, 9eil, 9eja, (9ekf), 9eky, 9elb, 9bk, 9cp, 9ct, (9es), 9il, 9lb, 9vm, 9wy, 9xm. If u hv hrd our 50-watter pse qsl via crd—tks.

By 9BVN, Kansas City, Kansas

(1aac), 1aaj, 1aaf, 1abb, (1abc), (1afa), 1afe, (1all), (1aoo), 1apc, (1are), (1arp), (1asr), (1atj), (1aur), (1bcr), (1bom), (1boq), (1bwj), (1cit), (1cmx), 1xah, (1ah), 1cu, (1er), (1fs), 1gv, (1ii), (1ka), 1il, (1lk), 1my, (1sw), (1vc), 1xy, (1yb), 2az, (2gk), 2od, 2ss, (2wr), 2aal, 2aay, (2abn), (2ate), (2axe), 2azy, (2bee), 2bom, 2bqt, 2brb, (2byg), (2cee), (2cor), 2cpq, (2csr), (2czy), (2xna), (3ab), (3bb), 3fs, 3gg, (3hg), (3hh), 3jx, (3lg), 3ll, (3vo), (3wb), 3abw, 3aec, (3aen), 3anj, (3apv), 3arz, 3atb, (3bpm), (3bva), (3ccu), (4ba), 4by, 4co, 4db, 4dq, 4dv, 4fs, 4gu, (4gz), 4ao, (4ku), 4my, 4rr, 4xc, (6bh), 6bs, 6fq, 6gp. (6gt), 6ka, 6kx, 6od, 6pl, 6tu, 6zh, 6zt, 6abk, 6abq, 6aby, 6afc, 6age, 6ahp, (6alk), 6aqf, (6arf), 6aru, 6avr, (6awt), 6bbc, 6bbl, (6bhw), (6bdi), 6beg. (6bez), 6bhd, (6bij), (6blr), (6bql), 6bul, 6bur, (6buy), 6bvg, 6bvv, 6cay, 6cbb. 6cbg. 6cbu, 6cdp, 6ceu, 6cgt, (6cgw), 6ckm, 6cms, 6cmb, 6cng, 6xad, 6xdc, 6zar, 6zau, 7ah, (7bj), (7co), 7fk, 7fq, 7fs, (7hw), 7lu, 7ly. 7mc, 7qd. 7rv, 7ry, 7tq, 7ty, 7vm, (7zu). 7abb. 7ajt. 7ali.

Can.—(1bq), 2be, 2bf, (2bm), (3ad), 3ai, (3bq), (3gk), (3hh), (3hi). (3ir), 3ni, (3ws), (3xi), (3zt), 4fs, (4hh), (4hi), (4ko), 5gk, 9bg, 9bp, (9bx).

Mex.—bx, hrd consistently. French—8ab, 8bf. ab4??? qra?.

Spark: 2om, (8bda), (4bl). Anyone hearing my 5-watt trans. pse qsl. All cards answered tnx.

By 6ALK, R. F. D. 3, Box 37, Fullerton, Calif.

(1agh), 1aur, 1bcr, 1bom, 1bnt, 1cmp, 1cpi, 1fs, (1ka), 1sl, (1vc), 2atz, (2awf), 2ayv, (2brb), 2bxd, 2cdp, 2cee, 2cvu, 2mu, 2or, (2rb), 2rk, 2wa, 2wr, 2xab, (2xna), 2xq, 3bgj, 3hh, (3hs), 3mb, 3pb, 3va, 3wh, 4ab, 4bz, 4cs, 4cw, 4dv, 4ed, 4fs, 4ik, 4io, (4li), (4mi), (4my), (4pb), 4rr, 4xc, 5aaq, 5aaw, 5aaz, 5ac, (5agv), (5aiu), 5ajt, 5akn, 5anf, 5bx, 5cv, 5dq, 5gm, (5lr), 5mb, 5nw, 5qd, 5qh, 5rb, (5rg), 5rh, 5rn, 5vm, 5vo, (5xau), 5xd, (8abm), 8aeg, 8aii, 8alm, 8alw, 8amn, 8amr, 8ape, (8awj), 8bcp, 8bjv, 8cjd, 8cmu, (8crv), 8ctp, 8cwp, 8cxi, (8cxm), 8cyi, 8dbu, (8dcy), 8dgp, 8dhi, 8die, 8dkb, 8dkj, 8dlh, 8er, 8fm, 8hn, 8jy, 8kc, 8mt, 8pl, 8sr, 8tt, 8vq, 8vt, 8xe, (8zk), 8zu, 9aal, 9aci, 9acx, (9agl), 9afm, (9aju), 9ami, 9ape, 9aqc, 9atn, 9ato, 9avm, 9avq, 9axi, (9axs), (9azg), 9bed, (9bly), 9bqj, (9brk), (9btm), (9bvn), 9bzi, (9ca), 9caa, 9cdo, 9cek, (9cfx), (9cga), (9cht), 9cim, (8co), (9ctr), 9cvo, 9cxo, 9cyb, 9cyw, 9czg, (9dbh), 9dhg, 9dkb, (9dp), 9dsw, (9dte), (9dxk), 9ee, 9eea, 9ejz, (9eky), (9eld), (9elv), 9elz, 9eq, 9hw, (9mc), 9qe, 9ry, 9wa, 9wn, 9xbe, 9yau.

Can.—2be, 3bq, 3ni, 3nr, 4cb, 4co, 4cr, 4dq, 4hh. Mex.—bx.

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

1aaw, (1adn), 1aez, (1afx), 1ajg, 1ary, (1axz), (1azr), (1bbk), (1bzp), (1caz), 1cda, (1gl), (1oj), 1zs, 3adp, 3ahp, (3ais), 3buv, 3buy, 3ckl, 3xar, 3dt, 3lx, 3uz, 4af, (4ll), 4my, 4oq, 4rr, (4rz), 4sh, 4su, 5aiu, 5amh, 5he, 5mo, 5rg, 5wi, 6bcl, 6xad, 6fp, 7có, 7lu, 8abx, 8ada, (8amr), 8axf, (8bby), (8bci), (8bfe), (8bjs), 8bwc, 8cnw, (8cpk), (8daj), (8dbm), 8dft, (8dgp), 8dgs, 8dmc, 8dnf, (8bk), (8kg fone), (8oi), (8wz), 8yn, 9aci, 9azp, 9bbg, 9bep, 9bfl, 9bhd, 9bis, 9bly, 9bne, 9bwq, 9ctb, 9cte, 9cvs, 9cyg, (9cyw), 9dbm, 9dbw, 9dfn, 9djd, (9dma), 9edo, 9afo, 9eji, (9ba), 9ei.

Can.—1ar, 2bn, (3fc), 4co.

Dalite: 1aap, (1acb), (1alj), (1axz), 1bsz, (3auv), (3cs), (3ek), 8xbc. Wud appreciate cards from anione hearing 2AEY'S 15 watts C. W. All crds ansd. Pse note new qra.

By 6CNL, Myron Hexter, 127 N. Serrano Ave., Los Angeles, Calif.

2al, 2wr, 2cee, 3lg, 3me, 4cb, 4dq, 4ll, 4my, 4rr, 4xc, 5az, 5dc, 5eh, 5gm, 5jl, (5jc), 5lp, (5lr), 5lp, 5nk, 5ov, 5qy, 5sd, 5ua, 5va, (5aaq), 5aaw, 5aeb, 5agh, 5aib, 5aiu, 5ajt, 5alj, 5alm, 5alv, 5amu, 6's and 7's too numerous, 8do, 8vy, 8zm, 8acy, 8aiv, 8anm, 8anp, 8apt, 8ard, 8asv, 8bau, 8cdc, (8cgj), 8com, 8cpk, (8ddc), 8dha, 8dhs, 8xbc, 9er, 9ei, (9mc), 9ry, 9aep, 9agb, 9agl, 9apf, 9ahh, 9awv, 9axx, (9bcx), 9bff, (9bhi), 9bis, 9bkm, 9blb, 9bly, (9brk), 9bri, 9bpy, 9btm, 9bxa, 9ccv, 9ccw, (9cfk), 9cht, 9cjc, 9cvs, (9cju), 9czm, 9czq, (9cyg), 9dbf, 9dbp, (9dfn), 9dga, 9doz, 9dpp, 9dwa, (9dxn), 9dxu, 9dum, 9dkq, (9dyi), 9eae, (9eak), (9eky), 9elv, (9yam). Anyone hearing 6CNL pse qsl crd. All crds answered and appreciated.

By 6CPG, Earle Wiseman, 1004 Fulton Ave., Hollywood, Calif.

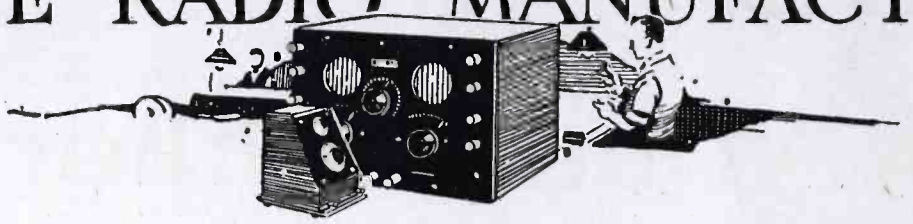
1yb, 1aur, 1awe, 1bcr, 1bie, 1bqe, 1cmp, 2al, 2aay, 2bqh, 2bwp, 2byg?, 2cee, 3hh, 3hs, 3lg, 3me, 3xi, 3acy, 3adb, 3aqr, 3atb, 3auv, 3blu, 3bva, 4ad. 4ai, 4ba, 4cr, 4cs, 4db, 4er, 4fg, 4fm, 4fs, 4ft, 4fz, 4gu, 4gz, 4io, 4iu, 4my, 4pb, 4pk, 4oa, 4oq, 4rr, 5az, 5be, 5bo, 5bz, 5cs, 5dn, 5dq, 5eh, 5gm, 5he, 5jl, 5lr, 5mb, 5mm, 5na, 5pa, 5ps, 5qd, 5ql, 5nh, 5rg, 5rh, 5rv, 5sd, 5sp, 5ts, 5aaq, 5aar, 5aat, 5aaw, 5afh, 5agn, 5aic, 5aij, 5air, 5ajb, 5ajj, 5ajq, 5akf, 5alc, 5alj, 5alm, 5ama, 5amj, 5amo, 5amu, 5xab, 5xaf, 5zas, 6's too numerous, 7av, 7bj, 7co, 7cr, 7en, 7fq, 7fr, 7ft, 7gn, 7ih, 7kk, 7ks, 7lw, 7oj, 7ot, 7no, 7qc, 7qd, 7qm, 7qu, 7td, 7ut, 7we, 7wq, 7wp, 7zj, 7abf, 7acb, 7acf, 7aci, 7ads, 7agr, 7ahs, 7ahz, 7aiv, 7ajo, 7ajy, 7akh, 7alk, 8ak, 8bf, 8bk, 8dp, 8er, 8es, 8jy, 8kc, 8mz, 8oa, 8pl, 8ry, 8sp, 8tt, 8vt, 8vy, 8wy, 8aaf, 8acy, 8amm, 8apt, 8arm, 8art, 8asv, 8atc, 8atm, 8atn, 8aue, 8aup, 8avt, 8bau, 8bbt, 8bcp, 8bda, 8bfh, 8bhn, 8bkn, 8bmb, 8bnh, 8boc, 8boe, 8bvy, 8bwb, 8bzc, 8cci, 8chy, 8cke, 8cko, 8cln, 8cus, 8cwk, 8cwr, 8czz, 8dae, 8dbm, 8dcb, 8dcy, 8den, 8dgp, 8dhn, 8dhs, 8dkb, 8dlb, 8xan, 9ap, 9er, 9fm, 9gz, 9hg, 9hm, 9iw, 9lb, 9nu, 9qi, 9ql, 9ss, 9vm, 9xw, 9zt, 9zy, 9aar, 9aau, 9aaw, 9abc, 9ace, 9aem, 9afy, 9agb, 9agl, 9agy, 9ahh, 9ahz, 9aim, 9ain, 9ami, 9amo, 9amu, 9aog, 9aol, 9aom, 9aon, 9aou, 9apf, 9arj, 9ase, 9asn, 9asw, 9ave, 9avg, 9avn, 9avs, 9avv, 9awj, 9awv, 9axs, 9axx, 9ayj, 9ayx, 9azg, 9azp, 9bak, 9bab, 9bcx, 9bed, 9beu, 9bfp, 9bfy, 9bhb, 9bhi, 9bis, 9biz, 9bjn, 9bly, 9bmx, 9bnu, 9bnx, 9bof, 9bop, 9boz, 9bpx, 9bpy, 9bqq, 9brs, 9bsg, 9bsi, 9bth, 9btt. 9bug, 9bvv, 9bvy, 9bwv, 9bxq, 9ccm, 9ccv, 9cdo, 9cdv, 9cee, 9ceh, 9cfi, 9cga, 9cgm, 9cgu, 9chc, 9chi, 9cho, 9cht, 9cjj, 9cjy, 9cka, 9ckw, 9cld, 9clq, 9cly, 9clz, 9cnv, 9crl, 9crr, 9ctg, 9cvo, 9cvs, 9cvv, 9cwj, 9cxo, 9czg, 9czm, 9dai, 9dav, 9daw, 9dcr, 9dbf, 9dbh, 9dcf, 9ddf, 9dej, 9dfh, 9dhn, 9dkm, 9djv, 9dlf, 9dmj, 9dnd, 9dne, 9dpy, 9dqm, 9dsm, 9dsp, 9dsv, 9dte, 9dug, 9dui, 9dun, 9dvn, 9dws, 9dyi, 9dyn, 9dyr, 9dyy, 9dzo, 9ead, 9edb, 9edm, 9eeg, 9ees, 9efh, 9efx, 9egu, 9eht, 9eky, 9eld, 9xak, 9xax.

Can.—3bg, 3ws, 4co, 4cr, 4dq, 5as, 5go, 9bx.

Cuban—2ww qra? Hawaiian—6ceu, 6ccr. Porto Rico—4je. Mex.—Bx, 1b. Pse qsl crds. All crds answered.

Continued on page 44

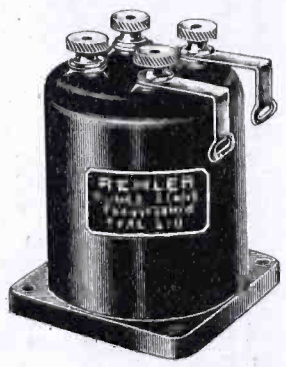
FROM THE RADIO MANUFACTURERS



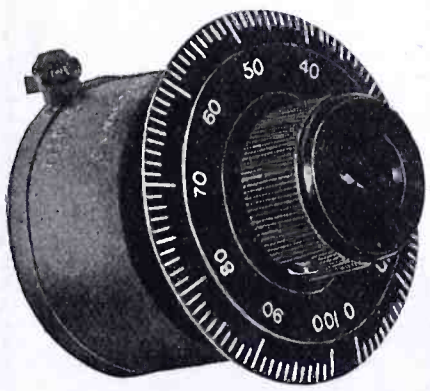
The new Jefferson long wave transformer is built with a laminated silicon steel core and impregnated coils assembled in a sealed metal case. It is designed to give maximum amplification at 6600 meters (45,454 cycles), and thus is particularly adapted for use as an intermediate frequency amplifier in a super-heterodyne receiver. Due to its construction, it is claimed to be sensitive and uniform in operation under all conditions.

The new Carter plug for use with head phone or loud speaker requires no screws, as the cord tips are pressed between heavy springs, making contact for their entire length. There is no chance for short circuits and body capacity is eliminated.

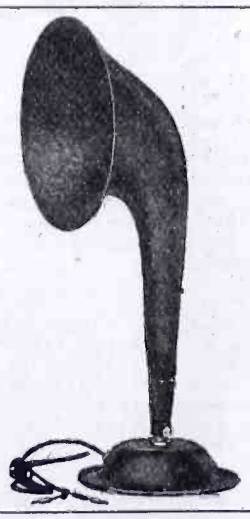
Remler Type 600 intermediate transformer is designed to give maximum amplification per stage at 45,000 cycles with minimum amplification of frequencies on either side of the 40,000-50,000 cycle bend. It is claimed to have no tendency to oscillate and to be free from distortion. It is made with an iron core and compactly mounted coils housed in a bakelite case.



Remler Type 610 tuned stage transformer is designed to work between the last intermediate frequency stage and the detector tube of a super-heterodyne receiver. With a .00025 mfd. condenser it gives maximum amplification at 45,000 cycles and fairly uniform amplification over a range of 3000 cycles on either side thereof. It is made with an air core and primary impedance to match that of a standard dry battery tube.



By a simple change in terminal connections the type D-10 Connecticut Triple Range condenser gives the capacity range equivalent to an 11-plate, 23-plate or 43-plate variable condenser. Only one panel hole is needed for mounting, it is completely shielded against body capacity and its dial rotates through 346 degrees, thus making closer tuning possible. Behind the panel it occupies a space 2 in. in diameter by 1 5/16 in. deep. Its effective resistance to radio-frequency currents is low.

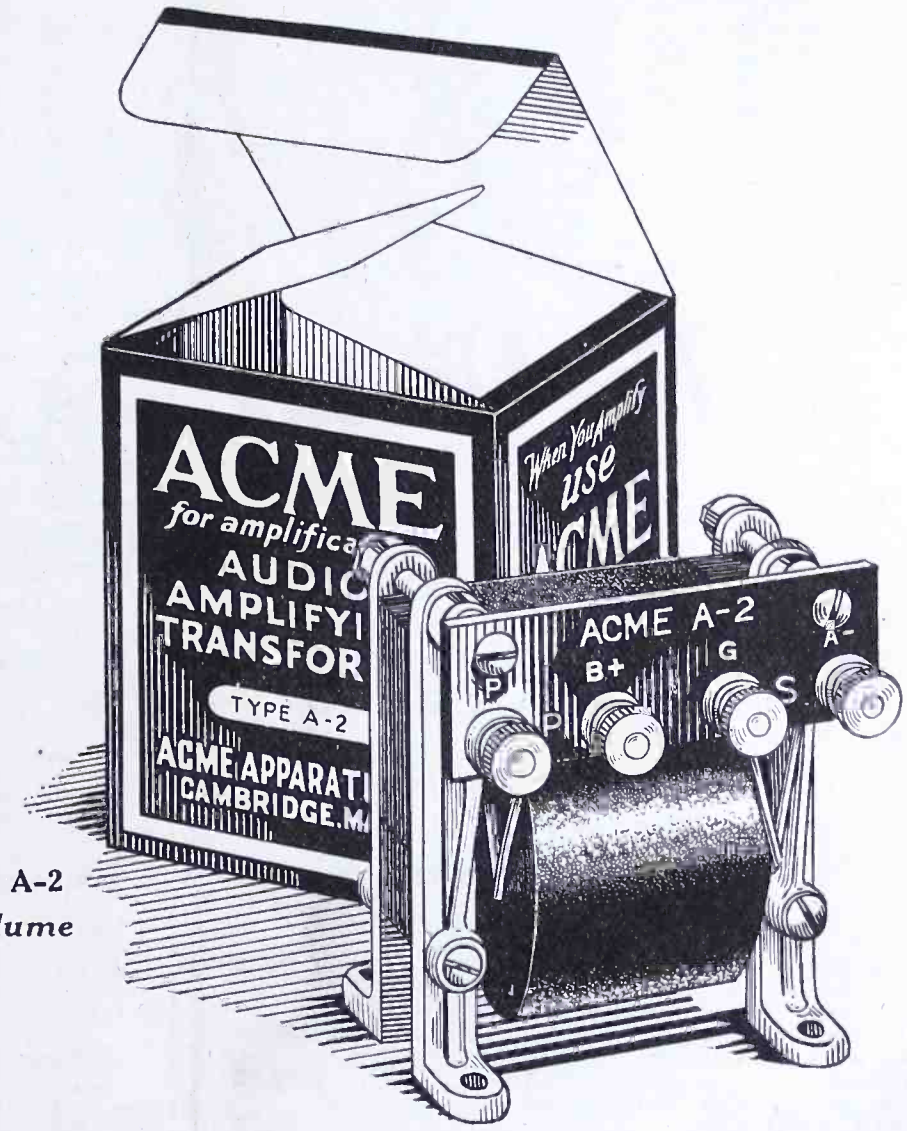


The Bristol "Baby Audiophone" is a model with fiber horn as illustrated. It is attractively finished in dull gold bronze. It gives a natural tone without mechanical distortion with sufficient volume to be heard in a large room.

Losses have been reduced to a negligible quantity in the new Cruver condenser designed by G. M. Proudfoot. The stator plates are mounted on two instead of the usual three plates so as to give a loss of but .007 per cent at a capacity of .001 mfd. By means of two scales the coarse adjustment is made by turning the knob to the right on the large scale and the fine adjustment by turning to the left on the small scale. Body capacity effects are eliminated by grounding the rotor plates.

The Bradleyohm is an adjustable resistor operated over a wide range by applying or removing pressure on two columns of treated discs by means of an adjusting knob. It is made in three sizes having ranges of from 10,000 to 100,000 ohms, 25,000 to 250,000 ohms and 50,000 to 500,000 ohms respectively. It is well suited for use as an adjustable resistance across a.f. transformers to reduce distortion, for coupling r.f. or a.f. resistance amplifiers, for adjusting filter couplers of super-heterodyne circuits or for adjusting push-pull amplifiers.

Ask your neighbor *--he knows*



ACME A-2
for Volume

ACME Transformers are used by thousands of radio owners to get increased range and louder, clearer radio. Acme Transformers give maximum amplification without distortion. Each transformer is tested and carries a guarantee tag. The name "Acme" is guarantee of best results. Use Acme Transformers in the set you build. Look for them in the set you buy.

ACME APPARATUS COMPANY
Transformer and Radio Engineers and Manufacturers
Dept. 79, Cambridge, Mass.

ACME
~ *for amplification*

Tell them that you saw it in RADIO

CALLS HEARD

Continued from page 41

By 6COU, Oxnard, California

2el, 3cbm, 4ba, 4eq, 4fd, 4jr, 4nv, 5ajh, 5ajj, 5akn, 5ald, 5amu, 5ct, 5ek, 5gn, 5in, 5lr, 5oq, 5ph, 5uk, 5uo, 5vo, 5xd, 5zav, 5zr, 7ahs, 7ip, 7aj, 7ajd, 7co, 7cr, 7di, 7fr, 7jy, 7lw, 7mf, 7qj, 7td, 8abx, 8acm, 8ahw, 8amm, 8anb, 8atc, 8bci, 8bfs, 8bxx, 8bzy, 8ceo, 8cjg, 8cmy, 8cv, 9dat, 8djd, 8fu, 8ic, 8lh, 8vt, 8wx, 8yn, 8xan, 9aaq, 9agb, 9ahz, 9aim, 9ami, 9apw, 9bav, 9bew, 9be, 9bjk, 9bk, 9blw, 9buj, 9bun, 9bqn, 9caa, 9ccz, 9cen, 9cht, 9clt, 9clq, 9clx, 9cow, 9cwj, 9dfn, 9dge, 9dgv, 9doe, 9dyr, 9ee, 9eea, 9ep, 9or, 9vm, 9zt.

Can.—4bk, 4co. Pse qsl if u hr mi 5 watter.

At 6AME, Route A, Box 11B, Modesto, Calif.

1agh, 1akl, 1avf, 1bcr, 1ci, 2atz, 2brb, 2bva, 2cee, 2hh, 2uu, 2wr, 2xna, 3cv, 3gc, 3je, 3me, 4xc, 5aaq, 5agn, 5alm, 5amo, 5gf, (5mi), 5nt, (5nw), 5ny, (5ph), 5qh, (5qy), 5rg, 5ts, (5zav), 8apt, 8bnh, 8bpa, 8bwb, 8cei, 8ctb, (8crv), 8cyi, (8cxm), (8dcy), (8dp), 8hn, 8jq, 8kc, 8xbl, 8zk, 9aci, (9acx), 9aec, 9afr, (9agl), 9aju, 9amx, 9ant, 9apt, (9avg), (9ayx), 9azj, 9bjk, 9bly, (9bmx), 9bop, 9bpv, 9btl, (9bvn), (9bwc), 9bxu, 9byc, 9bze, 9caa, 9ccw, 9cdb, (9cfx), 9cjy, (9clz), 9cme, 9co, 9cvn, (9cwf), (9czw), 9dcj, 9dcy, 9dms, 9doe, 9dpp, 9dun, (9dxk), 9dxy, 9eak, 9egw, 9eht, 9eld, (9hm).

Can.—(3pz), 4dq, 4hh, 5cn, 5cq, 5ct.

Mex.—hx, na?. Wl qsl crds to any of above on request. 24 watts input to 5 watter hr.

By Edw. Willis, S. S. Oleum, at Manzanillo, Mex.

1xa, 1aur, 2xaq, 2bxd, 2cjd, 3he, 3abw, 3uu, 4io, 5mz, 5zav, 5cv, 5rg, 5qd, 5ef, 5oj, 5ajt, 5ajj, 5va, 5oq, 5gr, 5lr (Can.), 5rw, 5ql, 5pa, 5rv, 5ft, 5gd, 7em, 7alk, 7fs, 7aek, 7afk, 7adi, 7lh, 7acm, 8bdu, 8bxx, 8abu, 8abm, 8dgp, 8cko, 8cei, 8xbc, 8hn, 8nb, 8abx, 9dmw, 9bmu, 9day, 9pe, 9crk, 9dyn, 9aau, 9bez, 9bjk, 9ayd, 9ajb. Brodacast stations—wbap, kyw, wfaa, woc, wos, kgo, wgad qra?. Long Wave—yn, nss, wso, nba, kia, nph, npm, nao, nat, nay.

By 6ASB, Melvin A. Russell, Box 271, Brea, California

4ik, 4fn, 4cb, 5amy, 5jc, 5xl, 5adb, 5he, 5nh, 5ql, 5aic, 5ahr, 5qq, 5zav, 5na, 5hd, 5zax, 5gj, 5vo, 5be, 5kr, 5jl, 5aao, 7pz, 7co, 8bmg, 8cwu, 8yn, 8jy, 8cud, 8ih, 8cgu, 8atp, 8apt, 8cpr, 9bsi, 9vm, 9dgk, 9zt, 9ckj, 9cgn, 9dxn, 9avs, 9edb, 9dtè, 9dun, 9clg, 9ccv, 9cjy, 9bjk, 9bp, 9eam, 9brk, 9azg, 9dyr, 9ss, 9drk, 9dwn, 9cwj, 9bun, 9elw, 9cr, 9cjm.

Spark: 6alw, 6avu, (6car), 6uc, (6bqt), (6bks).

By Fred Hoffman, Jr., 1963 61st St., Brooklyn, N. Y.

1ag, 1fu, 1qr, 1sq, 1tt, 3adq, 8uu, 4cp, 4ex, 4io, 4lr, 4og, 4ft, 5aa, 5ek, 5mo, 5nc, 6bcz, 6ti, 6bcl, 6xad, 6bum, 7bu, 7dj, 7ll, 8tu, 8un, 8abt, 8art, 8bag, 8box, 8cej, 8cgu, 8cuv, 8dat, 9bb, 9ea, 9ff, 9abl, 9cxw, 9dqi qra, 9arp.

By 8DCF, Vincent French, Ashtabula, Ohio

1abf, 1aeu, 1aez, 1aou, 1atj, 1awe, 1bqk, 1cdo, 1cib, 1ctp, 1fh, 1it, 1js, 1kc, 1ml, 1rr, 1uo, 1xam, 1xas, 1zs, 2aay, 2adj, 2anm, 2as, 2ayl, 2bm, 2bqb, 2bqh, 2bzi, 2bzl, 2cbp, 2cpa, 2cpd, 2cpx, 2cqi, 2cxd, 2cxl, 2cxy, 2eh, 2pf, 2vc, 2wc, 3aek, 3aky, 3ari, 3bdr, 3bgg, 3bhl, 3blc, 3bpp, 3btr, 3buy, 3bvl, 3ccx, 3cdk, 8cej, 3cgc, 3cgn, 3cgs, 3chb, 3cjn, 3ckl, 3dt, 3hh, 3hs, 3jx, 3lg, 3lx, 3ly, 3sl, 3tr, 3uc, 3uz, 8xar, 4cp, 4eb, 4my, 5aaq, 5aiu, 5bz, 5ws, 5zb, 6agk, 6bic, 6bm, 6bpm, 6bra, 6eb, 7fq, 7qc, 7wp, 9aek, 9aem, 9afy, 9aim, 9aqj, 9aqr, 9ard, 9awp, 9azp, 9bcb, 9bhi, 9bkr, 9bvz, 9ccj, 9cg, 9cjy, 9cka, 9cs, 9dbf, 9dcr, 9doe, 9dqt, 9dte, 9tg, 9ud.

Can.—2bn, 2fo, 3bi, 3kq, 3ml, 3tf, 3ux, 3vh.

By 9ASW, 977 West Central Ave., St. Paul, Minn.

1abf, 1abt, (1are), (1avf), 1ayt, 1bbp, 1bcr, (1bel), 1bgc, 1bgo, 1bie, (1brl), 1cit, 1cmx, 1ga, 1gv, 1sk, 2aay, 2afp, 2al, 2ate, 2axf, (2bbn), (2be), 2bgo, 2bxd, 2cbg, 2cdp, 2cee, 2cgq, 2cla, 2rk, 2sq, 2wr, 2xn, 2xq, (3abw), 3amr, 3apv, 3aqr, 3bei, 3ccu, 3cej, (3cjn), 3cz, 3dt, 3hh, 3lg, 3ly, (3qt), 3wx, 3xaq, 4af, 4ag, 4ba, 4eb, 4jn, 4oh, 4xc, 5aar, 5aas, 5adb, (5aiu), 5aiy, 5ajj, 5amo, 5cni, (5eh), 5ek, 5fv, 5jb, (5ka), 5lr, 5nw, 5ph, 5qd, 5sg, 5sz, 5zav, 6aao, 6agk, 6aoc, 6arb, 6bql, 6bui, 6buo, 6cdg, 6cef, 6cej, 6cka, 6cmr, (6cmu), 6cnf, 6fy, 6gq, 6th, 6jj, 6rn, 6zcd, 7afe, 7agi, 7ajy, 7akk, (7co), 7dr, 7ej, 7em, 7ew, 7ey, 7fs, 7gr, 7gw, 7if, 7iw, 7lk, (7no), 7nr, 8aaj, (8acm), (8alm), (8alx), 8apt, 8awj, 8avj, 8bce, (8bgw), 8bk, (8bqs), 8bwb, 8cei, 8chb, 8ctz, (8cwr), (8dae), (8dgp), (8djd), (8ig), 8qb, (8ry), 8sr, 8ej, 8uk, 8vn, (8xbc), 8xe, (8yae), fone 9ry, (9eeo), wnp.

Can.—3co, 3pz, 4ba, 4cb, 4ch, 4dq, 4eo, 4fx, (4fz), (4ws). Would appreciate reports on my 5 watts.

Continued on page 46

Vincent Lopez and his Hotel Pennsylvania Orchestra

From one who knows

VINCENT LOPEZ praises and endorses the rich, clear, natural quality of MUSIC MASTER reproduction. His Hotel Pennsylvania Orchestra is heard over the radio by untold thousands.

Even the most delicate and fugitive impulses from distant stations are caught by the precision instrument of MUSIC MASTER hidden in the art metal base. These impulses are developed into full, natural tones, free from blast and distortion, in the tapered tone chamber of heavy cast aluminum—which also imparts a quality of brilliance to the reproduction.

MUSIC MASTER is an enduring musical instrument. Hear it and see it at your dealer's, or have him send one to be tried and proved with your own set.

Dealers Everywhere

Music Master Corporation

(Formerly General Radio Corporation)

Makers and Distributors of High-Grade Radio Apparatus

S. W. Cor. 10th and Cherry Streets

Chicago **PHILADELPHIA** *Pittsburgh*

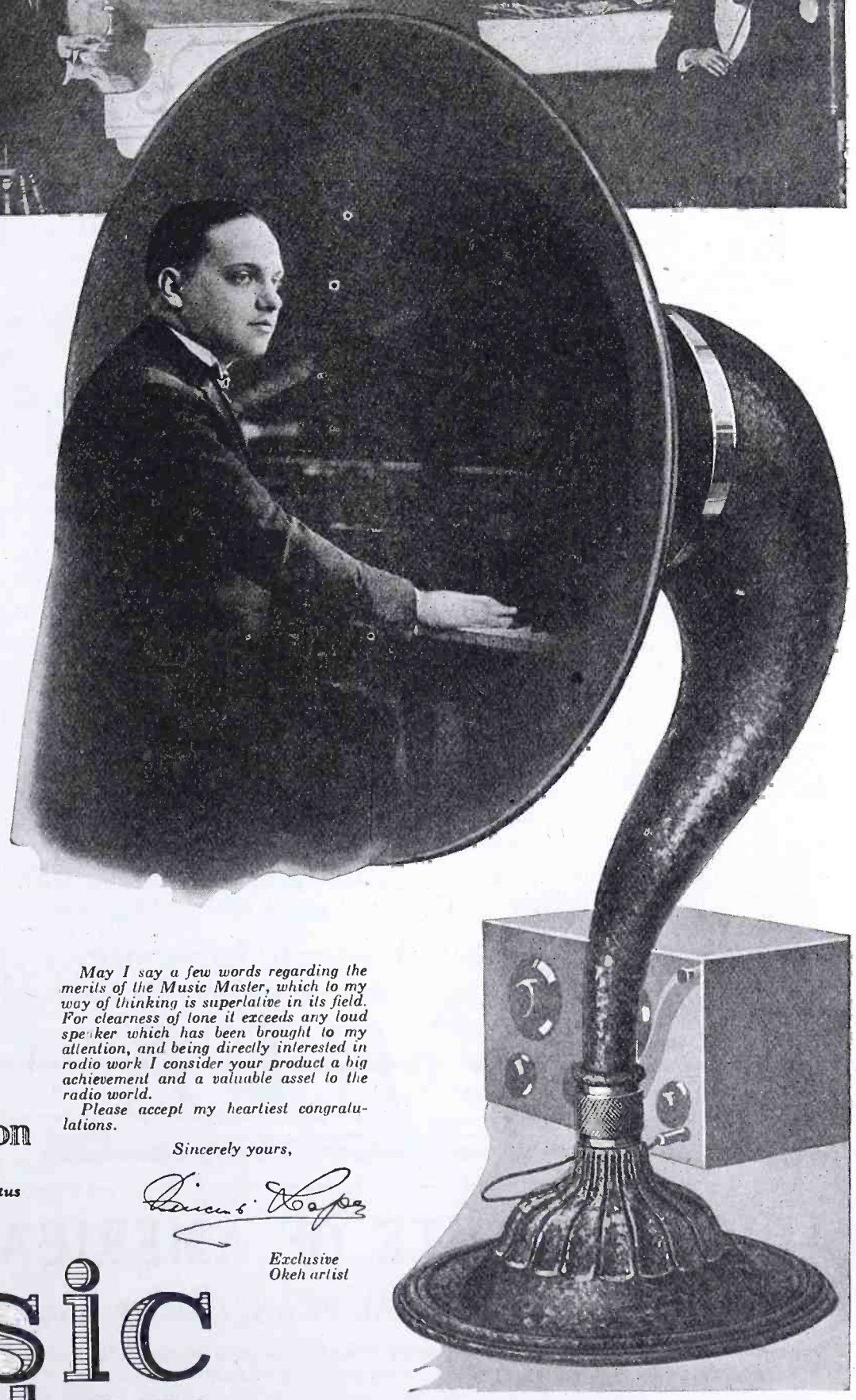
May I say a few words regarding the merits of the Music Master, which to my way of thinking is superlative in its field. For clearness of tone it exceeds any loud speaker which has been brought to my attention, and being directly interested in radio work I consider your product a big achievement and a valuable asset to the radio world.

Please accept my heartiest congratulations.

Sincerely yours,

Vincent Lopez

Exclusive Okeh artist



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

Tell them that you saw it in RADIO

Continued from page 44

By 6ZAT-6UW, L. Farwell, Los Gatos, Calif.

1er, 1fd, 1fm, 1kc, 1mo, 1xw, 1ajt, 1anr, 1art, 1bcr, 1xam, 2atr, 2cdp, 3qv, 3bei, 3blu, 3bva, 3ccv, 4mb, 4pb, 5ah, 5co, 5eh, (5jb), 5rq, 5sd, 5anc, 5xat, 8an, 8pe, 8wy, 8zk, 8aaf, 8acn, 8ada, 8adk, 8aig, 8ajh, 8ake, 8apt, 8ard, 8avj, 8bda, 8bkz, 8bwb, 8bwj, 8cqh, 8cqj, 8cpk, 8cwk, 8dae, 8dgp, 8dlb, 8xbp.

At 2BRB, Brooklyn, N. Y.

(4af), 4bz, 4eb, 4eq, (4er), (4fg) spk, 4fq, 4fs, 4gx, (4gz), (4hr), 4ia, 4io, 4mb, 4nv, 4pk, (4rr), 4sh, 4si, (4xc), 5am, 5be, 5ek, 5ez, 5gg, 5ka, 5li, 5mi, 5nw, 5ql, 5ov, 5rg, 5tj, (5ut), 5xa, 5aat, 5abn, 5agn, 5ajb, 5ajg, 5ajj, 5akn, 5amh, (5xab), 5xac, 5xar, (5xau), (5zas), (5zav), 6ea, 6fm, (6gt), (6lv), (6xad), 6nx, 6tu, 6xe, (6zp), 6abk, 6ahp, (6ajd), 6ajf, (6alk), 6amw, 6aoc, (6apw), (6arb), 6arf, 6bbw, 6bcl, (6bic), 6bjj, (6bui), (6buy), 6bvg, 6ccy, 6cjb, 6cef, (6cee), 6cmr, 6xbc, 6xbj, 6zcd, (6bql), (7bj), 7co, (7em), 7ey, 7fs, 7gp, 7gq, 7gr, (7ij), (7io), 7iw, 7lh, (7ly), 7oa, 7ot, 7abb, 7ael, 7afn, 7aft, (7akk), (7xba) qra?, (9ca), (9co), 9dw, 9em, 9es, 9hf, 9wc, (9yy), 9zt, 9aal, 9abe, 9ato, 9ayk, 9bhx, 9bib, 9bjf, 9bmd, 9bmx, 9bod, 9bov, 9bqo, 9brk, 9bvn, 9bwo, 9bzj, 9cco, (9cea), 9cex, 9cfi, 9cin, 9clq, 9cpo, 9csj, (9cxp), 9cyw, 9czj, 9day, 9dfq, 9dgy, 9diw, 9djj, 9djv, 9dkb, 9dkk, 9dld, 9dlw, 9dmj, 9dro, 9dtt, 9dxk, (9dyz), 9eht, (9eld), 9elj.

Can.—1bq, (1ef), (2az), (2be), (2bg), 2cg, (2bn), 4cr, (4dq), 4hh, 9ar, 9bw. Mex.—bx. British—(2nm), 2qd, 2sh, (2sz), 5nn, wnp.

By W. Jervey Ravenel, 4SS, 96 Bull St., Charleston, S. C.

1aj, 1avx, 1btw, 1cpn, 1cpo, 1gr, 1gm, 2bgi, 2by, 2cjb, 2cpw, 3afs, 3ajs, 3alx, 3bbs, 3cf, 3cjn, 3ms, 3ph, 3zo, 4's too numerous, 5agj, 5aiu, 5akn, 5amh, 5ek, 5gj, 5he, 5jh, 5lh (qra), 5mi, 5mw, 5nk, 5qw, 5qz, 5rh, 5sp, 5uk, 5yr, 5yw, 5za, 5zs, 6ach, 6acv, 6ahr, 6amw (qra), 6aps, 6bbh, 6bcl, 6cmu, 6cng, 6fr (qra), 6is, 6ot, 6vt, 6xad, 6zh, 6wt (qra), 7co, 7el, 7hw, 7sc, 8ajy, 8amr, 8ard, 8atc, 8bnh, 8boj, 8byi, 8cej, 8cko, 8cnw, 8cse, 8dat, 8dfr, 8fu, 8jy, 8ry, 8zc, 9aau, 9alf, 9aqk, 9arm, 9asn, 9avb, 9avn, 9bak, 9bax, 9bbf, 9bbr, 9bgh, 9bnh, 9bqf, 9byf, 9ccj, 9ccs, 9ccz, 9cfi, 9cgy, 9chn, 9clk, 9cpk, 9daz, 9dcp, 9dej, 9den, 9deu, 9dhr, 9dld, 9dlw, 9dof, 9drs, 9dsv, 9dte, 9dwk, 9dyh, 9edb, 9edo, 9efz, 9ly, 9mc.

Can.—1ar. Mex.—gw (qra).

By 7ALE, L. V. McMoran, R. F. D. No. 1, Mt. Vernon, Wash.

1aho, 1ajx, 1am, 1ka, 1wj, 1aua, 2si, 3awt, 3kr, 3ea, 4aa, 4aj, 4ak, 4ea, 4eo, 4eq, 4id, 4ne, 4nx, 4oe, 4zn, 5aic, 5ak, 5be, 5bt, 5cf, 5cn, 5df, 5dh, 5gm, 5ka, 5lk, 5lw, 5nw, 5ov, 5av, 5qd, 5uw, 5tm, 6abd, 6abh, 6abw, 6acv, 6ad, 6ady, 6aeq, 6afc, 6ail, 6ajv, 6ale, 6alk, 6am, 6amc, 6arp, 6av, 6awa, 6aww, 6bto, 6buh, 6bup, 6cka, 6cmo, 6ek, 6ex, (6gt), 6iu, 6ja, 6ka, 6kd, 6kj, 6la, 6lr, 6lu, 6ov, 6qw, 6td, 6wa, 6wm, 6wv, 6abb, 6aao, 6ga, 6aw, 8ad, 8an, 8bx, 8cya, 8nd, 8ia, 8re, 8ny, 9aav, 9aba, 9ak, 9akb, 9akh, 9ami, 9ars, 9asj, 9avn, 9awn, 9awp, 9awv, 9aww, 9bau, 9bav, 9baw, 9bec, 9bsy, 9bzi, 9ce, 9cjc, 9cit, 9dak, 9dbh, 9dbk, 9dkx, 9dqa, 9dro, 9eky, 9er, 9ga, 9kb, 9lz, 9nu, 9rc, 9vz, 9zn, 9zt, 9dar, 9al, 9agy, 9bqh, 9alu, 9aks, 9adb, 9eja, 9bsh, 9dn, 9dtn, 9daw, 9tf. Also U. S. 4on.

Can.—4ao, 4as, 4be, 5aj, 5ao, 5be, 5ct, 5ek, 5hj, 5au.

Phones: 7ali, 7qc, 7ob.

By 7WZ on SS "KUFJ," on voyage to New Zealand, Australia, Philippines, China and return. Detector and 1-step.

Nov. 23rd, 400 southwest Honolulu; 9ccs, 4dy, 9rn, 5ue, 7zu, 8xe.

Dec. 3rd, off Tonga Island, 1100 North Auckland, N. Z., thru heavy qrn; 9dyr, 6acm, 8zc 7sf, 6fh, 6asr. Can.—3bp, 6cmr, 9bzi, 6ahu, 6age, 8aqu, 7sc.

Dec. 4, 4809 SW San Francisco, heavy qrn; 5akn, 9bez, 6cf, 7abb, 6bf, 6bjj, 7ly, 7sc, 6cmi, 9bzi, 7qj, 6awt, 6aak, 6bvg, 6ceu, 7sf.

Dec. 5th, 4980 SW San Francisco; 7lr, 6awt, 9bzi, 6cmi, 6bvg, 9bjk?, 6zba, 7zu, 6cmr, 6cbb, 6bvr.

Dec. 7th, 60 miles north Auckland, N. Z., 7 p.m. daylight; 6pl, 9zt, 6aos, 6bic.

Dec. 10th, at Auckland; 6alk.

Dec. 14th, 300 north Wellington, N. Z.; 6aos, 6zah, 2rk loud, 6awt.

Dec. 18th, at Lyttelton, N. Z.; 6gr, 7ih, 6arb, 6aos, 5zb, 6adt, 9bwv, 7ahi, 9ccz, 6chl.

Dec. 23rd, at Dunedin, southern N. Z.; 6beo.

Dec. 29th, at Dunedin; kdef.

Jan. 1st, at Dunedin; 9mc.

Jan. 3rd, 150 south of Dunedin; 5zav.

Returning from HongKong, Mar. 15th, 2984 west Honolulu; 6avv, 6avj, 9bly, 6cdg.

Mar. 18th, 2541 west Honolulu; 6bz, 5kw, 7ih, 6dd, 6do, Can.: 5hg, 6ado.

Card will bring further particulars.

Continued on page 48

Continued from page 46

By 6CLZ, 2131 Grant St., Berkeley, Calif.

5ado, 5aip, 5aiu, 5ajb, 5ajj, 5akf, 5amu, 5ga, 5kc, 5na, 5nk, 5rg, 5rv, 5va, 5vm, 5za, 5zav, 6aam, 6acn, 6adh, 6aed, 6aja, 6amw, 6asv, 6atn, 6atq, 6bbh, 6blh, 6bnf, 6bpm, 6cbu, 6ceu, 6cjl, 6cki, 6pe, 6rm, 6zbt, 6zt, other 6's too many, 7acf, 7aci, 7adf, 7adg, 7adi, 7ads, 7aef, 7aek, 7afk, 7afn, 7afu, 7agi, 7agv, 7agz, 7aha, 7ahn, 7ahs, 7aim, 7ais, 7aiv, 7ajv, 7akf, 7ali, 7bj, 7cf, 7cm, 7co, 7cw, 7ju, 7ke, 7kz, 7ln, 7ma, 7mf, 7mi, 7mn, 7mp, 7no, 7nt, 7ob, 7ot, 7oy, 7pz, 7qc, 7rd, 7rp, 7ry, 7sh, 7sy, 7td, 7tq, 7ut, 7vn, 7we, 7wo, 7wp, 7zbu, 7zj, 7zu, 8bjv, 8bxx, 8czu, 8dgp, 8dhs, 8fu, 8hv, 8jy, 8kg, 8wl, 8zz, 9aau, 9aen, 9ahz, 9aii, 9aim, 9ajv, 9amb, 9atn, 9avn, 9awv, 9axx, 9bab, 9bav, 9bdz, 9beu, 9bez, 9bis, 9bly, 9bof, 9bpy, 9bqq, 9bsg, 9bsp, 9bto, 9bun, 9bxa, 9caa, 9ccs, 9cdo, 9cec, 9cfi, 9cly, 9cr, 9cwj, 9cyw, 9czl, 9daj, 9daw, 9day, 9dbf, 9dcw, 9dfh, 9dfn, 9dgi, 9dkk, 9doe, 9dpr, 9dpx, 9dro, 9dsw, 9dte, 9dun, 9dvw, 9dwn, 9dxn, 9dxr, 9dyn, 9ebt, 9ee, 9eky, 9elb, 9lz, 9mc, 9ql, 9rc, 9ss, 9vm, 9yu, 9zt.

Can.—4ab, 4ao, 4bk, 4co, 4er, 4fn, 5af, 5bj, 5ef. All crds answered gladly. Qrk 5 watts a.c.!

By 5QL, Oklahoma City, Oklahoma

1ah, 1ael, 1aer, 1afm, 1agh, 1akl, 1awl, 1ali, 1blm, 1bcf, 1ber, 1bfq, (1bgv), 1bnp, 1blb, 1bql, 1boa, 1brb, 1bsd, 1bsz, (1bwj), (1ci), (1cmp), 1cij, 1cit, (1cpn), 1cqz, 1er, 1gv, (1hx), 1il, 1iv, 1rv, 1sw, 1su, 1ve, 1xah, 1xj, 1xw, 1xz, 1xc, (1yb), 1zd, 1zo, 1ze, 2afp, 2agh, 2alh, 2azy, 2bgi, 2bri, 2bln, 2bxd, 2bqb, 2cj, 2ccx, 2cfy, 2cgj, 2cie, 2coy, 2cub, 2cuz, 2le, 2rb, 3alx, 3aqr, 3bd, 3bj, 3ccx, 3fc, 3byj, 3mf, 3ud, 4af, 4bz, 4db, 4eb, 4fz, 4hg, 4it, 4my, (6aao), 6abx, (6adh), 6afa, (6aft), (6ahp), (6ajc), 6aju, (6alq), (6alg), 6aqd, (6avr), 6awt, (6bij), (6bkb), (6blr), (6bmy), (6bny), (6bnt), 6bpm, (6buh), (6bup), (6cdg), 6cgw, 6chb, 6cih, (6cdo), (6do), (6ea), (6eae), (6fp), 6fy, (6if), 6ka, (6nb), 6od, 6ql, 6tn, 6tr, (6ue), (6ux), (6vc), (6wv), 6xad, 6zap, 6zp, 7afc, (7ael), 7ahv, 7akl, 7akh, 7aqd, 7ajt, (7dq), 7ej, (7ih), 7jc, (7ke), 7kz, (7ly), 7lj, 7om, 7nr, (7qc), (7tq), (7zu), (8aab), (8aaj), (8acm), (8ah), (8ahq), (8ahs), (8aib), (8aig), (8aqg), (8azy), (8bcp), (8bgw), (8bkv), (8bnh), (8bry), (8cho), (8dhq), (8er), (8kc), (8tt), (8zc).

Can.—1ar, 1dd, 1bq, 1qd, 2be, 2bg, 2bn, 2oh, 3le, 3ib, 3ea, (3ly), 3oh, (3ia), 3aib, 3xi, (4ab), (4ea), (4eo), (4fv), (4fz), 5cn, 5go, 5co, 9ar, 9al, 9bj. Cuban—(2by), 2ww. Hawaii—6bdt. Alaska—7mn.

By 6EB, 343 S. Fremont Ave., Los Angeles, Cal.

1ary?, 1anc?, 1cmp? — (all qry), 2abd, (2brb), 2dr?, 2rk, 3cdg, 3hg. 3qv, 4cs, 4fz, 4io, 4my, 5adb, 5ado, 5aec, 5agn, 5ah, 5ahd, 5aic, 5aij, 5aiu, (5amo), 5amu, 5az, 5be, 5bn, 5dw, 5ek, 5ga, (5ht), (5lg), 5lr, 5nw, 5od, 5ph, 5px, 5qd, 5qh, 5ql, (5rg), 5sk, 5tj, 5xb, (5xd), 5yt, 5za, 5zas, (5zav), 5zb, 5zh, 7abb, 7aby, 7aci, 7adg, 7adm, 7adp, 7ads, 7aea, 7ael, 7afe, (7aff), 7afk, 7afo, 7age, 7agv, 7ahi, 7ahs, 7aim, 7aiv, 7ajd, 7ajq, (7ajy), 7akh, 7akk, 7ald, 7alk, 7all, 7aod, 7apw, 7ba, (7bb), 7bj, 7br, 7cf, 7cg, 7co, 7di, 7dr, 7eb, 7ei, 7ej, 7em, 7fq, 7fr, 7fs, 7fy, 7gi, 7gq, 7go, 7gr, 7hg, 7hw, 7ih, 7io, 7it, 7iw, 7je. 7ju, 7ke, 7kk, 7kr, 7ks, 7lh, 7ln, 7lr, 7lu, 7lw, 7ly, 7nn, 7ny, 7ob, (7oh), 7om, 7ot, 7ow, 7pf, 7pw, 7qc, (7qd), (7qj), 7ql, 7qt, 7qu, (7rs), 7ry, (7sc), (7sf) 7sh, 7so, 7sy, 7to, 7tq, 7tt, 7uu, 7vc, 7ve, 7vn, 7wl, 7wm, 7ws, 7xb, 7xt, 7ya, 7yl, 7zn, 7zr, 7zt, 7zx, 7zu, 7zz, 8aiv, 8atc, 8bdu, 8bfh, 8ceh, 8cek, 8cgj, 8cjd, 8cmy, 8cp, 8cwp, 8dha, 8fj, 8gz, 8in, 8kc, 8qy, 8vy, 8wa, 8xe, 8yn, 8yv, 8zk, 9ab, 9abc, 9acm, (9aec), (9ahz), 9aim, 9amb, 9amp, 9aoj, 9aou, 9ape, (9apf), 9aqc, 9att, 9auw, 9avc, 9avs, 9avz, 9awv, 9ayu, 9azg, 9baw, 9bcw, 9beu, 9bez, 9bik, 9bji, (9bjk), 9bkf, 9bly, 9bqy, 9bri, 9bsg, 9bth, 9bto, 9bun, 9bxm, 9bxq, 9bzi, 9caa, 9caj, 9cay, 9cby, 9ccs, 9ccv, 9cdq, 9cdv, 9ceh, 9cfj, 9cfy, 9cga, 9cju, 9cjy, 9cld, 9cly, 9cns, 9cte, 9ctg, 9ctv, (9cuc), 9cvc, 9cvo, 9cvs, 9czg, 9czq, 9dah, 9daw, 9dfh, 9dkb, 9dkq, 9dkx, 9dmo, 9dpp, 9dsw, 9dte, 9dug, 9dvj, 9dyi, 9dxx, 9eae, 9eak, 9eam, 9eea, 9eiq, 9elb, 9ell, 9elv, 9hm, 9mc, 9pf, 9ss, 9vm, 9xi, 9xax, 9xba, 9xbe, 9yaj, 9yau, 9xy, 9zt, 9zy, wnp, kfz, kdef buzzer & cw.

Canadian: 3ni, (4dq), 4cb, 4cl, 4fn, (4sh), 5cn, (5go), 5hg, (9bx).

Mexico—(rf), bh2.

I just had 500 new cards printed so if any of the above stations mentioned have not received one yet, please write me and I will be glad to send one. Also don't forget to mention if you have heard me. Most all of the above were heard on a special receiver and no antenna, just a ground. One stage of audio-amplification used.

By 9CFK, Lewistown, Ill.

cw, 6dd, 6gt, 6gq, 6ji, 6nb, 6rn, 6vc, 6zh, 6zt, 6aao, 6acv, 6aft, (6ahp), 6aja, 6akw, (6awe), 6anq, 6blw, 6bri, 6bqb, 6buh, 6bur, 6bwp, 6cgd, 6chv, 6cbf, 6ccy, 6cdg, 6cdn, (6cfm), 6cgo, 6chl, 6cix, 6cmr, 6cmu, 6cng, 6cnl, 6xad, (7ax), (7co), 7ej, (7fs), 7gi, 7go, 7hw, (7ih), 7iw, (7ke), 7kr, 7kz, 7pz, 7qc, 7sh, (7vn), (7wp), 7zu, (7abb), (7adg), 7adi, 7ajt, 7ajy.

Continued on page 50

GO!

MAKE your plans right now to attend the gigantic Pacific Radio Exposition in San Francisco—August sixteenth to twenty-first. Regardless of where you are located, you can come to San Francisco by rail for less than the price of the usual half fare summer rates. The "RADIO EXPOSITION SPECIAL," an exclusive radio train running out of New York and Chicago, will arrive in San Francisco one day prior to the opening of the mammoth exposition. Passenger agents for the Southern Pacific, Union Pacific, New York Central, Chicago & Northwestern and other railroads, will cheerfully furnish you with full details regarding the special excursion train. Whether you are an amateur, a broadcast listener, a manufacturer, dealer or even a radio novice, you are welcome on the "RADIO EXPOSITION SPECIAL." Many of the most prominent Eastern radio manufacturers have already made reservations for the trip. Combine business with pleasure—come to San Francisco for your vacation this year and attend the Pacific Radio Exposition. The entire main section of the Civic Center Auditorium will be used for the exposition. 150 exhibitors will be there. We assure you that this exposition will be the most spectacular, educational and interesting affair of its kind yet held in America. Every exhibit will be a show in itself. Every exhibitor will have something in operation—something in motion—something entirely out of the ordinary. And it is going to be such a different exposition. It is not a money-making affair. The Pacific Radio Trade Association is conducting, operating and financing it on a co-operative and non-profit basis. The admission price will be 25 cents.

Prospective Exhibitors Please Note--

The entire available exhibition space for the Pacific Radio Exposition has been sold. Arrangements can be made with a number of present space holders to have them divide their space with prospective exhibitors who desire to partake of this mammoth affair. It will be well for you to telegraph us at once, stating your minimum requirements for space. If you delay, it will be impossible for you to secure "standing room."

PACIFIC RADIO EXPOSITION

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San Francisco

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17 West 42nd Street
New York

157 E. Ontario Street
Chicago

52 Irving Street
Boston

"America's Greatest Co-operative and Non-profit Radio Show"

Tell them that you saw it in RADIO

Continued from page 48

At 3CCU, Emigsville, Pa.

1aal, (1abf), (1abl), (1acr), (1adi), (1afa), (1aft), (1ags), 1aiv, (1akz), (1ami), (1anr), (1aow), (1apm), (1apw), (1are), (1aur), 1avq, (1axk), (1azr), 1bbk, (1bel), 1bgt, (1bhm), (1bho), (1bie), (1bnk), (1bnl), (1btt), (1bym), (1bzp), (1cax), (1caz), (1cbh), (1cbj), 1ccw, 1cgv, 1cit, (1cgr), (1cpo), 1cmp, (1cnp), (1coe), (1ctp), (1ctw), (1df), (1di), (1dz), (1fd), (1fm), (1ga), (1hn), (1ij), 1nt, 1pp, 1pb, 1pl, (1on), 1rb, (1rr), 1sn, (1va), (1vu), 1wd, 1xam, 1xz, 1xu, 1xav, 1yd, 1zx, (2aay), (2al), (2acs), (2adu), (2agc), (2ajf), (2apy), (2aqb), (2arb), 2baw, (2bqh), (2bsl), (2bts), (2bue), (2buy), 2cee, (2cfa), (2cfw), (2chb), (2chz), (2cjr), (2cjx), (2cmu), 2cpx, (2cty), (2cue), (2cwj), (2cwp), (2kf), (2ry), 4ag, (4af), 4ba, 4bx, 4bz, (4aq), 4er, 4ft, 4fz, 4gv, (4hw), (4io), 4iz, (4jm), 4jr, (4li), 4ll, 4lr, 4ly, 4my, (4oa), (4og), (4pv), 4qw, (4rf), 4rg, (4rr), 4sh, (4si), 4su, (uz), 4xc, 5aac, 5ac, 5abn, 5adv, 5aeo, 5afh, 5agd, 5aht, (5aic), 5ail, 5air, (5aiu), 5ajb, 5akn, 5alv, (5aom), 5aov, (5be), 5cn, 5dw, 5ek, 5ft, 5gm, (5gj), (5io), (5jb), 5jl, (5ka), 5lr, 5mn, (5nw), (5ph), 5oh, 5ql, 5rg, 5rh, 5rq, 5sg, 5uk, 5ux, 5vm, 5vv, 5wi, (5xa), 5xbh, (5zav), 5za, 5zb, 6aao, 6abt, 6adt, 6age, 6agk, 6ame, 6anw, 6arb, 6avr, 6bcl, 6bur, 6cbu, 6cee, 6cef, 6cgs, 6cgw, 6cix, 6cmu, 6cnc, 6cor, (6gt), 6kj, 6lv, 6pl, 6rn, 6tu, 6xn, 6xad, 6xbc, 6zcd, 6zp, 7adg, 7akk, 7bj, 7co, (7dz), 7em, 7fo, 7ge, 7gq, 7gw, 7ih, 7iw, 7ly, 7lh, 7mp, 7no, 7zu, 8aaf, 8abs, (8ago), 8agw, 8aig, 8aih, 8alw, 8anb, 8aok, 8apt, 8aqm, 8aru, 8avf, (8awj), (8baj), (8bbh), (8bcf), 8bcp, (8bff), (8bge fone), (8bk), (8bky), (8blu), (8bnc), (8boe), 8bop, 8boq, (8boy), 8bqy, (8byn), 8bzy, (8cc), 8cci, (8cln), 8cmy, (8con), (8cru), (8cuk), (8cwh), (8cwl), (8cyi), (8dbm), (8ddy), (8dff), (8dfo), (8dga), (8dgc), 8dgp, (8dhq), (8djr), (8dki), 8dmc, (8dmx), (8dnf), (8dpo), (8dtl), 8ic, (8jb), (8kc), (8nd), 8qb, 8sr, 8uh, 8vy, (8wb), (8xan), (8xbc), (8zu), 9aaq, 9abl, 9abp, (9acs), 9cax, 9ada, (9adg), (9aec), 9aed, 9aem, 9aep, (9agb), 9agl, 9ago, (9agz), (9aic), (9aim), 9aiu, 9ajv, 9ake, 9amz, (9apu), (9aqd), 9aqt, 9arp, (9arr), (9ash), (9asl), 9asw, 9ato, 9atr, 9aue, 9auu, 9ayj, 9ayk, (9ayx), 9aza, 9azj, 9azr, 9bbg, 9beb, 9bhd, (9bhw), (9bij), 9bio, 9bjk, 9bkf, (9bkr), (9blg), (9bly), 9bnu, 9bof, 9bpv, (9bre), 9bsg, 9bsp, 9bun, (9bva), 9bvz, (9bwo), 9bzi, 9caa, (9cah), 9ccg, 9ccj, 9ccw, (9cdb), 9cdc, 9cdv, 9cel, (9cfk), (9cgh), 9cho, (9cjh), 9cka, (9ckb), 9ckh, 9cko, (9clz), (9cm), (9cmc), 9cmd, (9cme), (9cmn), 9co, 9cow, 9csa, (9ctg), 9ctr, (9cui), 9cvo, 9cvs, 9cvv, (9cxi), 9cxp, 9cyb, 9cyp, 9cyw dalite, (9czq), 9dbm, 9dcj, 9dcp, 9ddc, 9dfq, (9dhr), 9dja, 9dkk, (9dli), 9dlm, 9dma, 9dml, 9dmw, (9dnf), (9dnp), (9dp), 9dr, (9dsv), (9dub), 9dvh, 9dwa, 9dwn, 9dwq, 9dxc, (9dxk), 9dxl, 9dxu, 9dyc, 9dyn, 9dyr, (9dzn), 9dzy, 9eak, 9eb, (9ebh), (9ecb), 9edo, 9efu, (9eg), 9eev, 9ehn, 9ehy, 9ei, (9eji), 9ejy, 9eky, 9elb, 9eld, 9eli, 9eqa, (9ep), 9er, 9es, 9hy, (9hm), 9lb, (9le), (9lz), 9mc, (9ml), 9rc, (9tm), (9vm), 9xn, 9xbd, 9zg, 9xax qra?.

Can.—2da, 2dn, 3bp, (3oh), 3nr, 3wc, 3ws, 3yv, 3zt. Complete log on above, crds on request. Would appreciate qsl my sigs over 1000 miles.

At 6ATN, Fallon, Nev.

1cpf, 4iu, 4jr, 5be, (5ht), 5na, 5rg, 5za, 5zh, (5aiu), 5aja, 5ajj, (6bq), (6co), (6fc), (6fm), (6fy), (6hs), (6pe), (6qj), (6rv), (6ux), (6zh), (6aan), (6adt), (6afy), (6aib), (6aik), (6aju), (6akz), (6aph), (6aoh), (6aos), (6auu), (6bad), (6biq), (6brf), (6bur), (6buy), (6cay), (6cbw), (6ccq), (6cdg), (6ccy), (6cdn), (6cdv), (6cfm), (6cgd), (6ckf), (6ckr), (6clz), (6cmd), (6cmr), (6cmv), (6cjv), (6zbu), (7ak), 7ad, 7au, 7by, 7co, 7df, (7di), (7dm), 7eo, (7em), 7fr, 7gr, 7gu, 7gw, (7ho), (7lh), (7no), (7om), (7pz), (7qc), 7qd, (7qw), (7rc), (7rd), (7td), 7tq, 7we, (7wh), (7wq), 7zh, 7zu, 7abu, 7acf, 7adf, 7ael, 7afk, 7adi, (7aek), (7ajd), 7alc, (7alk), 8fc, 8fm, 8hu, (8vy), 8xg, 8aih, 8ard, 8bxx, 8bzb, 8cvg, 8dhq, 8djd, 9aj, 9bj, 9bk, 9dp, 9dx, 9mc, 9wy, 9aaq, 9aff, 9afm, 9aim, 9aiw, 9amm, 9and, 9asw, 9aum, 9bdh, 9bez, 9bjk, 9bly, 9bri, 9bun, (9bxa), (9caa), 9cbr, 9cga, (9cju), 9ckj, 9cly, (9cka), 9cjy, 9cld, 9cvm, 9czq, 9dbf, 9dgn, 9dhg, 9dve, 9dwx, (9eam).

Canadian—(5af), (5ak), (5ef), 5go, 4co, (4eo).

New Zealand: 4aa.

By 6AAQ, 107 E. Buckthorn St., Inglewood, Cal.

5adb, 5ado, 5aiu, 5ajb, 5aju, (5be), 5ce, 5dc, 5go, 5ht, 5jg, 5jl, 5lr, 5na, (5nw), 5qq, 5qy, 5rd, 5rv, 5sc, 5xd, 5za, 5zav, 6ceu, others too numerous, 7adi, 7adm, (7afu), 7ag, 7agi, 7aj, 7ajg, (7akh), 7akk, 7bj, 7co, 7ej, 7em, 7en, 7fd, 7ft, (7gr), 7gu, 7ih, 7ij, 7iu, 7ke, 7mp, 7ob, 7ot, (7qc), (7qd), 7qu, 7rd, 7rp, 7ry, 7tq, 7tt, 7wa, 7zd, 7zu, 8adk, 8apt, 9ab, 9aby, 9ahz, 9alg, 9apf, 9avs, 9avu, 9axx, (9azg), 9bez, 9bcj, (9bop), 9bum, 9bvv, (9caa), 9cbm, 9chy, 9cjc, 9ckr, 9ctq, 9cvo, (9cwj), 9dcp, 9dfh, 9dro, 9dte, 9dun, (9dyr), 9mc, (9ql), 9rc. All crds answered. QSL's on my 5-watter appreciated.

By 6BUH, Salt Lake City, Utah

1lg, 1vi, 2bnu, 2cy, 2sj, (2wr), 3cm, 3gc, 3ubf, 4ab, 4dq, 4fu, (4fv), 4ix, 4uh, 4my, 4nx, 5abu, 5ac, 5ado, 5ah, 5aiu, 5aiy, 5ajj, (5ak), 5alo, (5ia), 5ln, 5lr, 5na, 5nk, 5qd, 5ql, 5rg, (6alc), 6avr, 6arc, (6agk), 6akw, 6adb, 6ahp, 6aqm, 6aft, (6auu), 6alg, 6aol, 6ahz, 6afc, 6aeh, 6awt, (6aan), 6atv, 6abk, 6ahu, 6ajb, (6age), 6aqd, 6avv, 6awq, 6ajh, 6ams, 6anh, 6aps, 6avj, 6agd, 6awe, (6adt), 6ano, 6apw, (6afa), 6alv, 6ahx, 6aji, 6asv, 6atn, 6aur, 6bij, 6bjx, 6brc, 6bwd, 6bur, 6bqs, (6bls), 6baz, 6bkb, 6baw, 6bnt, 6bhp, 6bsg, 6bdt, 6bic, (6bkb), 6bbw, 6blq, 6buf, 6bqb, 6bbc, 6beg, 6bri, 6bvn, (6bqr), 6bra, 6bql, 6bcz, 6bny, 6bqf, 6bon, 6cgo, 6cmt, 6ceq, 6cdc, (6cdn), 6clr, 6cka, (6cfs), 6ckr, 6cfz, 6cqe, 6ccu, 6cnm, 6ccy, 6cbw, 6cbd, 6cmi, 6cgs, 6cms, 6cdg, 6chc, 6cng, 6cfm, 6cgg, 6cjv, 6cix, 6cab, 6clr, 6ckl, 6cgw, 6ceu?, 6cbb, 6cei, 6clx, 6cmu, 6cmo, 6ckh, 6chl, 6cqd, 6dd, 6eb, 6mg, 6lv, 6hp, 6ih, 6zh, 6ei, 6ii, 6or, 6gt, 6tu, (6li), 6zp, 6ue, 6pl, 6nb, (6kn), 6tg, 6rd, 6fc, 6zb, 6ux, 6ja, 6bm, 6qj, 6bz, 6rb, 6ac, 6rf, 6ea, 6ff, (6tu), 6ol, (6fm), 7ald, 7aiz, 7ajk, 7alk, 7aby, (7ajt), 7agi, (7adg), 7adi, (7aci), 7ads, 7aiw, 7acf, 7aiv, 7acm, 7agj, 7ajv, 7ahv, 7akh, 7ais, 7ajd, (7ael), 7afk, 7afe, 7amu, 7agz, 7qu, (7fq), 7ih, (7fr), 7co, 7iy, 7if, 7ke, 7sk, 7ks, 7dz, 7ak, (7zf), 7fs, 7qc, 7vm, 7ws, (7ry), 7sn, 7qd, 7ju, (7dd), 7zj, 7fd, 7tq, 7iw, 7di, 7vn, 7wp, 7qu, 7cf, 7qt, 7zw, 7lk, 7ij, 7dr, 7lg, 7mp, 7sh, 7bj, 7gw, (7fq), 7gq, 7pz, 7hw, 7pl, (7ax), 7ip, 8aq, 8cav, 8dae, 8dnb, 8es, (8dgp), 8yb, 9aok, 9aom, 9acl, 9apf, 9auw, 9afm, 9apb, 9ach, 9aek, (9amp), 9ajj, 9aec, (9abc), 9aem, 9awv, 9ayu, 9atl, 9and, (9bqy), 9bof, 9bkf, (9btt), 9bbg, 9bre, 9beu, 9nxa, 9bpt, 9bhp, 9bgh, 9bdq, 9bun, 9btf, 9bpy, 9bmq, 9bfi, 9bzi, (9cjy), 9cjm, 9czm, 9cyw, 9cdv, (9czg), 9clq, 9cht, (9cju), 9cln, 9cdf, 9cyg, (9cdv), 9csy, 9dgr, 9doe, 9dyi, 9dfn, 9cle, 9dun, 9dwx, 9dkq, 9dxr, 9dro, 9dbf, 9dkd, 9dgi, 9dfh, 9dej, 9dud, 9ab, 9db, 9hm, 9ss, 9ax, 9mi, 9gz, 9aj, 9fc, 9mi, 9ejn, 9eli, 9ebt, 9eae, 9eak, 9eky, 9yau, wnp. Qrk my short wave sigs with 68 watts to the plates?

By 6CJD, P. O. Box 33, Merced, Calif.

2caw, 2ce, 4da, 4dq, 4fs, 4ft, 4io, 4it, 5ado, 5ahy, 5amd, 5az, 5be, 5bd, (6aaq), (6aan), 6aao, 6abx, 6aci, 6acl, 6acr, 6adf, (6adh), 6ado, (6adt), (6adv), 6ae, 6aem, 6afo, 6age, 6ajh, 6aji, 6aju, (6akw), 6am, 6amm, 6ang, (6anp), 6apc, 6aps, 6apv, 6aqd, 6asy, 6atn, 6aur, (6avv), 6ay, (6bbq), (6bbw), (6bds), (6cdn), (6che), (6clb), (6cmd), (6cng), (6dt), (6in), (6kt), (6qb), (6zh), es many others, 7acf, 7ad, 7adf, (7adg), (7adr), 7afe, 7agt, 7ah, 7ajd, 7ak, (7akh), 7akk, 7al, 7ald, (7ali), 7au, 7avh, 7ca, (7cm), 7co, 7dc, (7ais), (7ls), (7gi), (7tq), (7gq), 8ala, 8ago, 8ak, 8cgj, 8caa, 9aby, 9acc, 9ahy, 9atn, 9bbl, 9bbt, 9beu, 9bji, 9bjk, 9btl, (9caa), 9cld, 9cmc, 9cpu, 9cru, (9dwn), 9dro.

Fones: 6asy, 6azy, 6mp.

Canadian: 3oh, 4ea, 4co, 4dg.

Wud appreciate repts on my 10 watt cw sigs. All crds anserd.

By 6EA, H. C. Seefred, 343 South Fremont Ave., Los Angeles, Calif.

1fd, 1fs, (1abf), (1are), (1awe), 1bsd, (2cla), (2cwo), (3bva), (3xaq), 4bz, (4io), (4xc), 5bx, 5ek, 5lg, 5oq, (5ph), (5ql), 5rg, 5vm, 5za, 5ado, 5aic, 5aiu, (5amo), 5amw, 5anf, 5zav, 7bj, 7em, 7ey, 7fd, 7fq, 7fr, 7fs, (7gq), (7gp), (7gr), 7ih, 7io, 7ip, 7iw, 7je, 7ke, (7lh), 7ln, 7mi, 7no, 7om, 7qc, 7qd, 7tq, 7vn, 7wm, 7ws, 7zu, 7abb, 7acm, 7adg, 7adq, 7ads, 7ael, 7afn, 7age, 7agr, 7ahv, 7ajq, 7akk, 7ald, 8er, 8vy, (8zk), (8abs), 8acm, 8anm, (8bda), 8bfm, (8bxx), 8ctp, 9eq, 9gk, (9mc), 9ry, 9vk, 9zk, 9amb, 9apf, 9avu, 9azg, 9azr, 9beu, 9bjk, 9bly, 9bmu, 9bpy, 9btl, (9bun), 9bvn, 9bxq, 9caa, 9cjy, 9cld, 9czg, 9day, 9dcw, 9ddp, 9dfh, 9dte, 9dtj, 9dug, 9dyi, 9dyr, 9eae, 9eak, 9ekf, 9xba, 9xax, kfz, kdef buzzer and c.w.

Can.—4cb, 5go, 9bx. Would appreciate reports from distant points hearing my five-watt tube.

At 8WY, Akron, Ohio

1ci, 1ml, (1qr), 1uj, (1uo), (1aal), 1acr, 1aep, 1ags, (1aiv), 1ajg, (1anx), 1atj, 1axz, (1bef), (1bet), 1bgq, 1bwj, (1caz), 1coe, (2at), 2kx, (2sq), 2adc, 2aey, 2ayp, 2bco, 2beo, 2cei, 2cij, (2cvf), (2cyq), 3ii, 3ly, 3rg, 3sh, (3ti), 3zt, (3adq), 3adt, (3aeu), (3ale), 3aoy, 3apv, 3atb, 3bdo, 3bms, (3ccx), (3cdk), (3cjn), (4bw), 4bz, 4eg, (4gv), 4hw, (4it), (4jr), (4js), 4ll, 4og, (4pk), 4qw, 4rf, 5cg, 5cn, 5ht, 5na, 5uk, 5vc, 5xa, 5za, 5zr, 5afh, (5aiu), 5ajj, (5akn), (5anw), 6aao, 6adt, 6agk, (6ahp), 6ahv, 6aja, 6xad, (7fq), 7iw, 7iy, 7xt, 7adg, 7ahs, (9bk), 9db, (9eg), 9jf, 9vk, 9aal, 9aap, 9aqq, (9asr), (9bdb), 9bis, 9bmu, 9bsi, 9bye, (9caa), (9caj), 9cdo, 9cjh, 9cop, 9cui, 9cyd, (9djz), (9dlf), (9dpp), 9dro, 9ekf.

Daylite: 2boi, 3le, (3buy), (4fz), 4sh, 9abl.

Can—3gg, (3nj), 3ud, 3wv, 3yv, 3ada, 4fz, 5am. Hvy qrn during past month; also power leak sum nites.

RADIO WAVES

Continued from page 14

Theoretically, two radio stations should not be assigned wavelengths closer than 20,000 cycles in order that the upper band of one will not overlap the lower band of the other. In actual practice, however, it has been found that if two distant stations are separated by 10,000 cycles it is possible to tune in either at will without the overlapping of the bands producing interference. This is the basis of assignment of the Class *B* wavelengths at present. For instance, KSD, the longest wavelength broadcasting station, is operating on a frequency of 550,000 cycles (wavelength 546 meters), KYW is using a frequency of 560,000 cycles (wavelength 536 meters), WOAW is using a frequency of 570,000 cycles (wavelength 526 meters). At the other end of the band KGO is using 950,000 cycles (wavelength 316 meters), while WGR, the next highest wavelength station, is using 940,000 cycles (wavelength 319 meters). The separation of stations in wavelength at the lower end of the Class *B* band is 3 meters, while at the upper end it is 10 meters. The separation in cycles is the same at either end, namely 10,000 cycles, or, as it is called, 10 kilocycles, 1000 cycles being called a kilocycle.

Class *B* stations make use of wavelengths between 300 and 546 meters, that is, frequencies between 1000 and 550 kilocycles. Allowing 10 kilocycles for each station, this permits the simultaneous operation of 46 Class *B* stations without interference. (This, of course, does not hold if the receiving set is close to a high-powered station, in which case the interference band is much broader, due to the characteristics of the receiving set. However, the writer has been able to receive without interference distant stations within 40 kilocycles of the local Class *B* stations which are less than five miles from him.)

The accompanying table shows the assignment of Class *B* wavelengths according to the most recent information. As the demands for Class *B* wavelengths has exceeded the possible available non-interfering 10 kilocycle bands, it has been necessary to do two things: (1) assign two or more stations in the same locality to the same frequency, in which case they must divide the time, (2) to assign the same frequency to two stations which do not divide time when one of the stations is located on the Pacific coast and the other is on the Atlantic. Thus we find WOO and WIP, Philadelphia, and KLX, Oakland, California, using 590 kilocycles (509 meters); WEAF and WBA, New York, and KGW, Portland, Oregon, using 610 kilocycles (494 meters), etc. The frequency and wavelength assignments given in the table refer to

the carrier frequency. The side bands extend 5 kilocycles above and 5 kilocycles below the assigned frequency. One difficulty which has been met with in the assignment of wavelengths is that our wave meters and frequency standards have not been sufficiently accurate to place stations on assigned frequencies within the necessary limits of error. It is to satisfy the needs of greater accuracy that the Bureau of Standards has been conducting extensive research on standard frequencies and has undertaken a program of transmission of standard frequencies which will enable stations to accurately standardize their wave meters.

ASSIGNMENT OF CLASS B FREQUENCIES

(Frequency assignments are 10,000 cycles apart.)

Frequency	Wave Length	
970	309	(WLW) (WSAI) Cincinnati
960	312.5	
950	316	(KGO) Oakland, Calif.
940	319	(WGR) Buffalo, N. Y.
930	321.5	
920	326	(KDKA) East Pittsburgh, Pa.
910	330	
900	334	
890	337	(WBZ) Springfield, Mass.
880	341	
870	345	(WCBD) Zion, Ill.
860	349	
850	353	
840	357	
832	360	All Class C.
820	366	
810	370.5	(WGN) Chicago, Ill.
800	375	
790	380	(WGY) Schenectady, N. Y. (WHAS) Troy, N. Y.
780	385	(WOAI) San Antonio, Texas
770	390	(WTAM) (WJAX) Cleveland, O. (WBAV) Columbus, O.
760	395	(WFI) Philadelphia, Pa. (KHJ) Los Angeles, Calif.
750	400	(WHAS) Louisville, Ky.
740	405	(WJY) New York, N. Y. (WOR) Newark, N. J.
730	410.5	(WEAF) (WHB) Kansas City, Mo.
720	417	(WLAG) (WBAH) Minneapolis, Minn.
710	423	(KPO) San Francisco, Calif.
700	429	(WSB) (WGM) Atlanta, Ga.
690	435	
680	441	(WOS) Jefferson City, Mo.
670	448	(WMAQ) Chicago, Ill.
660	455	(KFOA) Seattle, Wash. (WJZ) New York City
650	462	(WCAE) Pittsburgh, Pa.
640	469	(WCAP) (WRC) Washington, D. C. (KFI) Los Angeles, Cal.
630	476	(WBAP) Fort Worth, Texas (WFAA) Dallas, Texas
620	484	(WOC) Davenport, Ia. (WHAA) Iowa City, Ia.
610	492	(KGY) Portland, Ore. (WEAF) (WBAY) New York City.
600	500	(WMC) Memphis, Tenn.
590	509	(KLX) Oakland, Cal. (WOO) (WIP) Philadelphia, Pa.
580	517	(WCX) (WWJ) Detroit, Mich.
570	526	(WOAW) Omaha, Neb.
560	536	(KYW) Chicago, Ill.
550	546	(KSD) St. Louis, Mo.

THE INVISIBLE WIRE

Continued from page 22

from which Martindell thought Kork had taken something.

Kork left the cabin, and Martindell tested the apparatus. Darkness had fallen—whether the night had anything to do with the operation of the transmitting instruments Martindell was not certain—but he was quite aware that the transmitter failed to give the normal current to the aerial. The receiving instruments were tested but they functioned almost as usual.

"Say old man," said Martindell when Kork made his appearance about a half hour later. "Has the receiving set a separate aerial?"

"Yes, I believe it has, in fact I know it's a longer one."

"Well, Kork, old fellow," said Martindell with a little enthusiasm, "I've got a pretty good idea what is causing this trouble."

"The same idea as the other men, namely that the aerial is grounded. You're right I think, for with the same aerial as the transmitter the receiver doesn't work very good, nevertheless you'll not find anything the matter with the antenna."

"I'd like to see that aerial."

"Tell it to the radio experts and they'll laugh. By the way, someone must have clubbed that monkey belonging to the crew. The old boy has a big cut over the eye. He was found on the boat deck quite unconscious. But he was brought to and went about some business of his own not more than a minute later."

Martindell liked animals, but not all, especially a foolish looking monkey. "Sorry he got hurt," was his short answer.

"Now to look in that drawer," thought Martindell after Kork retired. The examination brought forth nothing new. He decided to ask Kork what was so interesting in the drawer. Now that he began thinking about the man his actions were not just right. Come to think about it, Kork had been mad that he was not made chief operator. Was it possible that Kork was the cause of all—

"A very important message," interrupted the captain of the vessel entering the radio cabin without ceremony. "Get it to San Francisco immediately."

"Sorry, sir," replied Martindell, "I cannot promise to do so."

"Why, is the apparatus out of order again?"

"Yes, sir."

"Get that message off no matter what you have to do."

"I'll put up a temporary aerial," said Martindell, "as I think our difficulty is with the one we have."

"Go ahead, I'll send a couple of men to help you."

No sooner had one of the crew started to climb the steel mast in the center of the ship than a strange thing happened. Martindell watched the performance to a finish. Although he could not see all that happened he guessed correctly just what had been done.

He gave orders to his helpers and asked them several questions. Soon Martindell had not only solved the mystery of the set but the cause of it.

He awoke Kork somewhat earlier than usual after sending the captain's message without delay. "Just one question Mr. Kork," Martindell began, "what do you keep in that drawer that you don't want me to see."

"You're a good fellow, Martindell, and I don't care if you do see it. What I keep in that drawer is the picture of a girl I hope to marry—when I get the job of chief radio operator on some ship. When the old man made you chief of this ship I felt pretty bad about it, and maybe I showed it in my actions."

"Well, old man, I've found out what was causing all the trouble."

"You have, what was it?"

"The monkey!" Martindell laughed. "The old boy always would climb up the center mast after dark and attach a wire from the aerial to the steel mast, which, even though painted, caused a fair ground in wet weather. He saw one of the crew do it on your first trip. I must have pressed the key tonight when he had the wire in his hand, with the result that he fell to the boat deck. The old fellow climbed up again though to make his connection complete. Guess he wouldn't have done so if he knew what caused his fall. When one of the crew started up the center mast the monkey was coming down with a stout wire in his hand."

"Wouldn't that beat you?"

"Yes," continued Martindell, "one of the crew told me the animal had once been whipped for climbing the masts. He continued to do his favorite stunt at night when no one could see him."

"Being that we discovered the mystery of the radio set when radio engineers failed—I don't blame them—I guess you will be advanced to chief operator as I shall request that I be transferred to another ship."

RADIO IN AUTOMOBILE

Continued from page 12

each. The inductance switch should be of the two-blade type.

The rotor is of cardboard, 2¾ in. in diameter by 1⅜ in. long. Starting at each end, 25 turns are wound toward the center, of No. 26 S.C.C., which will leave sufficient space for a quarter-inch shaft.

A variable condenser, of from 5 to 7 plates capacity is placed in series in the antenna circuit. This will allow bridging between taps, and will be ample capacity for the purpose.

In designing the receiver for automobile use, the wiring should be preferably stranded lamp cord. While not making a pretty job, it will stand vibration much better than will hard-drawn copper. Making use of the WD-11 tubes, it is possible to design the set so that only one rheostat is used on three tubes, and it will also be found that a single 22-volt *B* battery may be used for both detector and amplifier voltages. A single dry cell may be used for the *A* battery—while naturally it will not last as long as would three cells in parallel, it will take care of the outfit nicely.

The cabinet for holding the various parts of the receiver may be a standard card index cabinet which may be purchased at stationery stores at a reasonable price, and in a number of sizes. Such cabinets, which are dovetailed at the corners, and have hinged covers, make very neat containers.

Inasmuch as such a receiver should be as compact as possible, the constructor will find it possible to take liberties in placing the various parts, which, while not standard practice, nor consistent with general shop workmanship, will be found effective in operation, and not detracting from the efficiency of such a set. The ingenious builder will also be able to devise a clamp by means of which the cabinet may be placed in a convenient operating position in the car, and at the same time readily removed from the machine when desired.

The writer shows herewith a circuit diagram that may be utilized where space is a factor, which does away with the use of jacks in the amplifying circuits, permitting the use of a single-blade switch to advance from successive stages. This is practical only where the voltage for detector and amplifiers is the same. It will be noted that the primary of the transformer is in shunt with the receivers on detector and first stage, but this is not a serious impediment to the operation of the set and does away with the necessity of a plug and three jacks.

On the 500-watt radiophone stations, it will be found possible during the

daylight hours to operate a loud speaker in a closed car up to distances of 50 miles, using two stages of amplification. At night the range will go up to considerable distances.

"How To Build and Operate the Ultradyne", price fifty cents, has been published by the Phenix Radio Corporation, 3-9 Beekman St., New York City. The ultradyne differs from the super-heterodyne in that the beat note is produced by a modulator tube preceding the oscillator tube instead of by a detector tube following the oscillator. In the instrument described, the intermediate frequency amplified by special "Ultraformers" is 81,081 cycles. Complete information is given for assembling, wiring and tuning six and eight-tube receivers.

SUPPLYING THE OBVIOUS

Continued from page 16

plain that he already knew the rest of the circuit. That if he were not suited with his *A* battery polarity one way, he most surely would by reversing it. The question of the rheostat was a serious one but he was allowed to decide upon the nature of the same after consulting the specifications published by his tube manufacturer relative to *A* battery voltage.

There is no need to prolong examples of the type enumerated. In future let us go over our circuits carefully or study the text diligently with a view to understanding the main functions. If we have progressed far enough in radio to understand an elemental circuit we may be sure that we have intelligence enough to supply most of the "obvious omissions" occurring in current literature. Of course there may be at times some really important omission. If one has no well informed local adviser who can supply the missing link, one can rest assured that authors will gladly try to be further helpful if addressed by letter, and one should take the precaution in writing for this data to make the letter short and snappy, have it legible, preferably typewritten—and a sheet of stationery and self addressed envelope should invariably accompany the questionnaire.

One's imagination is stimulated as to the condition of the mails following contributions such as the super-regenerative and regenerative amplification of Armstrong, Hazeltine's neutrodyne, Dows' C. W. Manual, Valentine's radio telephony, DeForest's reflex, Grimes' duplex, and the "jiggers" of Tom, Dick and Harry relative to the bastard circuits which are appearing under cognomens of most fearful and wonderful consonant supply. The last word has not been said yet, in some of the really really popular radio problems, and we may look for a very healthy literature in the future, richer by far in practical points than that of the past. May it not be suggested that we keep in mind the foregoing in order that we may do ourselves justice?

HANDLING PANELS

Continued from page 18

remove the mounting screws, placing the screws next to their respective instruments so there won't be a mix-up.

Insert the countersinking tool in the auger brace and start at one end of the panel. Countersink all holes where flat-head screws are used which would project above the surface of the panel otherwise. Try the "fit" of each screw before countersinking too deep and do this job with a slow motion, endeavoring to maintain the brace straight up and down so the countersinking will be even. The tool is made so that it fits the angle at which the heads of all mounting screws are cut. This holds true for wood screws as well, and the holes for the brass or nickel-plated wood screws are also countersunk so they fit accurately.

During these stages of the "game," we must be very careful not to allow our drill to slip, and it is the purpose of the deep punch mark to start the drill on the right track. Neither must we allow screwdriver or countersink to get out of place for fear of damaging the panel's appearance.

If there is to be a baseboard or sub-panel, these should be fastened to the main panel first. Then start with the instruments in any convenient order, using pliers and screwdriver to tighten up the mounting securely. If a certain condenser does not seem to lie flush with the panel, do not force the third bushing up against the panel with a few vigorous strokes of the screwdriver, but insert a washer to bridge the gap. This relieves the panel of undue strain and bending. Similarly, if you have failed to get a certain hole in the right place, don't merely force the screw through willy-nilly, but drill a little larger hole. And if the 5/16th-in. hole for the condenser and other ¼-in. shafts seems a bit tight or to rub against the side of the shaft, get a round file (rat-tail file) and remove a little of the panel to allow freedom at the point of binding.

A good job of soldering is also requisite, but this art is fairly well known already and sufficient directions usually appear in the constructional advice. Do not allow a hot soldering iron to rest against or come too close to the panel, nor try to solder bus-bar directly to the screw-head of a large binding post already tightly fastened to the panel. The conductive properties of the post will dissipate the heat rapidly to the panel and result in a poor joint. It is far better to use a soldering lug which can be soldered to the end of the connecting wire before the lug is fastened to the post. Less solder, less heat and less time and patience are lost then.

Fig. 4 illustrates most of the small tools needed in panel work, and also shows the side-cutting pliers used in bus-

bar wiring. This pair of pliers may be replaced by a pair of electrician's "flats" and a pair of "cutters" with more ease of handling. The knife is useful in cleaning the ends of connecting wires or for cutting off lengths of cotton insulation. The cutters are very handy for clipping off lengths of bus-bar and spaghetti, although the use of the latter is being more and more frowned upon.

Those of us who do take the pains necessary to the construction of a durable and handsome receiver are rewarded by the workmanlike product which we have completed. The feeling of a "good job well done" is followed by a wealth of satisfaction when the weak DX signals are successfully amplified, when we can touch our hands at will upon the panel on a damp and muggy day without hearing the faintest click, when we know that every possibility of leakage or loss, whether by actual conduction through the panel insulation or by condenser effect is prevented day in and day out by the panel which we have chosen for our radio receiver.

RADIO LODGE

Continued from page 26

But do not give your mind the habit of listening to code without having to do the work of translation, or the bad habit will persist and you will find your mind balking and "going dead" when you do want to copy.

If you can possibly help it, don't try to learn the code by yourself. Get a friend. Two men working together can do more work than two men working apart, that's an old story; but two men learning code together can learn ten times as rapidly as the same two practicing by themselves.

But you don't want to do all your receiving practice on your friend's sending. You need good sending for variety. For this you can go to a radio school; or there are two other ways to get it, both good. One is, to acquire one of the automatic sending machines now on the market. You can key them down to almost any speed, and no matter how slow you are at first they'll help you. Another is to tune in on the long wave stations, many of which send very slowly, and sometimes in addition send each word twice.

Send jokes, things that you'll want to get for their own sake, and if the one who is receiving gets impatient and asks "What was that?" never tell him by word of mouth. Make him get it in code. Intersperse this practice with "ten-letter code," which is this sort of thing—*AX739CQ2BF, 26YF8Z71M4, KOWZQ6J18,* etc.—and with practice on groups of numbers.

Sending code is much easier to learn than receiving, but this statement does not apply to *good* sending. That is harder to acquire. There is only one rule for acquiring good sending—DON'T TRY TO SEND FAST. Send only just a little bit faster than you can receive. It's a temptation to go hitting it up to twenty-five when you can't copy ten, but don't do it!

In sending, keep your muscles relaxed. Don't tense up as if you were about to hit Jack Dempsey. And don't tighten the spring of your key till it takes a sledgehammer to work it, and then rise half out of your chair and bring your weight down on it when you want to make a dot. Keep your key just tight enough so that it balances nicely—don't rely on the spring to do all the work of bringing the lever up after a dot or a dash; help it along with your thumb on the edge of the knob. Don't get *lazy* while sending; and again—don't—race!

The length of time it takes to learn necessarily depends on the amount and frequency of your practice, and also on whether you practice alone or with a friend. Don't expect to do it in a week. It can't be done.

WOOD FINISHING

Continued from page 28

had sufficient use on varnish work so this dust and dirt is all worn and cleaned out of it; a good new brush, preferably with bristles set in rubber, will serve, however. The varnish must be thinned with turpentine so that it will flow easily from the brush, but will not tend to run and drip. This can only be determined by test.

The varnish should be applied smoothly, starting at one edge, and the brush stroke should be run along one edge, *with* the grain of the wood. The next stroke should be so spaced that the brush edge just laps over on the first, and the two brushfuls tend to run together. This should be repeated until the entire surface is varnished. After this is done the whole surface should be brushed over at right angles to the first brushing, so as to get an even and smooth surface, taking care to keep the surface as even as possible. The varnish will then set and dry smoothly and evenly.

The first coat of varnish should be allowed to dry at least 24 hours, and preferably for 48 hours, before any more work is done. When the varnish is thoroughly dry, some of the finest sandpaper obtainable (No. 0 to 000) should be used to rub down the surface until it is perfectly smooth. Great care must be taken not to rub too hard or unevenly at the edges of the work, or the sandpaper will cut through varnish, stain, filler and all, down to the wood. After rubbing down, the surface should be cleaned with clean cloths to remove all trace of dirt, sandpaper particles, loose varnish, etc., and a second coat of varnish applied. When this has dried it should be rubbed down and the whole process repeated until four or five coats of varnish have been put on. Then discard the sandpaper as a smoothing substance and obtain some fine powdered pumice stone, and, moistening it with common water, smear it on the varnish. Now take the "heel" of the palm of the hand and carefully rub this over the surface until a sort of dull smoothness results, and again varnish is applied. Rub down each coat, using finer pumice each time, until three or four more coats have been applied. The last and final coat is then applied and allowed to dry. Take some "rottenstone," mix with cottonseed oil, smear this all over the varnish, and very carefully polish, using the heel of the hand, or a piece of soft felt. Gradually the polish will appear, and the more the rubbing the better the polish, until a wonderfully high permanent gloss is obtained, and the job is done. When applying varnish, and whilst the varnish is drying, the work must be placed in a room free from dust.

The above method gives a "piano"

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Tell them that you saw it in RADIO

Continued from page 64

finish, and is quite a long process. The total number of coats of varnish may be cut down, on some woods, or under some conditions, without serious damage.

The simplest method of finishing is to stain and fill the wood as described and to then apply a coat of the so-called "prepared wax." This can be obtained on the open market, and contains substances and mixtures that are almost impossible to imitate successfully in a small way. A fair grade of rubbing wax can be made by melting beeswax and adding turpentine to this in sufficient quantity to make a sort of "mushy" mass. This wax will not, however, compare with the factory-made article.

Prepared wax is rubbed on with a cloth, allowed to set for from ten to fifteen minutes, and then the surplus is rubbed off. The surface is then rubbed to a sort of dull gloss with a soft, clean cloth and then allowed to harden. When hard, a second coat may be applied and again rubbed down. This method of finishing is much simpler and more easily applied than the piano polishing method, and for some classes of work will be just as good. A waxed surface, if not badly marred or scratched, can be brought up to its original finish by a simple re-waxing. Waxed finishes have nothing to chip, scratch or peel, and are also much better when the work is to be handled a great deal, as in the case of a portable set, wavemeter, or the like. It is, generally, a much easier finish for the novice to apply.

Besides the above described, there are many other finishes which can be used with good success. Some kinds of lacquers and enamels can be applied and very beautiful effects obtained. A celluloid base lacquer, applied to wood with an "air brush" or sprayer, can be obtained in any color and will give a very beautiful finish, if properly applied. An oiled finish can be given wood by covering with and rubbing in common linseed oil, to which turpentine has been added to make it "set" properly. Even common asphaltum varnish can be used to finish wood, and, if applied carefully and smoothly, will give a nice finish with a handsome black gloss.

Wood finishing is like any other finishing process, either as much time as is needed should be spent on getting a first-class job, or else some cheaper and easier method should be tried.

"The Super-Heterodyne Manual," price $1.50, by Victor Grieff, has been published by The Receptad Press, 57 Bank St., New York City, primarily as a guide for the use of Receptad parts in constructing an 8-tube set (A tubes). It briefly explains the theory of operation and presents full-scale constructional drawings.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of Radio published monthly at San Francisco for April 1, 1924.

State of California, } ss.
County of San Francisco }

Before me, a notary public in and for the State and county aforesaid, personally appeared H. W. Dickow, who, having been duly sworn according to law, deposes and says that he is the business manager of the "Radio" and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on reverse of this form. to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are:
Publisher, Pacific Radio Publishing Co., Inc., Pacific Bldg., San Francisco.
Editor, A. H. Halloran, Berkeley, Calif.
Managing Editor, none.
Business Manager, H. W. Dickow, San Francisco, Calif.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.)
Pacific Radio Publishing Co., Inc., Pacific Bldg., San Francisco.
A. H. Halloran, Berkeley, Calif.
D. W. Dickow, San Francisco, Calif.
H. L. Halloran, Berkeley, Calif.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)
None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is——. (This information is required from daily publications only.)

H. W. DICKOW,
Business Manager.

Sworn to and subscribed before me this 19th day of March, 1924.
(Seal) J. D. BROWN.
(My commission expires April 4, 1926.)

CURRENT SUPPLY SET

Continued from page 30

tubes such as the G. E. Kenetrons and the Western Electric 217-A rectifier tube may be used in place of the C-301-A tubes, but they are more expensive and will require a much higher filament current, without giving any better results in the rectifier circuit.

An additional winding of 6 volts could be placed on the same transformer that supplies the rectifier tubes, and the output of this winding would furnish the filament voltage for the last stage of an audio-frequency amplifier, but it would not be satisfactory for use with more than one stage, on account of the A. C. hum which would be introduced. The extra winding should be 30 turns of No. 18 D. C. C. wire, with a center tap at the 15th turn, and may be wound over the rectifier filament secondary. This secondary is wound to 6 volts because there are still a number of 6 volt tubes in use, and if the tube to be used requires less than 6 volts, a filament rheostat will be necessary although its use will cause a small amount of noise in the loud speaker. Fig. 5 shows a typical receiving circuit, with detector and two stages of audio-frequency amplification, the detector and first stage of amplification employing dry cell tubes, and the last stage being a storage battery type tube. Its filament is operated from the power transformer. This circuit will also illustrate the use of the current supply outfit in actual practice, and shows how a receiving set may be operated with only three dry cells, the remaining power being supplied entirely from the power lines.

SOLDERING ALUMINUM

Continued from page 19

After tinning, wipe off all remaining stearic acid, and the resultant surface can be soldered using standard flux and half and half solder.

The only secret, so-called, is to keep the air from getting at the surface of the aluminum after the oxide (Al_2O_3) has been removed by scraping.

The method of tinning described is followed in soldering aluminum wire. Then a copper or brass terminal or sleeve is soldered on exactly as if the wire was copper.

Bakelite Corporation, 247 Park Ave., New York City, has issued an interesting booklet, "Bakelite and Radio," in which its properties and applications are fully illustrated and explained. Similar facts are also brought out in "Bakelite for Radio and Why."

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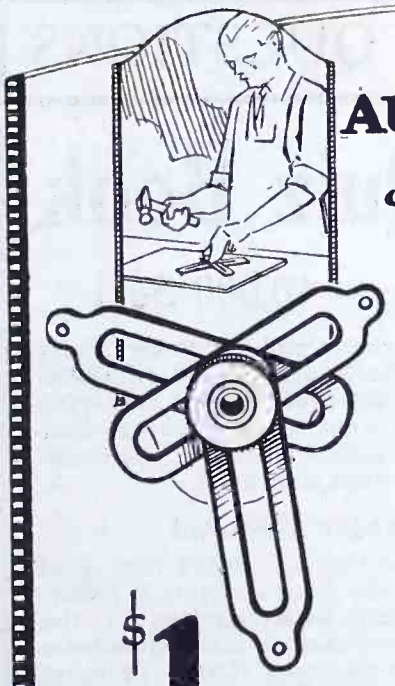

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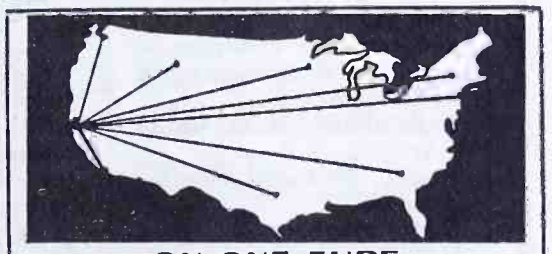

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SUPER-HETERODYNE THEORY

Continued from page 32

according to the heterodyne principle explained in the previous paragraph the output of the receiver will be an oscillation whose amplitude varies at a frequency equal to the difference of the component frequencies, namely 700,000-650,000, or 50,000 cycles. Furthermore, the individual characteristics of the received signal are not altered in the least by such action (therein lies the beauty of this scheme). The only change that occurs is that by means of an external oscillator a 700,000-cycle signal is converted into a 50,000-cycle signal of the same characteristics as the original 700,000-cycle signal. Thus a low wavelength signal is converted into a high wavelength signal, and, since radio-frequency amplification of high wavelengths is efficiently accomplished, this is a solution to our original problem. For, if we now build a 50,000-cycle r. f. amplifier, to amplify the 50,000-cycle beat oscillations, and then detect and rectify them, we will hear the signal of the 700,000-cycle wave. Thus this method avoids the necessity of actually amplifying the low wavelength signal.

The above explanation will be readily understood in the case of the 700,000-cycle signal and the 650,000-cycle oscillator. Suppose one happens to be receiving, not a 700,000-cycle signal, but, say, a 640,000-cycle signal. What then? The external oscillator is made so that its frequency of oscillation is adjustable, as by means of a condenser. Thus the external oscillations may be adjusted to have a value of 690,000 cycles per second, in which case the difference between the two, or the beat oscillations, will be 50,000 cycles as above, which frequency is capable of efficient amplification. Of course there is no necessity for this particular frequency of 50,000 cycles to be chosen. Any other low frequency, such as 30,000 or 60,000 cycles, could just as well be chosen. The important point is that the beat frequency, which is called the "intermediate frequency," should correspond to a high wavelength at which radio-frequency may be accomplished very efficiently. Modern practice has set 50,000 cycles as this frequency, simply because highly efficient 50,000-cycle transformers have been designed.

It will clarify matters considerably if we will consider the super-heterodyne system part by part. Fig. 6 is a diagram of the circuit connections of a super-heterodyne and Fig. 7 is merely a schematic, showing the different parts of a complete super-heterodyne set.

In the first place we have the tuner proper. The tuner may consist of antenna and regular receiver or a simple loop and condenser. The latter is by far preferable and is recommended.

For the amplification of the super-heterodyne is so great that a loop is capable of picking up all the signal desired. Secondly the antenna is disadvantageous because it picks up so much energy that, with the additional great amplification secured by the system, it will cause overloading of tubes and so produce distortion of signals. The use of a loop makes the pick-up system very simple: loop and 0.0005 microfarad condenser, that is all. This circuit is tuned to the incoming signal which is applied to the grid of the first tube.

The next element in the system is the external oscillator. This need not be elaborate, in fact it is nothing more than a simple regenerative circuit with tickler coupling. The tuned circuit is the grid circuit to which the tickler coil is coupled, and the tickler coupling is adjusted so that the circuit oscillates. Honeycomb coils may be used to advantage here, such as a 35-turn coil in the grid circuit and 25-turn coil as tickler. The grid circuit tuning condenser for the oscillator should be variable, 0.0007 microfarads or 0.001 if the other is not available. The oscillator must be coupled to the circuit containing the incoming signals so that these oscillations and the signal oscillations will combine and produce the beat frequency or intermediate frequency of 50,000 cycles. This is accomplished by means of a coil coupled to the oscillator. This may likewise be a honeycomb coil.

Thus we have applied to the grid of the first tube two oscillations which differ in frequency by about 50,000 cycles, and hence in the plate circuit there will appear an oscillation of this beat frequency, which is to be amplified by a radio-frequency amplifier, for obviously 50,000 cycles is still radio-frequency. Now the question may arise in the reader's mind as to how it is known when this beat frequency of 50,000 cycles is obtained. Or, to put it another way, if there are two incoming signals very close to one another in wavelength, then the oscillator will give rise to two beat frequencies not very far apart, as, for example, 50,000 cycles and 60,000 cycles. Then interference may result unless one of these frequencies is not passed. To avoid this the intermediate frequency amplifier (or radio-frequency amplifier) is made so that it is highly selective at 50,000 cycles and amplifies most efficiently at this frequency, thus not permitting any other beat frequency to pass through it. Thus the oscillator is tuned until maximum signal is secured, and the setting of the oscillator is then such that the beat frequency is about 50,000 cycles. In this way the great selectivity of the super-heterodyne is partially secured.

To make the intermediate frequency amplifier more selective the last stage is generally tuned. The last transformer

may consist of two 150-turn honeycomb coils, the primary being shunted with a condenser (value obtained by trial) which tunes the circuit to 50,000 cycles. There may be two or three stages of untuned intermediate transformers especially designed for the intermediate frequency.

If a frequency below 40,000 cycles is used the two scale points where the signal is heard will come so close together at the shorter wavelengths that tuning is almost impossible.

The great advantage of this system is that radio-frequency amplification takes place at only one frequency and it is easy to build such an amplifier.

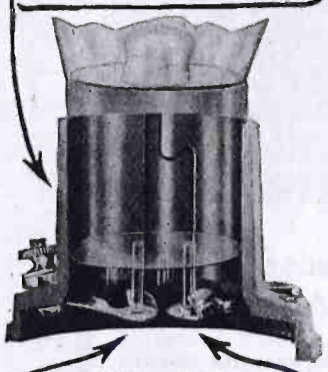
After the 50,000-cycle signal is amplified by the intermediate frequency amplifier it is then applied to the detector tube, rectified, and then amplified by the audio-frequency amplifier of one or two stages. This part of the system needs no elaboration.

The same precautions should, of course, be observed in the super-heterodyne amplifier as in any other, such as, for example, proper biasing of the grids of the tube. However, there is one additional precaution that is absolutely essential, namely shielding of the intermediate frequency amplifier and all leads and parts that have any direct connection to it. The amplification of this amplifier is so great that howling or radio-frequency oscillations are very likely to occur. To avoid this the whole system should be well shielded with heavy copper sheeting, which may be grounded.

In using the super-heterodyne this effect will be observed. Any given station may be heard with two different settings of the oscillator, one above the frequency of the received signal and one below. The reason for this is simple. Thus suppose you are receiving a 700,000-cycle signal. If you tune your oscillator to 750,000 cycles the beat or intermediate frequency will be 50,000 cycles and the signals will be heard. If, on the other hand, you tune the oscillator to 650,000 cycles, the beat frequency is again 50,000 cycles and the signal will again be heard. Theoretically there should be no difference in the intensity of the signal with either setting. However, practically there may sometimes be a difference which is due to the fact that the oscillator may oscillate more efficiently at one frequency. Hence the signal may be louder at this particular setting. In practice one uses the setting which gives the louder signal.

The super-heterodyne system is without doubt the most sensitive and most selective receiver thus far developed. These highly desirable characteristics are in part due to the selectivity of the tuned loop circuit with its additional directive effect (aiding selectivity) and in part to the highly selective and extremely powerful intermediate frequency amplifier.

UNIFORM CROSS SECTION OF THE NA-ALD DE LUXE SOCKET



SPECIAL DIPPED BRIGHT PHOSPHOR BRONZE CLIPS, LAMINATED AND EXERTING DUAL-WIPE PRESSURE.

THIS ILLUSTRATION SHOWS HOW THE CONTACT STRIPS CAN BE MADE TO CLEAN TUBE TERMINALS AUTOMATICALLY BY ROTATING TUBE SEVERAL TIMES.

Look for the socket board

In leading radio stores you will find the Na-ald Socket Board, displaying the five standard Na-ald Sockets: For the 200 and 201 tubes, the De Luxe at 75c, and also the Small Space at 35c. For the U V 199, No. 499 at 50c and adapter at 75c. For W. D. 11, No. 411 at 75c.

Ask your dealer to show you the self-cleaning arrangement of contacts in Na-ald De Luxe, No. 400. These dual-pressure contact strips cut into the sides of tube terminals, keeping their surface clean and bright, and resulting in perfect contact.

These sockets have the highest dielectric properties, obtained by the thorough cure of the Bakelite used, and made possible by uniform cross-section.

There can be no noisy circuits due to poor contact with these sockets in use.

New rotogravure booklet "What to Build" now packed with each Na-ald product. If your dealer's stock doesn't have this booklet send cover of Na-ald carton or 15c for it.

Alden Manufacturing Co.

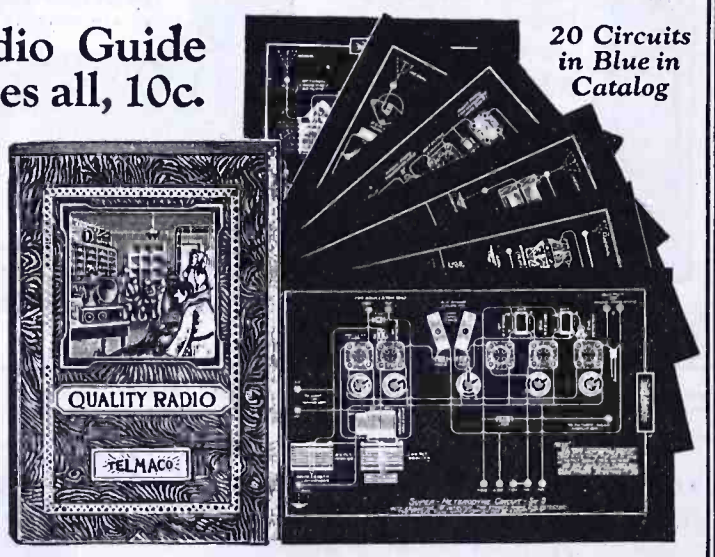
Dept. H
SPRINGFIELD, MASS.

NA-ALD

The Best in Radio

Telmaco Radio Guide Book describes all, 10c.

20 Circuits in Blue in Catalog



Our new 64-page Catalog No. TGR contains twenty of the most popular radio circuits printed in blue. These include the Super-Heterodyne, Neutrodyne, Grimes Inverted, Colpitts, Flewelling, Reinartz, Diode Electrad, Super-Regenerative and many others. Each article used in circuits is attractively pictured instead of appearing in straight schematic form. Besides containing blue prints, the best in radio is also illustrated and described. Catalog sent postpaid for Ten Cents. Each circuit worth double.

Send for your copy today.

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Our New Dealers' Catalog and Price List describes nearly all the better Standard Radio Lines. You should have it. Mailed FREE to all bonafide dealers making request on their business stationery.

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Quality Radio Exclusively
Established 1918

Radio Division

TELEPHONE MAINTENANCE CO.
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RADIO MAP OF THE U. S. 35c

For Sale by

Pacific Radio Pub. Co., Inc., San Francisco

You're due for a surprise if you never used DE Forest Audions!

FREE RADIO CATALOGS Drop us a postcard and we will send you full information regarding De Forest Reflex Radiophones, Audions, and Parts.

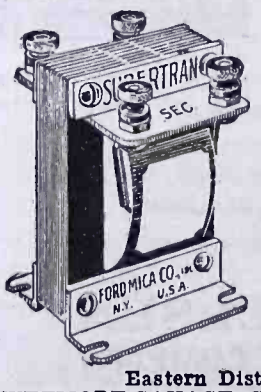
DE FOREST
RADIO TEL. & TEL. CO.
Dept. R. 10 JERSEY CITY, N. J.

SUPERTRAN

Registered U. S. Patent Office.

CERTIFIED!

Supertran Audio Transformers have been certified by the largest testing laboratory in the United States. They are "certified" by scientific measurements to be unequalled for volume, quality, and electrical efficiency.



PRICE $6.00

These Transformers are specially designed for the Neutrodyne and Reflex circuit.

Can be used with any amplifying tube on the market with excellent results.

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VICTOPHONE
For all Phonographs and Loud-Speaking Horns

$7.50 Postpaid
Complete with Cord

In addition to the large diaphragm used in the Victophone, every other detail has been given the closest attention. When incorporated with your phonograph or horn, it will reproduce with the utmost volume and purest tone. No battery required to operate it. Your money back if not satisfied.

It can be furnished to fit all phonographs—the Standard Type fits the Victrola, Columbia, Jewett or Sonora. Specify make of phonograph when ordering. List Price, Standard Type, $7.50.

Order the New Victophone and test it before buying any other loud speaker.

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J. Thos. Rhamstine*

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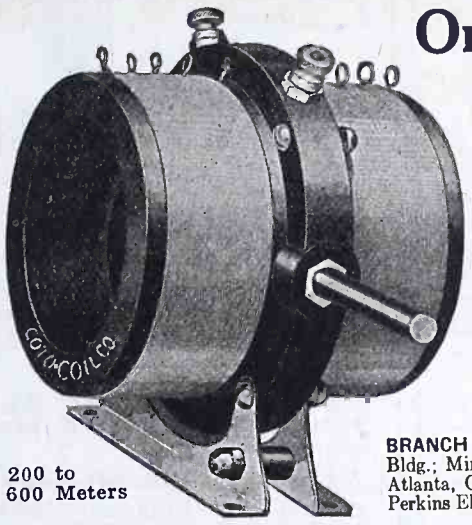
Maker of Radio and Electrical Products

Coto
"Built First to Last"

Detector and One Stage On Panel Only 5x10 Inches



200 to 600 Meters

Coto Compact Variocoupler operates splendidly with series condenser in standard circuits and standard sized sets.

But what a portable set you can build for spring and summer use! Just cut a piece of paper 4x8 inches. That's the size of a set that will get real D. X. with plenty of volume.

If your dealer fails you write us, giving his name and address and list of Coto parts you need.

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BRANCH OFFICES: Los Angeles, 329 Union League Bldg.; Minneapolis, Geo. F. Darling, 705 Plymouth Bldg.; Atlanta, C. P. Atkinson, Atlanta Tr. Co. Bldg.; Canada, Perkins Elect. Co., Ltd., Montreal. Toronto, Winnipeg.

SAMSON
201 A TYPE ¼ AMP. 5 V
TUBES
$3.50

Excellent for Volume and Clarity. Tested and approved by the foremost Radio authorities. A trial will convince — with money-back guarantee. Mail orders filled.

PHOENIX TUBE CO.

23 E. 26th St.
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Dealers' and Agents' trade solicited

Bristol Single Control Radio Receiver
(Non-Regenerative)

Using Grimes Inverse Duplex System

ONE CONTROL ONLY Makes it Most Simple to Operate

Simplicity of Operation is the outstanding feature of this Receiving Set. One Control Dial includes every adjustment. To tune in, turn this Dial. A station once located can always be brought in again at the same setting.

Not Confined to Local Broadcasting—This four-tube set has power equal to six. Because the Grimes Inverse Duplex System utilizes the first two tubes for both Radio and Audio Amplification.

Fully Equipped for Loud Speaker—No additional amplification is necessary—the patented Bristol One Stage Power Amplifier is incorporated as the last stage of amplification.

Antenna or Loop—Either may be used to suit conditions.

Solid Mahogany Case with walnut finish encloses the complete Receiving Set. It is a beautiful piece of furniture fully in keeping with the most luxurious room.

The price—Bristol Single Control Radio Receiver.....$190.00

Ask for copy of Bulletin 3013-R describing this set.

THE BRISTOL COMPANY, WATERBURY, CONN.

Don't You Get Tired

of only hearing LOCAL stations on your Crystal Set? There's music on your aerial every night from stations far away. If you want to hear it without buying a tube set, WRITE ME TODAY.

LEON LAMBERT

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of United States, Canada and West Indies with indexed Broadcasting booklet guide.

SPOT STATIONS YOU HAVE HEARD WITH COLORED MAP-PINS

Map size, 22 x 14 in. mounted on map-pin board. Shows all broadcasting cities, distance scale, relay and time divisions. Guide gives all call signals, locations, stations, wave lengths, etc., indexed separately by call signals and cities. Price complete, 85c; Map pins, 10c per dozen. Any color.

Above booklet with folded paper map. 35c.

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MAPS OF EVERY DESCRIPTION
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Dealers and Representatives wanted

The Traffic Cop of the Air

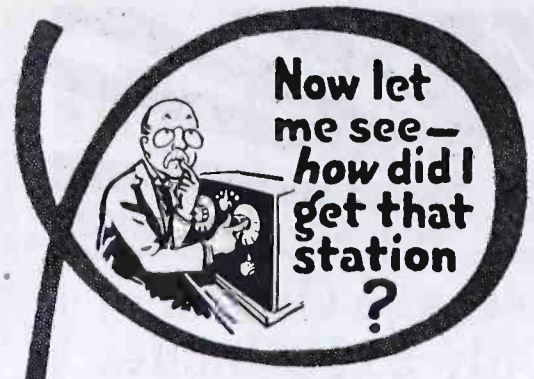
He arranges in orderly fashion the mass and jumble of Broadcasting Stations that are seeking entrance to your set and brings 'em in, one at a time, so you can enjoy them! Never reduces, but nearly always increases volume. Add a Ferbend Wave Trap to your set and "Police" your reception. Regulate the Traffic!

Guaranteed to tune out any interfering station. The price is $8.50. Shipment is made parcel post C. O. D. plus a few cents postage. If you prefer, send cash in full with order and we will ship postage prepaid. Send us your order today.

FERBEND Wave Trap

FERBEND ELECTRIC COMPANY
17 E. South Water St.
Chicago, Ill.

Tell them that you saw it in RADIO



LEFAX RADIO LOG WOULD TELL

With the Lefax Radio Log you can keep an accurate record of all useful information about each station that you tune in.

Space is provided for recording the call letter, location, distance in miles, date, time, tuning, weather, special features, quality, etc.

A column is provided in which a special symbol is placed after a station the first time it is heard. This means you can quickly find the total number of different stations heard on your set by simply counting the symbols in this column.

Dial settings need be recorded but once.

A blank line is provided for making notations when additions or improvements are made in your receiving set. This will show the reasons for the improved results recorded subsequently. Even slight improvements, like a new B battery may be so recorded.

If your equipment allows switching over from antenna to loop you can record type of aerial used.

The sheets are loose leaf, 6¾x3¾ in. (the same size and punching as the pages of the Lefax Radio Handbook and therefore fit the same binder and files).

The regular Radio Log is ruled on both sides and will allow 32 entries.

Price 25c (in U. S. A.) for pack of 40 sheets.

For sale by leading stationers and

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TELOS RADIO

—that the world may hear the world

Danziger-Jones, Inc. New York

SOLD OUT

We have no copies of May RADIO available but we can supply reprints of Best's Super-Heterodyne at

25 Cents Each

RADIO :: San Francisco

Genuine
Miller-B-Metal

(Reg. U. S. Pat. Office) **50c**

Two extra pieces of Miller-B-Metal suitable for container with every crystal.

Alive-Loud

The last word in a scientifically made crystal and loaded with the famous B-Metal (originated by A. H. Miller). Miller-B-Metal is always alive and loud.

Contact is certain—violent oscillation on reflex work is practically eliminated.

No wonder Miller-B-Metal is demanded by fans everywhere. It makes your crystal set something to be proud of. Order direct if your dealer cannot supply you.

Miller "Platine" Catwhisker 25c

Dealers

There is always an active demand for Miller-B-Metal crystals. Ask about other Miller products and our merchandising plan.

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1218 20th Street Detroit, Mich.

If You Build Your Own

don't fail to use Super-Heterodyne

you will find that it is necessary to get the right Grid Leak Value

YOU NEED TWO

FRESHMAN

VARIABLE GRID LEAKS

with .00025 Mfd. Condenser combined

$1.00

FREE! Write for complete Super-Heterodyne wiring diagram showing all connections and parts required. Ask for Circular L-10.

The Freshman variable grid leak is the most compact, most efficient, most adaptable to all grid circuits and, being entirely sealed, is unaffected by any climatic changes.

Chas. Freshman Co. Inc.
Radio Condenser Products
106 Seventh Ave., New York

CALLS HEARD

Continued from page 51

At 5QP, 410 Reynolds St., Gadsden, Ala.

3ams, 3auv, 3buy, 3bvh, 3cjx, 3hs, 3lv, 4ai, 4bk, 4cp, 4er, 4eq, 4ez, 4jr, 4my, 4nx, 3oa, 4pk, 4qf, 4sh, 4su, 5ad, 5agn, 5ail, 5alj, (5bp), 5cn, (5gp), 5gi, 5kc, 5kq, 5mi, 5oc, 5qh, 5rg, 5rv, (5vc), 5ws, 5zas, 8acs, 8aim, 8ajn, 8apt, 8atc, 8ayt, 8bk, 8bbf, 8cgi, 8ceo, 8ckz, 8cpk, 8czz, 8def, 8dha, 8dkm, 8er, 8ei, 8tj, 8yn, 9aau, 9aac, 9aai, 9aaq, 9aci, 9ags, 9ajw, 9aqd, 9aqr, 9aus, (clg wnp), 9avf, 9baz, 9bpv, 9buk, 9buz, 9brx, 9bsd, 9bsp, 9bsj, 9bvz, 9bye, 9cfk, 9clx, 9cmn, 9cjt, 9cza, 9dhg, 9dub, 9dro, 9dvw, 9dxf, 9dxk, 9eac, 9edo, 9efo, 9efz, 9ejx, 9ekf, 9eky, 9mm, 9ss, (9ta), 9vk.

Spark: 4fg. ICW: 9dyn. Phone: 5lj, 9dzo, 9ed. Can.—3oh. Pse qsl crd if u hear mi 10-watt ACCW, now on 180 meters, OM. All crds answered at once. TNX.

By 6VD, Herbert B. Drake, Box 387, Anaheim, Calif.

1ka, 2cdp, 2cee, 3ahp, 3atb, 3bei, 3cjn, 3gc, 3hh, 4dq, 5aat, 5aaq, 5amw, 5dw, 5iu, 5lr, 5na, 5nk, 5xy, 5rv, 5ue, 5xd, 6's es 7's too numerous, 8aih, 8bk, 8bmb, 8brm, 8cei, 8cgi, 8cmy, 8cun, 8cwr, 8dpa, 8do, 8rn, 8vt, 8xe, 8xs, 8zz, 9aau, 9aec, 9ahz, 9aim, 9amb, 9ap, 9aqr, 9awv, 9bal, 9bkf, 9bmu, 9bun, 9cdv, 9cju (dalite), 9ck, 9cpz, 9cvo, 9daw, 9ddp, 9dte, 9dun, 9dvw, 9dwn, 9dxr, 9eea, 9ehq, 9elb, 9eli, 9qr, 9xbf. Also kdka on 100 meters without aerial or gnd.

Can.—3bq, 4hh.

By 1IV, Bridgeport, Conn.

U. S.—(4hs), (4io), 4iz, (4xc), (4xe), (4xr), 4xs, (4xw), 4xx, (5dw), 5tj, (5xat), (6bcl), 6cgw, 6fp, 6ka, 6lv, 6pl, 6xaq, 6xbc, 6xbe, 6zh, 7co, 7lu, 7zd, 7zu, (9aem), (9aii), 9amb, (9bmx), 9bxq), 9caa, (9cbg), (9ccm), (9cfi), (9dpx), (9em), (9eq), (9er), (9xba), (9xbd), (9xbe), (9yy), 9zt.

Porto Rico—4ja, 4je. Canadian—(1dt), (2bn), (3tb), 4cr, (9bl). English—2kf, 2nm, (2od), (2sz), 2wj, 2yt, 5at, 5lf. French—8ab, 8az, 8bf, fl (daylight; 100 meter test). Dutch—pa9, (pcii).

By 7GR, Station A, Vancouver, Washington

1abf, 1are, (1ah), 1bcr, 1iv, 1bie, 2brb, 2byw, 2cee, 2cjt, (2cpd), 2cxw, 2gk, 2wr, 2xar, 3bva, (3hh), 3pz, 4fz, 4oa, 4rr, 4xc, 5aar, (5agl), 5aiu, 5ajt, 5akn, 5in, 5lr, 5nw, 5oq, 5ov, 5ph, 5qd, 5ql, 5rg, 5sd, 5uk, (7aeb), (7ahb), (7mj-7lr), (7mn), 8abx, 8ada, 8anb, 8cci, 8ajm, 8dmc, 8pl, 8rn, (8zk), 9acx, 9aec, 9apf, (9aqc), 9aqv, (9avg), 9ayd, 9bdq, (9bgi), 9bvz, 9bhi, 9bis, 9bkf, (9bib), 9bxq, 9bze, 9bzi, (9ccw), (9cdv), (9cea), (9chc), 9cld, 9cte, 9dai, 9day, 9dcw, (9dix), 9dp, 9doe, 9dun, 9dvw, 9dxc, (9dxy), (9dyi), 9fm, 9ql, 9ro, 9ry, (9tm), 9we, 9xax.

Can.—(2az), (3aec), (3bq), (3ms), (4dq), 4cb, 4cn, 4ab. G2od? All cards answered or refunded.

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DID YOU KNOW THAT OUR SUPER-HETERODYNE INTERMEDIATE FREQUENCY TRANSFORMERS ARE TUNED? EACH TRANSFORMER A FILTER ITSELF! WOUND WITH NO. 24 WIRE—NOT NO. 32 AS OTHERS ARE. ENTIRELY ENCLOSED IN BAKELITE HOUSING. MOUNTING FEET ARRANGED TO MOUNT TRANSFORMERS ON BASE BOARD IN NEUTRODYNE FASHION. TUNED RADIO-FREQUENCY AMPLIFICATION DELIVERS FOUR TIMES THE VOLTAGE TO GRID THAT OTHER TYPES GIVE. WHY NOT USE IT? PRICE FOR 3 TYPE 10-A TUNED RF TRANSFORMERS; 1 INPUT TRANSFORMER; 1 OSC. COUPLER; CIRCUIT AND INSTRUCTIONS FOR BUILDING 8 TUBE SET, ONLY $35.00 POSTPAID. IF AT THE END OF TEN DAYS YOU ARE NOT SATISFIED WITH ITS PERFORMANCE YOU MAY RETURN THE ENTIRE EQUIPMENT (IF IN GOOD CONDITION) AND WE WILL CHEERFULLY REFUND YOUR MONEY! SEND FOR CONVINCING TESTIMONIALS FROM ALL OVER THE U. S. AND CATALOG.

THE RAY-DEE-ARTCRAFT INSTRUMENT CO.,
1005-17 TRIBUNE ST., REDLANDS, CALIF.

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158 GENUINE Foreign Stamps. Mexico War Issues. Venezuela, Salvador and India Service. Guatemala, China, etc., only 10c. Finest approval sheets 50 to 60%. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 years. Hussman Stamp Co., Dept. 150, St. Louis, Mo. (3T)

PATENTS PROCURED. Send sketch or model today for examination, prompt report and advice. No charge for preliminary advice. Write for free Booklet and blank form on which to disclose your idea. Highest references. Promptness assured. Clarence A. O'Brien, Registered Patent Lawyer, 198-C Security Bank Building. Directly across the street from Patent Office, Washington, D. C.

AMERICAN MADE TOYS—Manufacturers on large scale, and others wanted to manufacture metal toys and novelties. Millions needed of barking dogs, wag tail pups, wild animals, automobiles, Indians, cowboys, baseball players, cannons, toy soldiers, crowing roosters, statues of Liberty, miniature castings of capital, hatLing girl souvenirs and others. Unlimited possibilities. Guaranteed casting forms furnished manufacturers at cost price from $5.00 up, with complete outfit. No experience or tools necessary. Hundreds made complete per hour. We buy goods all year and pay high prices for finished goods. Cash on delivery. Contract orders placed with manufacturers. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1696 Boston Road, New York.

Special!!!! Inch Display Adv. 166 Magazines Thrice $15. Year $50. Wood's Popular Services, Atlantic City.

RADIO GENERATORS—500V 100 watt $28.50. Battery Charging Generator $8.50. High Speed Motors. Motor Generator Sets, all sizes. MOTOR SPECIALTIES CO., Crafton, Penna. (tc)

MAGNAVOX R3. Latest nationally advertised reproducers; electrical modulator. List $35. Introductory $25. The factory sealed carton is your guarantee. Radio Central, Dept P, Abilene, Kansas.

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Amrad wavemeter, $4. Cost eight. Will trade for radio apparatus. A. W. Nicolay, Benton, Wisconsin.

BARGAIN—Unused Murdock oscillation transformer and Murdock rotary spark gap with or without motor. In perfect condition. G. W. McCormick, Jr., 1711 State St., Menominee, Mich.

TELEGRAPHY—Morse and Wireless—taught at home in half usual time and at trifling cost. Omnigraph Automatic Transmitter will send, on Sounder or Buzzer, unlimited messages, any speed, just as expert operator would. Adopted by U. S. Government and used by leading Universities, Colleges, Technical and Telegraph Schools throughout U. S. Catalog free. Omnigraph Mfg. Co., 16 J. Hudson St., New York City.

Kennedy Loud Speaker, same as new $15; phones, condensers, variometers, plugs at less than wholesale; slightly used Edison primary cells A and B bats. at your own price. Box A-"Radio," S. F.

WILL SACRIFICE $235 KENNEDY TYPE 220, 150-3600 METER RECEIVER AND 525 TWO STAGE, $100; MAGNAVOX, $24.50; MAGNAVOX 2 STAGE, LESS CABINET, $28; All parts for Haynes 7 tube Super-Heterodyne, drilled panel, $40; Genuine Tuska Superdyne parts $13.50; 5 tube Neutrodyne, lincensed parts, $69. Terms 1/3 cash or M. O. balance C. O. D. D. V. Dawson, Elwood, Indiana.

BIG Money and Fast Sales—every owner buys gold initials for his auto. You charge $1.50, make, $1.44. 10 orders daily easy. Samples and information free. World Monogram Co., Dept. 68, Newark, N. J. (SAS)

Type 201A Tubes, UV199, WD11, WD12, $4.25 each. Write for our complete price list of bargains. The RadioMart, 693 Mission St., San Francisco, Calif.

MAKE BIG MONEY
OUT OF RADIO

Thousands of People want to buy a good Radio instrument. They have read that vast improvements have been made and they are ready to buy now if you show them the best.

It is one thing to make a good radio instrument for your own amusement, but why not cash in now on your experience? Let us send you full particulars of the Ozarka Plan which shows you how to

"MAKE $120 WEEKLY"

selling long-distance Radio sets. The season is on right now. Let us tell you how to combine the clear signal of the crystal detector with the distance of the vacuum tube. Write today and don't fail to give the name of your county.

OZARKA INCORPORATED
814 Washington Blvd., Chicago

C. W. and RADIO PHONISTS—Our new converters will satisfy your need for a more efficient and durable direct current plate supply. No armatures to burn out. Output from seven hundred to two thousand volts at .4 amperes. Synchronous Motors, Transformers and other parts sold separate. Write immediately, Kimley Equipment Mfg. Co., 290 Winslow Ave., Buffalo, N. Y. (tc)

ARC & SPARK SYSTEMS
Send for Descriptive Circular QRD.
Interesting and Instructive (tc)
Pacific Radio School 433 Call Bldg., San Francisco

RADIO WORLD, THE GREAT NATIONAL WEEKLY—published every seven days with all the latest news, developments and pictures of the radio field. 15c a copy. $6.00 a year (52 numbers), $3.00 six months, $1.50 three months. Special to radio readers. Send $1.00 and we will send you the next eight issues of RADIO WORLD. Pub. Office, 1493 Broadway, New York. (tc)

Vacuum Tube Hospital
We repair and guarantee them.
Agents, Dealers, and Customers Wanted.
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BARGAINS

1 Grebe "13" Amateur receiver, new	$75.00
1 Paragon DA2 detector amplifier unit with jack for external detector to use with Grebe set	30.00
Both above units	100.00
1 Jewell O-25 thermo, new	8.00
1 Jewell O-150 milliameter, new	5.00
1 Acme inductance	5.00
1 Amrad "S" tube old type, never used	4.00
1 Faradon Mercury variable transmitting condenser	4.50
1 General Electric double current aviation generator, supplies 120 mils at 550 volts for plate and 8 volts for filament. Right for two five watters. Extension shaft with key for pulley or coupling. May be used as dynamotor with twelve volt battery. New	22.00
1 pair Como Push Pull transformers, new	10.50
1 Jewell wavemeter like new	15.00
1 Complete transmitter, 20 watts C. W. or 10 watts fone; entire set factory built; best instruments used. Weston meters, G. E. motor generator, Federal filter, wonderfone, microphone, etc. Built by an employee of a well known radio factory for his own use. Wonderful D X. Complete with tubes ready to go for	200.00

Complete information regarding this transmitter furnished upon request. P. L. Williams, Box 451, Bend, Oregon.

Directory of Broadcasting Stations corrected to date, postpaid 15c. Broadcasting post cards, per doz., 15c. Sample free. Pacific Screw Co., 645 N. E. 53 St., Portland, Oregon.

Large Size Edison Elements. Makes a real "B" Battery. 5½ cents per pair, post paid. Arthur Chapelle, Woodburn, Oregon.

1500 VOLT D C GENERATORS FOR PLATE Supply, for $45, built by General Electric Co., to Navy Specifications, Ball bearing dynamotors, which will give most satisfactory service when belted to an external power source, as a gas engine, motor, etc., and which will make a pair of 50 watt tubes make a REAL noise! Rated at 600 watts on the high voltage side, and 25 volts 31 amps on the low side. As dynamotors are ideal for power supply when operated from farm lighting plants, etc., and when driven will charge storage batteries, and do anything else a high grade 25 volts DC shunt wound generator will. Speed 6,000 RPM. ALL BRAND NEW AND UNUSED, guaranteed. $48 with shafts extended for belt drive. D. B. McGown, 1247 Forty-seventh Ave., San Francisco, Calif.

If your Neutrodyne won't "Neut" o. k., send 10c for details of Kladag Coast To Coast Circuit, bill of materials, etc., to change over your Neut into a set that will bring them all in from Mexico City to Tunucu, Cuba, on a loud speaker. Or send $5.00 for all extra parts, blue print, etc., you need to do this. Uses same panel layout. Stamps accepted. Radio List for stamp. Kladag Radio Laboratories, Kent, Ohio.

Tell them that you saw it in RADIO

QUERIES AND REPLIES

Continued from page 37

bridge, and wind the wire on a porcelain tube or other convenient tubing, of small diameter. The center of the wire should be found before winding it on the tube, so that the wire can be double, and wound on the tube from the middle, the two ends going on last. This makes the winding non-inductive, which is absolutely necessary in high-frequency work.

Please publish the changes necessary to make the 100-watt transmitter described in May, 1922, RADIO, suitable for use with two 5-watt VT-2 tubes, instead of two 50-watt tubes.—H. D. W., Bowerston, Ohio.

The principal changes will be in the sockets, filament rheostat, and power transformer. You will, of course, require a set of sockets for the VT-2 tubes, a filament rheostat with a carrying capacity of 2.5 amperes instead of 13 amperes, and a power transformer having a 110-volt primary, 8-volt filament secondary, and 1000-volt secondary with a center tap. On this page is a description of a power transformer for providing 550 volts for one 5-watt tube. Wind 3320 turns of No. 30 D.C.C. wire instead of 1825 turns, and take out a center tap at the 1660th turn. This transformer will then be connected in the circuit exactly as shown in the original circuit diagram in the May, 1922, issue of RADIO, and no other circuit changes will be necessary.

Is the current from the secondary of a Ford spark coil a.c. or d.c.? What is the secondary voltage when six volts is applied to the primary? Please publish a diagram for a 5-watt transmitter, using a Ford coil for plate supply.—W. E. J., Middleton, Idaho.

The output of a spark coil is alternating current. It cannot be otherwise, for direct current will not pass from the primary to the secondary winding of any transformer. Under ordinary conditions, the voltage with small load on the secondary will be of the order of 500 volts. A diagram of a 5-watt transmitter employing a Ford coil was shown in Fig. 2, page 35, of January RADIO.

Please give the circuit of the Grebe CR-13 receiver.—U. B. C., Columbus, S. C.

The circuit was published in February RADIO, page 37, Fig. 1. Constructional data for the variometers was included in the text accompanying the illustration.

ANNOUNCEMENT—A number of letters received by this department remain unanswered because the writer either forgot to sign his name, or signed only his initials and not his address. Correspondents should sign their names and addresses on the same sheet with the questions, and if a fee is enclosed for personal answer they should so state in the letter, in order that there will be no misunderstanding.

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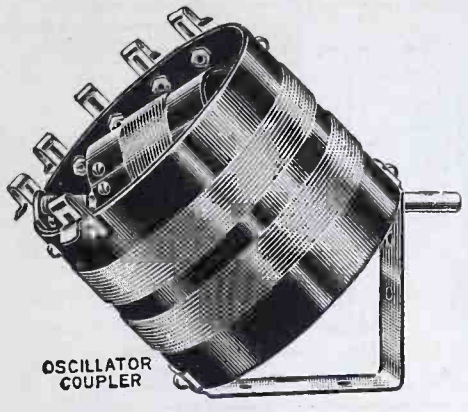

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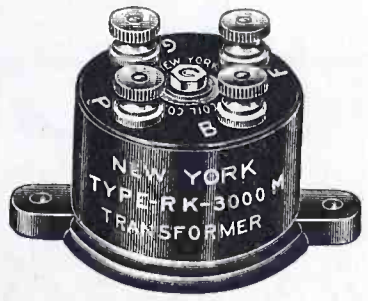
Capacity	Retail Price
.0001 Mfd.	.35
.00015 "	.35
.00025 "	.35
.0005 "	.35
.001 "	.40
.002 "	.40
.005 "	.60
.006 "	.75

.00025, with Grid Leak Mounting attached, 45c list.



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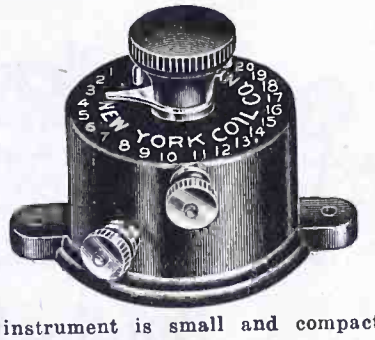

This instrument is small and compact. It gives an unbroken, gradual resistance variation of from ¼ to 6 meg. ohms. A permanent resistance element is employed; a roller arranged to travel over same thus avoiding wear on the resistance element. It avoids the necessity of buying three or four various sized Fixed Grid Leaks, and is a quality product throughout.

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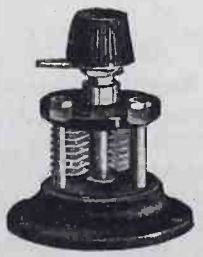

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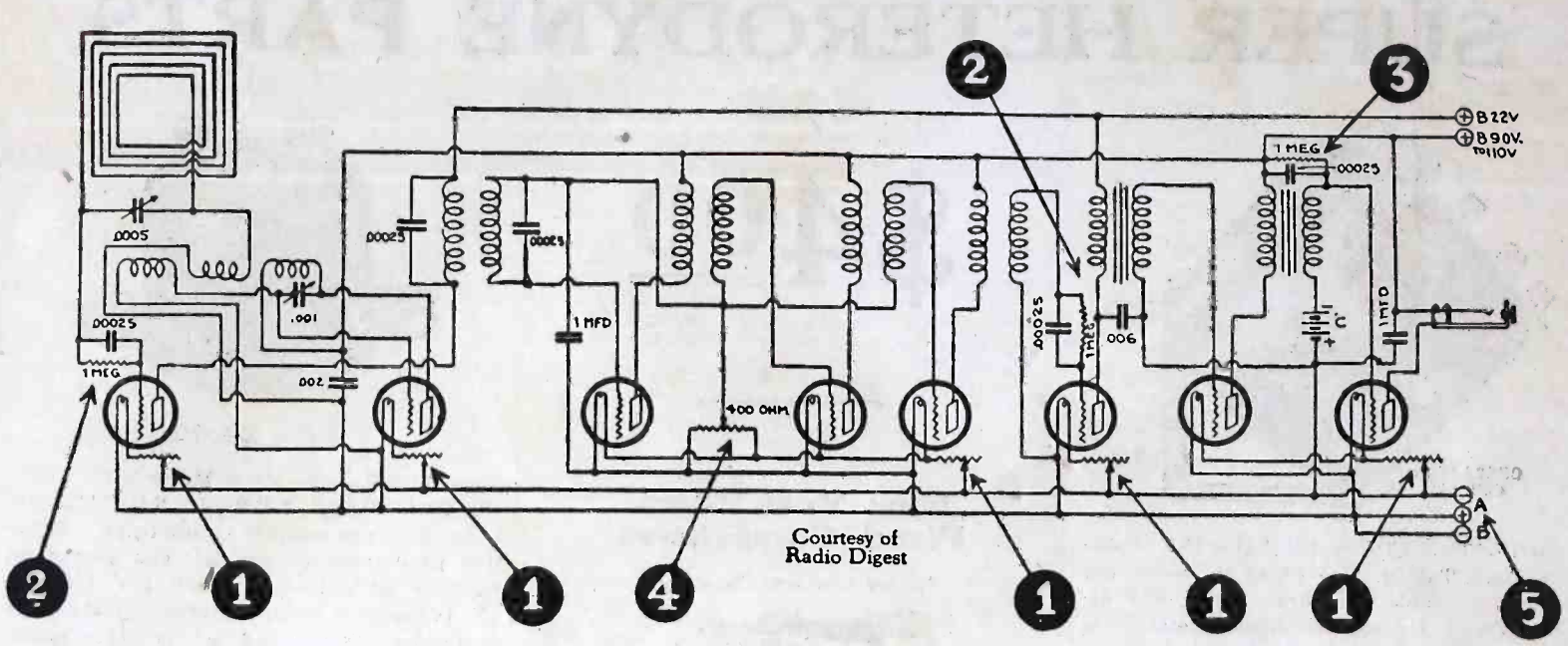

For the Super-heterodyne

1

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For all tubes. Provides a stepless, noiseless range of control that simplifies tuning and oscillator control. Holds the record for long range tuning.

2

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3

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4

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THE PERFECT POTENTIOMETER

Made in 200-ohm and 400-ohm ratings for all circuits. Gives a smooth, stepless range of potential control, so essential for super-heterodyne circuits.

5

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The surest way to build a successful super-heterodyne receiver is to use only the finest parts. Among the important items are the adjustable grid leaks, potentiometers, special resistors, filament rheostats, and battery switches. In fact, there are no parts more important than the grid leaks and condensers.

For these parts, standardize on Allen-Bradley radio products listed on this page. They represent the experience of rheostat designers with more than twenty years of training in this important field. Attempts have been made, from time to time, to imitate Allen-Bradley radio products, but without avail. They stand supreme in their field, and with a record of successful performance that places them in the front rank of high-grade radio products.

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If you will drop this coupon in the mail, with your name and address, we will send you a complete set of folders describing Allen-Bradley radio products in detail. Be sure to get this information before you lay out your super-heterodyne receiver.

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at a capacity of 330 micro-microfarads on a wave length of 215 meters.

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Will see in the above the real reason why this condenser should be used by all who wish to obtain the greatest degree of signal strength and sensitivity from their receiving equipment.

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These three ranges of capacity enable it to take the place of the ordinary eleven, twenty-three and forty-three plate instruments.

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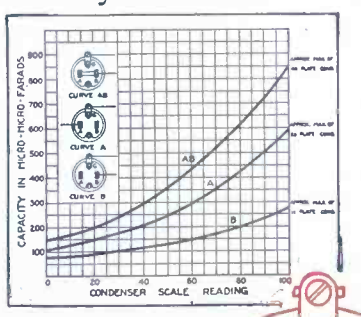

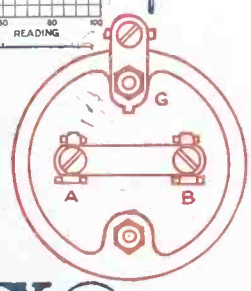

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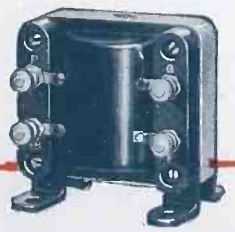

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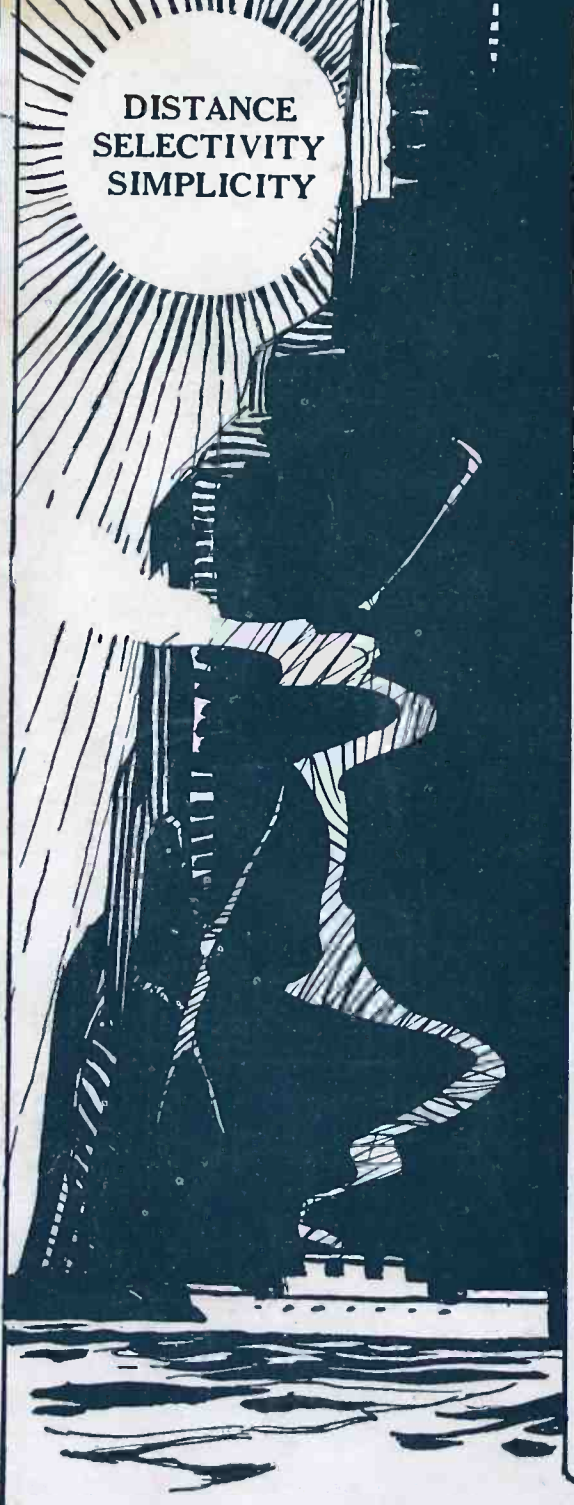

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