RADIO BROADCAST

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MARCH, 1926
Vol. VIII, No. 5

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BEHIND EDITORIAL SCENES

THE present number of RADIO BROADCAST was prepared and edited during the week of the International Radio Broadcast Tests, but in spite of the disorganization of office personnel and the conventional magazine routine, we feel that a very interesting lot of radio material has been assembled. E. E. Horine, who wrote, "A Man and His Hobby" which is the leading article, is known to many radio men as assistant radio manager of the National Carbon Company. Professor Morecroft, in his comments about the Naval Radio Service, has stirred up considerable discussion, with rather vocal partisans on each side. In attempting to take a neutral position, we have been accused of attempting to accomplish all sorts of dire ends. But as Professor Morecroft has stated, the only purpose has been to indicate what seemed to us to be the facts and to try to discover how conditions may be remedied.

RADIO'S relation to weather conditions has been discussed ever since the coherer days of the art, but we doubt if any more important or complete information has been presented than Mr. Jensen gives in his article, "Can We Forecast Radio Reception from the Weather?" By carefully studying the maps and curves in the article, experimentally inclined radio folk have opened to them a most interesting field for investigation. And Mr. Landon's article on multiple regeneration is also a frankly experimenta presentation of a subject which has very large possibilities and we expect many interesting reports from home constructors who put some of Mr. Landon's suggestions to practical tests. The long-awaited third article in the series for the home constructor who wants to go further in radio than set building appears on page 573, and if the letters addressed to Mr. Henney, the author of the series and director of our Laboratory are any indication, those to follow are also eagerly awaited. That interest is not hard to explain, for the series is packed full of material of the utmost help to the radio-ambitious.

FROM our correspondence from the increasing number of experimenters interested in short wave transmitting and receiving, it would appear that RADIO BROADCAST'S $500 prize contest for the design of an efficient short wave receiver was attracting a great deal of interest. Our amateur contemporary, *QST*, devoted a page to announcing the contest in its February issue. For those who have not seen particulars of the contest, full information may be had by writing to the Director of the Laboratory, RADIO BROADCAST, or on page 444 of this magazine for February.

IN THE April RADIO BROADCAST, we can promise another one of Keith Henney's absorbing and informative articles on tubes. There will also be a distinctly helpful article on various means of filament control, prepared by John B. Brennan, Technical Editor of this magazine. There will be a review of the International Radio Broadcast Tests which will be of interest to nearly every radio listener who has a receiver more elaborate than a crystal set.—W. K. W.

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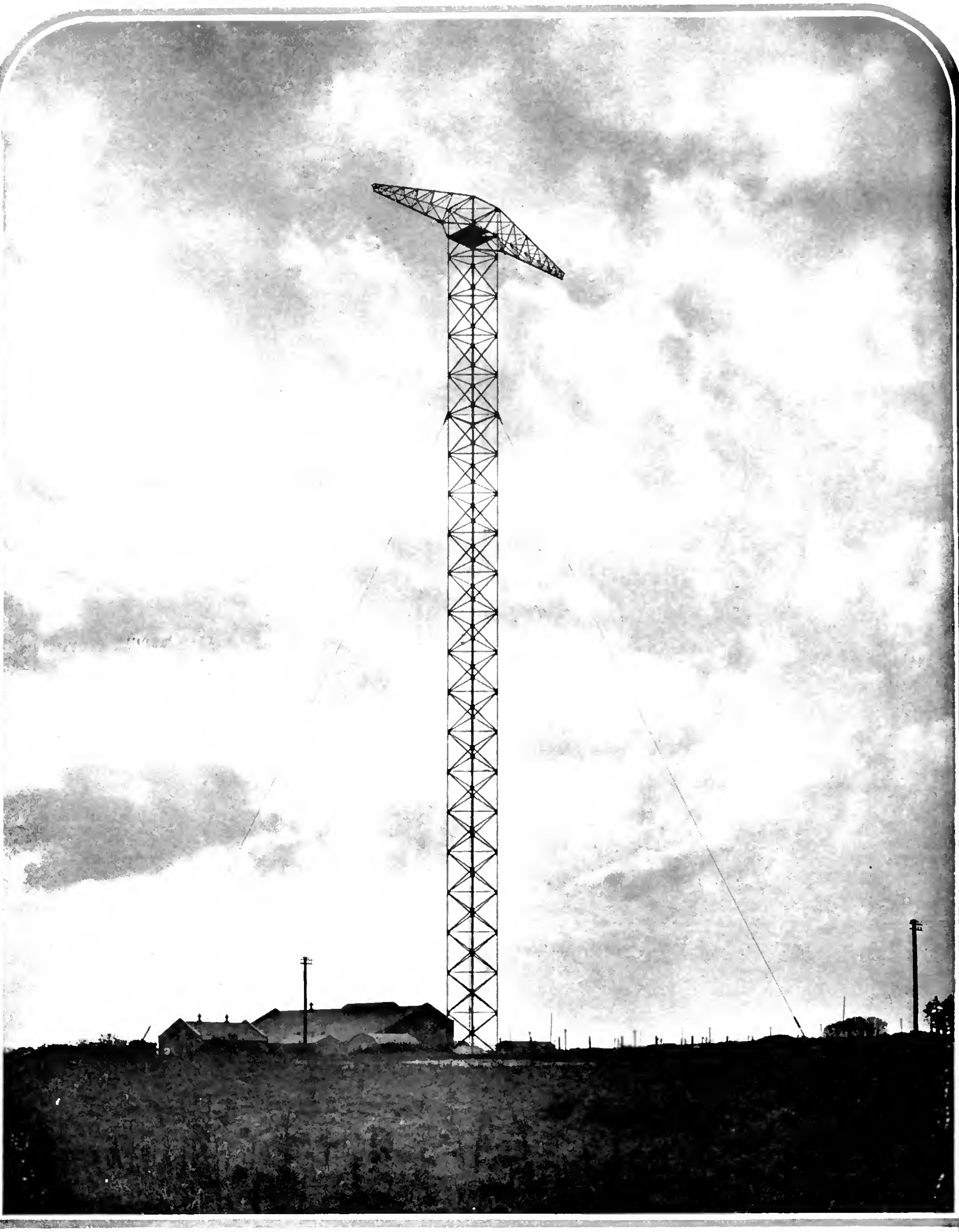

WHERE ENGLISH MESSAGES LEAVE FOR THE UNITED STATES

One of the majestic towers of one of the new beam stations of the British Marconi Company. The station is located in Dorchester, Dorsetshire and was chiefly erected to communicate with stations on the east coast of the United States. Tests with the new equipment have been progressing for some time

RADIO BROADCAST

VOLUME VIII NUMBER 5

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A Man and His Hobby

The Story of One Man's Experiences With Short Wave Code Transmitters on Low Power—The Philosophy of the Radio Amateur—How Australia Was Reached From British Columbia With Batteries and a Receiving Tube as a Transmitter

By E. E. HORINE

A NEW and thrilling experience is in store for the dyed-in-the-wool broadcast listener when he first tunes-in on the shorter wavelengths set aside for the use of the amateur. Around about 7500 kc. (40 meters), the air is literally full of signals of all kinds, day and night, summer and winter. It's all code down there. No grand opera stars singing in heavenly voices; no prominent speakers wagging the silver tongue; no jazz. Only a succession of queer sounding dots and dashes, in all manner of tones and pitches, from low gutteral growls to high-pitched, clear, chirping notes. Some of them sound as if they might have originated next door, while others create the impression of having come across thousands of miles of ocean and land; and the chances are they have, for it is an everyday occurrence for amateurs of different nations, on opposite sides of the world, to converse with each other. The field of amateur radio is the DX fan's paradise, and therein lies a part of the fascination of the game.

Listening-in on the amateur bands stirs the imagination and arouses the curiosity. There seem to be thousands of these amateurs at work, bombarding the ether with their messages, clamoring away, trying to engage some one's attention perhaps thousands of miles distant. Who are these amateurs? What kind of folk are they? What do they talk about? What keeps them so everlastingly at it?

The best way to answer these perfectly natural questions is to recount the story of what one amateur has done. Clair Foster, or to give him his correct entitlements, Colonel Clair Foster, 6 HM, Carmel, California, is more or less a newcomer to the ranks of amateur radio. He calls himself a greenhorn, but there are those who will take emphatic issue with him on this score. Two years ago, he knew nothing about amateur radio. He had constructed a few broadcast receivers and was beginning to yearn for new worlds to conquer, when he met John Reinartz. And that meeting was the beginning of a new life for Colonel Foster.

His first and natural objection was he couldn't read code, but this was pooh-poohed, laughed at, ridiculed. Anybody can learn the code; a little study, a little practice, and you are ready to stand the examination for a transmitting license. Age is no barrier, nor is sex, for there are many girl amateurs, YL's in "ham" language

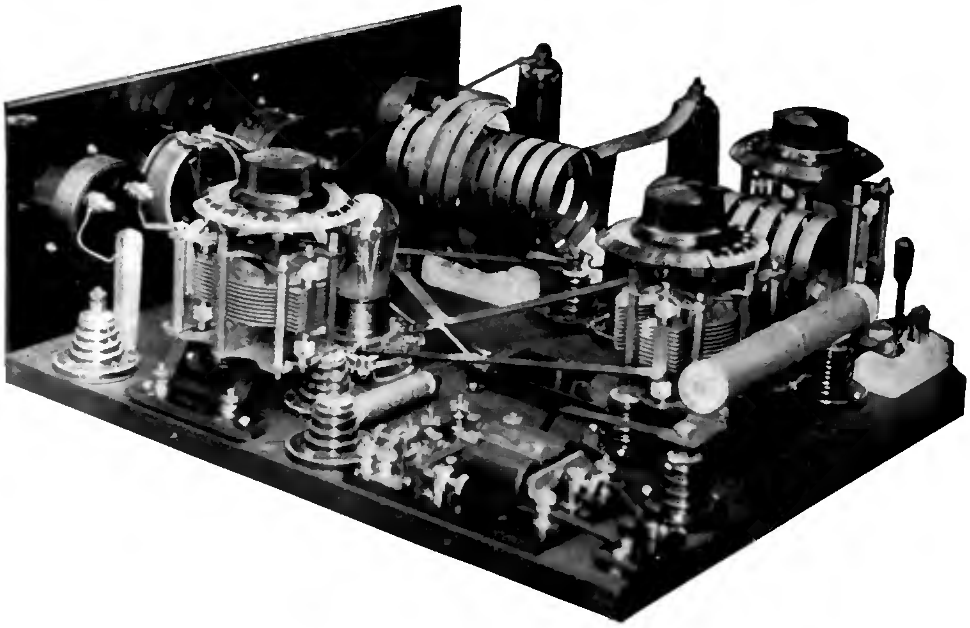
Foster says the small time and study he devoted to learning the code was the best investment he ever made. It has been the means of opening up for him a new field of activity; it has brought him a host of new friends, many of them on the other side of the world, with whom he is on terms of closest intimacy, yet whom he has never seen, and probably never will see. It has drawn him into an international fraternity guided by a self-imposed code of ethics that comes closer to being a literal application of the golden rule than anything else on this earth. It has afforded him the most pleasant hours of his life, and turned him into a youth again, bubbling over with enthusiasm.

LOOKING TOWARD AUSTRALIA
From the little shack of Col. Clair Foster's radio cabin near Port Alberni, B. C. The mountain is called Mount Arrowsmith, and did not seem to block the modest radio signals from the battery-operated, 5-watt, short wave transmitter installed here by Colonel Foster and operated under the call C9CK. The story tells how a simple transmitter was built and communication established all the way across the Pacific with amateur radio men in Australia

HATS OFF TO THE FIVE WATTERS

HIS station at Carmel, California, 6HM, uses a 250-watt tube, and with it he has "worked" fellow amateurs in the Philippines, Japan, Australia, and other countries. But he feels that reaching out to great distances with high power isn't so remarkable. It's the fellow who does it with low power that deserves credit for real achievement, and this "most miles per gallon" idea is now coming in for a great deal of attention on the part of the amateur. Commenting on this phase of radio transmission, Foster says,

After working a number of distant stations that were using very low power, my hat came off to the chaps who could put out such clear and steady signals with 5 watters—and even 201-A receiving tubes. Every one I bumped into I boned for his dope, and I have collected through their courtesy quite a bunch of it. I see no especial credit coming to the fellow who busts out with the big tubes. Of course it is satisfying to have a wallop so that when you answer a CQ (general call) you are the fellow the other chap almost surely hears; but the big field for the practical use of radio can't be opened up with the use of big, expensive equipment. Only a small proportion of those who will become interested in transmission can afford the heavy outlay.



THE TRANSMITTER THAT TALKED TO SOUTH AUSTRALIA

The photograph was taken before the coils were changed. The most notable feature of the outfit is the careful placement of the parts which certainly had much to do with the extraordinary results produced by the arrangement

The big tubes themselves are expensive, and they require a rather costly array of auxiliary apparatus for their operation—a high voltage motor generator, or a system of rectifiers and filters to convert the commercial alternating current into as close an approximation of the pure direct current of batteries as possible. But with the small tubes, the installation cost of a complete transmitter becomes ridiculously low. The transmitter itself can be built for much less than the cost of a good broadcast receiver, and it can be operated successfully and reliably from B batteries.

Foster's low power transmitter, 9 CK, was designed and built in California, but was operated all summer at a point on Vancouver Island, about 125 miles north of Victoria. The outstanding characteristic of this transmitter is the careful and painstaking workmanship expended on its construction. There is nothing ragged or loose about it. Every part fits perfectly in its appointed position, and the coils, as can be seen, are made of heavy copper strips, with nothing touching the turns. They are supported by their own rigidity, and the whole transmitter is just about as low loss as it is possible to build such a set. This careful attention to small details is largely responsible for the fine work done by this transmitter.

THE COMPLETE OUTFIT AT C9CK

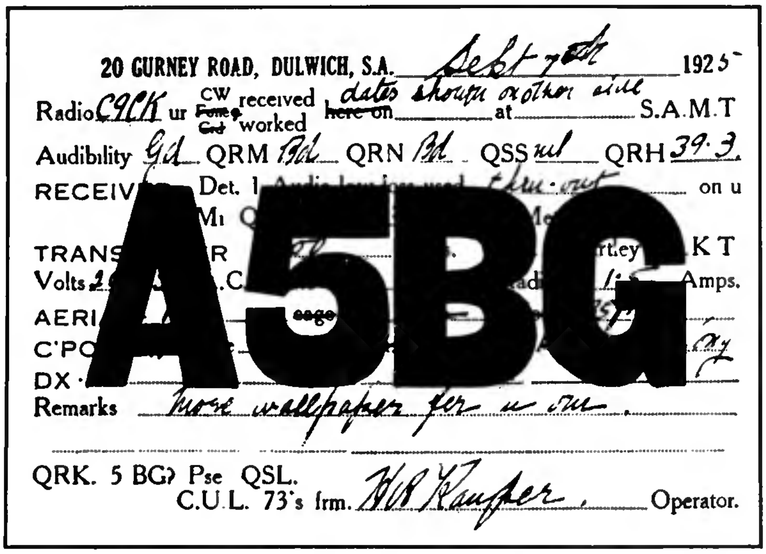
The transmitter, receiver, "power plant," and operator — Colonel Clair Foster himself. Note the wavemeter on the right top of the table

The shack was located on the shore of a lake surrounded by snow capped mountains over which or through which the signals from the little transmitter had to pass to get anywhere. It is a wild, rugged country, remote from civilization, and naturally no electric power available for any purpose. There is only one way to get power in that country, and that is to carry it along in the form of batteries.

But that wasn't the real, fundamental reason for deciding to run his low power transmitter with B batteries. If the weak signals put out by such apparatus are to get anywhere, it is essential for the note emitted to have a high, penetrating sound, otherwise it can't be read at considerable distances, and batteries are ideally suited to impart to the transmitter a tone that is not only penetrating, but steady and free from swinging.

In connection with the use of B batteries for power supply for transmitters, Colonel Foster said, in one of his earlier letters written before leaving Carmel for Vancouver Island,

Along this line, most of us on 15,000 kc. (20 meters) have been using 250-watt tubes. But 9 DFH has the steadiest signals I hear, and he is using a lonely 5-watter (about the size of an ordinary receiving tube) with less than 20 watts input. And recently, I worked 4 BL, in Lakeland, Florida, who was coming in here fine through heavy static disturbance, using a 201-A receiving tube for transmitting! It wasn't a freak transmission, for 4 BL has worked some of Canada, all United States Districts, and Porto Rico on 7500 kc. (40 meters) with this tube. At present, the big drawback to the use of 15,000 kc. (20 meters) is that it is so responsive to slightest variation in current that the signals keep swinging into and out of tune. I think batteries for plate and filament ought to help a lot.


20 GURNEY ROAD, DULWICH, S.A. Sept 7th 1925

Radio C9CK ur CW received / worked dates shown on other side at S.A.M.T

Audibility Gd QRM Bd QRN Bd QSS nil QRH 39·3

RECEIV... Det. 1 ... on u

TRANS... KT

Volts ... Amps.

AERI...

C'PO...

DX...

Remarks more wallpaper for u om.

QRK. 5 BG? Pse QSL.

C.U.L. 73's frm. HR Kauper. Operator.

THE VERIFICATION CARD FROM "A 5 BG"

The call letters of H. R. Kauper, the amateur operator in Dulwich, South Australia, who maintained a faithful schedule with C9CK, to learn how reliable communication with a 5-watt, battery-operated transmitter could be. The back of the card lists details of their schedule: "Aug. 27—10 watts; 28th, QSA (strong signals); 29th QSA; 20th, 201A tube, 11 watts; 31st, QSA; Sept. 1st, OK, but QRZ (weak signals); 2nd, my transmitter out of action; 3rd, QSA; 4th, QRZ, but OK; 4th, later, QSA; 5th, QSA; 6th, vy. QSA (very strong); 7th, vy. QSA

HIS "A. C." BATTERIES

WHEN the little transmitter first went on the air, reports received indicated that its note was rough and ragged, as if produced by rectified a.c. which Foster couldn't understand, on account of the battery supply. Many a time he was kidded over the air by facetious hams about his "a.c. batteries," but he finally solved the puzzle. The flat copper-strip coils were thrown into slight mechanical vibration by the thumping of the relay, and it was this vibration that caused the rough quality of the note. New coils, made of ¼-inch copper tubing, were substituted for the original ones, after which reports began to come in saying "Pure d.c. OM VFB"—pure direct current, old man, very fine business."

Your radio amateur is an optimistic individual. Everything that happens is encouraging. Witness this, written a few days after the transmitter was set up.

> The little 5-watter, signing itself C 9 CK, here among the mountains of Vancouver Island, seems to be getting out a bit, on 7900 kc. (38 meters.) Have had encouraging reports from two stations in southern California.

Southern California! And he calls it encouraging! In view of what he had accomplished before the summer was over, Southern California was just around the corner. Colonel Foster's ambition was to work an Australian, but results along this line were not so encouraging at first.

> Saturday night I hollered my head off at the Antipodes until 2 A.M. I imagined batteries would show some drain after all that use. But at the end of that time the eleven in use still tested exactly as when I began, 485 volts.

He continued to "holler his head off" at the Antipodes night after night without result, until the ordinary individual would have given up and dumped the apparatus, batteries and all, in the lake. But your radio amateur is not an ordinary individual. For nearly two months he kept at it, never losing hope, never giving up. And then, on the morning of August 11th, he made the grade! You can imagine the pride and enthusiasm with which he dashed off this telegram.

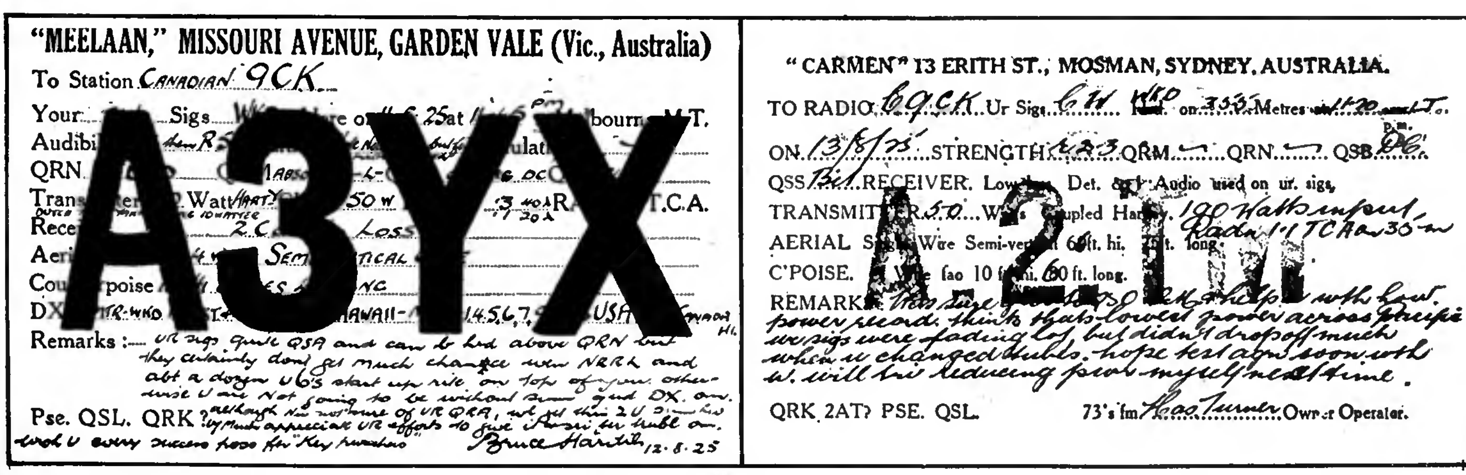
> Port Alberni, British Columbia,
> August 11th, 1925.
> E. E. HORINE,
> Radio Division,
> National Carbon Company,
> New York.
> Using only one 201-A receiving tube with input just ten watts from Eveready Batteries worked satisfactorily this morning five forty to six forty-five A.M. Pacific Standard Time Australian 3YX on thirty nine meters. Report on other work follows soon.
> CLAIR FOSTER C 9 CK.

Some telegram! And some message! For over an hour, he had conversed with this Australian amateur, and at a time of year when broadcast listeners have ceased to fish for distance on account of summer static. And look at the time of day it all happened! 5:40 A.M.! Apparently amateurs never sleep.

Once the ice was broken, things began to break rapidly in the direction of Australia. On August 13th, the performance was repeated, this time communication being established with Australian 2TM. And on August 27th began what constitutes one of the outstanding performances of amateur radio. On that morning, Colonel Foster reported in a telegram:

> To-day again the receiving tube stop this time forty-five minutes perfect communication with 5 BG near Adelaide South Australia stop these signals had to travel thousand miles or more over land after passing the other three stations already worked with this tube stop input thirteen watts wavelength thirty eight and seven tenths stop more than quarter of distance full daylight.

The mere fact of establishing contact


"MEELAAN," MISSOURI AVENUE, GARDEN VALE (Vic., Australia)

To Station Canadian 9CK

Remarks :— UR sigs quite QSA and can be hrd above QRN but they certainly dont get much change with NRRK and abt a dozen U6's start up rite on top of you.

Pse. QSL. QRK? ... Bruce Hartill 12.8.25

"CARMEN" 13 ERITH ST., MOSMAN, SYDNEY, AUSTRALIA.

TO RADIO C9CK Ur Sigs CW ... on 35.5 Metres

ON 13/8/25 STRENGTH ... QRM ... QRN ... QSB ...

QSS ... RECEIVER. ... Det. ... Audio used on ur. sigs.

TRANSMITTER ... Watts ... Coupled Hartley.

AERIAL ... Wire Semi-vertical 60 ft. hi. ... ft. long.

C'POISE. ... fan 10 ... 60 ft. long.

REMARKS ... power record. think that's lowest power across Pacific ur sigs were fading lot, but didn't drop off much when u changed tubes. hope test agn soon with u. will be reducing pwr myself next time.

QRK 2AT? PSE. QSL. 73's fm ... Owner Operator.

"BUSINESS CARDS" OF TWO AUSTRALIAN AMATEURS

Sent to Colonel Foster after his station C9CK was heard in Australia. The initial "A" before the call signs means that the station concerned is in Australia, just as the "C" used with Colonel Foster's call means that his station is in Canada. United States amateurs use "U" as identification. The practise is necessary because the air is full of signals from amateurs all over the world. Note that A2TM says "I think that that's lowest power record across the Pacific. Your signals were fading a lot, but did not drop off much when you changed tubes. I hope to test again with you soon. Will try reducing power myself next time" with an Australian station from Vancouver Island, using a 201-A receiving tube, is a notable achievement, but not a record. Other amateurs have surpassed this performance, and while naturally elated at his success, Colonel Foster was conscious that there was danger of his lapsing into the role of the joyous ham experiencing a major thrill instead of maintaining the attitude of a cold-blooded observer; for after all this might prove to be freak transmission. To settle this point, he and 5 BG arranged a daily schedule, the idea being, that if they could repeat the performance day after day, it would establish beyond any doubt that there was nothing freakish about it. The maintaining of that schedule is one of the outstanding points of amateur radio history, for they kept it up for fourteen days without a break, through all kinds of interference from other stations and static, under conditions not considered favorable for transmission and reception. And the daily schedule was finally discontinued, not because communication became impossible, but because they had demonstrated conclusively that reliable two-way communication could be established and maintained with extremely small power.

THE AMATEUR: CURIOUS MIXTURE

AMATEUR call letters consist of a numeral followed by two or more letters. This was all very well for a while, but of late, international communication has become such an everday occurrence, that it has become necessary to adopt some means of separating the nations of the earth! It is customary to precede the regular call letters with an initial, designating the country in which the station is located. For example: U 6 HM is station 6 HM in the United States. C 9 CK is in Canada; A stands for Australia, Z for New Zealand, etc. This old earth of ours is rapidly getting too small to hold the amateur!

The fourteen day schedule with Kauper reveals the many-sided nature of the ham. He is interested in his work, and takes it seriously, but not too seriously. He is human, just like the rest of us, and enjoys a joke as well as anybody. In fact, the amateurs have coined a word which is used to indicate the appreciation of a joke, or to call attention to what is considered a joke. Like most of the words in ham language, it is short, for it must be remembered that all communications are spelled out, letter by letter, and short words are at a premium. This particular word is "Hi." Freely translated, it means, "That's a hot one! Consider me laughing. Ha! Ha!" Or, in case the sender interjects a "Hi" into a sentence, it means, "That's a joke—you are supposed to laugh now."

They have a lot of fun, these hams, in the pursuit of their labors. There is no formality about them. Everybody is OM—old man. Log sheets of amateur stations fairly bristle with OM's and other abbreviations which are as useful and effective as they are curious. Here is the way it goes. This is A 2 TM talking to C 9 CK at 6:15 A.M. August 13.

> Only last part OM—missed QRA (your location) again OM—say OM, send V's after call till I get you best then QRA please—think about record for low power OM—congratulations OM, very fine business—want get your QRA OM please try again.

Six "old mans" in one short message! That's ham language.

The intimate side of the relations between amateurs is revealed in this message from Foster, commenting on his intercourse with Kauper, A 5 BG.

> Our times are, of course, widely apart. Kauper takes in an evening movie show, then goes to his "shack" as every ham fondly terms his little sanctum, the privacy of which must never be invaded by the uninitiated without special invitation—to listen for C 9 CK. Day before yesterday he asked "Just what is your time now," and added "Ours is 11:25 P.M., August 27th". I replied, "5:55 A.M., August 28th." Next time he came back he said "Thanks for time. Hi."

Such conversations flashed back and forth across the vast expanse of the Pacific bring out many intimate touches like that. The daily habit of going to the movies; the fact that Kauper is married and that his wife sometimes objects to his sitting at the key so late at night; and many others. And all this with a man more than nine thousand miles away, but who, thanks to radio, is also your next door neighbor. That's the kind of associations formed by amateurs. No wonder the ranks are filling up with newcomers.

One of the first things Colonel Foster told Kauper was that his little transmitter was being run by B batteries, such as are used for reception, because that was one of the unusual features of the installation. Kauper appreciated the significance of the use of batteries, and made frequent comments on it. Several times, when the going got too hard for him he said "Can read, but can't you stick a few more B batteries on her?" One day, when the signals arriving in South Australia were exceptionally loud and clear, Kauper said "Say OM, you must own a couple of B battery companies, Hi."

This kind of thing kept up for two solid weeks. The original plan was to keep the schedule for only one week, but the going was so good that they hung on for another week. Colonel Foster is convinced they could have kept it up indefinitely. Even after the schedule was completed, he and Kauper chatted back and forth every now and then, apparently enjoying the freedom from their self-imposed task.

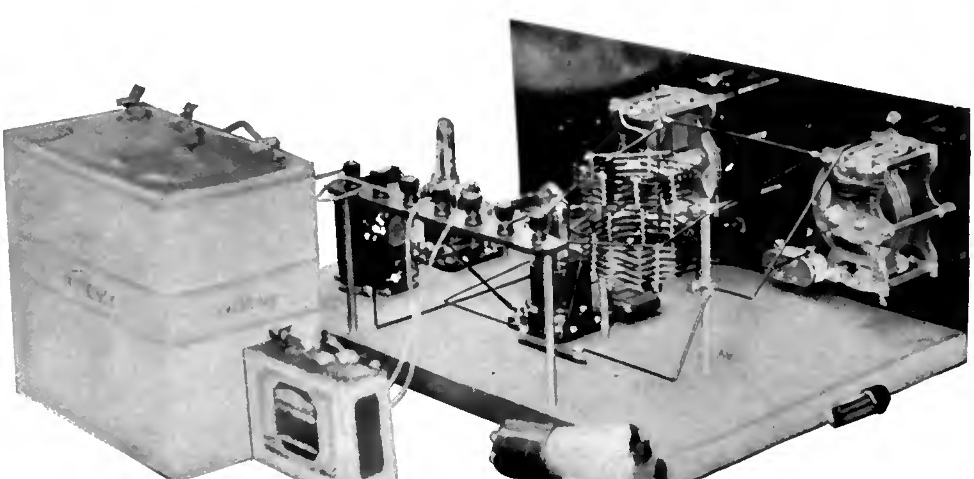
TRANSMITTER COST VERY LOW

IT IS hard to realize that this vast distance was bridged with a little transmitter that any one with a little knowledge of the subject can build at a total outlay of not to exceed $50.00. That's the wonderful part of it. This low power, long distance transmitting is not a rich man's game—it is within the practical reach of all. And in the amateur ranks, there is room for all. They welcome the new comer with open arms, and go to unbelievable lengths to help him get started right.

Colonel Foster, like all hams, has his facetious moments. Commenting on the performance of the 201-A tube in his transmitter, he said:

> In all fairness I should make the confession that this particular 201-A tube is not an ordinary 201-A. It was especially prepared for this job. It spent eighteen months as an oscillator in a broadcast super; then it worked for a while as a detector in a receiver built solely for very short waves. In this way it gained a lot of experience as an oscillator so of course it knew its business when it entered the transmitting field.

Colonel Foster is thoroughly convinced of the value of using B batteries with low power transmitters. In his enthusiasm over this form of power supply, he is doing all he can to get other amateurs to duplicate his apparatus, batteries and all, for he is convinced that with any other kind of power supply he



THE SHORT WAVE RECEIVER

Which is not much larger than a B battery. A receiving 201A tube, used as a transmitter is on the table, near a "peanut" tube used in the receiver would never have made the fine record of keeping a two weeks daily schedule with Kauper, away down yonder on the under side of the world.

Writing about his plans for the winter at Carmel, he said:

"I'm going to keep on using dry cell B batteries for this work even if I have to give up a hundred dollars apiece for them"

That was written after five months grilling had only partially exhausted the B batteries he took with him to Vancouver. They are now reposing in a warehouse in Port Alberni, waiting for next summer's work.

He takes none of the credit of his accomplishment to himself but distributes it impartially between the batteries and the amateurs who helped him out—typical of the generous spirit of hamdom. His letters are full of praise for Kauper and the way he hung on through the schedule. He goes on to say of his Australian friend:

"Am simply lost in admiration of that chap. Just think of the courage displayed in asking for a report that of necessity must be more or less complicated, and knowing that it must come back to him in a thin, high, bird-like note that must take a mighty fine pair of ears to hear at that distance. Only one thing in his favor—C9 CK's note is *absolutely* steady. It has been so reported all over the map. This is due partly to the set and the way it is adjusted, but more to the fact that both filament and plate supply are from batteries."

And again:

Kauper is a wonderful chap. It is obvious that he is keenly alive to the fact that in keeping this daily schedule under actual working conditions Australian amateur station 5 BG and Canadian amateur station 9 CK are helping to make radio history.

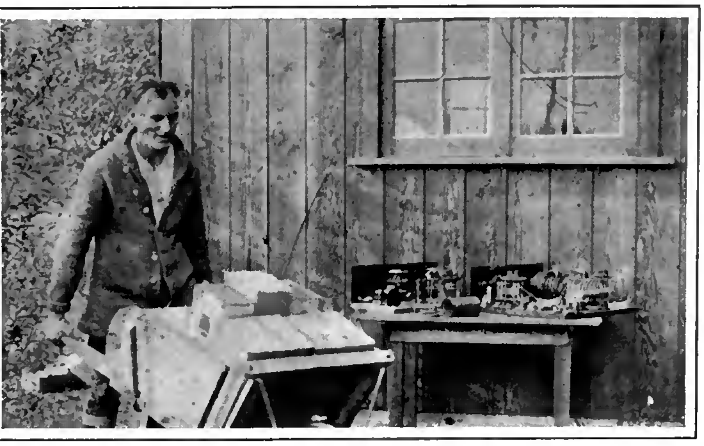
Once, after recounting in detail all the messages flashed back and forth across the Pacific in one of their scheduled communications, Colonel Foster burst out with:

"There's a game boy for you! That's the kind of stuff that has sent the amateurs ahead so fast in this new and marvelous short-wave field that the commercial interests, professionals, and high-brows can only plod along behind in the dust and pick up what the amateurs let drop."

And that's a typical amateur attitude too. But pardonable.

Enthusiastic as he is over past amateur performances, Colonel Foster is even more enthusiastic over the future possibilities. And the more amateurs there are testing away and experimenting with new things, the sooner his dream will come true. It isn't an expensive game—quite the reverse, especially in the short-wave, low power field. And in the opinion of many, that is the field where the greatest radio progress is to be made in the next few years. The ease with which one can embark on this fascinating, thrilling enterprise of radio transmission will doubtless be responsible for hosts of new recruits into the amateur fraternity.

Colonel Foster's comments on the future of amateur radio are timely and pertinent.

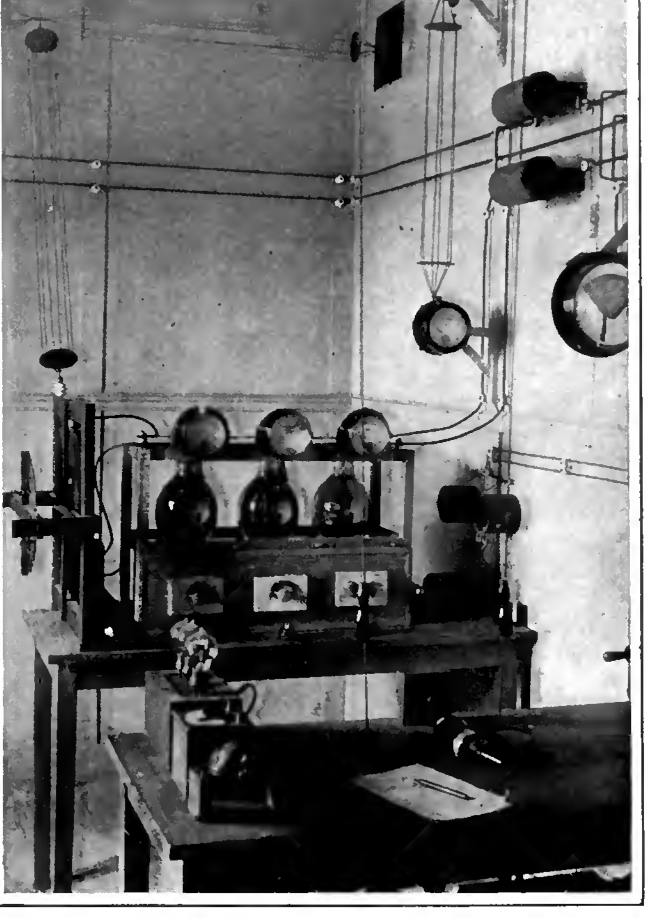


BREAKING CAMP AT 9CK

As Harry Lyman started away from the radio shack, he remarked, "Well, here goes C9CK's famous QSB", Which meant C9CK's high, penetrating, flute-like note

"I feel that in these experiences of mine there is really a big story. You know me well enough to know that I don't mean big because I did it. It is big because the infant art of radio did it, and is continuing to do it. It is big because of the far-reaching possibilities it discloses for the human good. Not theorizing as to the probability of long distance communication with extremely low power, but proving the practicability of it by doing it day after day. Unlike the automobile, heralded as the greatest promoter of human progress, radio can never be used to the great advancement of the bank robber, gunman, and bootlegger. And just look at the future possibilities, certainties of this inexpensive low power stuff as a promotor of peace among the peoples of the earth. Why, with all the warm friendships that are being born every day among the radio amateurs of one country with those of another, it will soon be all a politician's life is worth to say, "Let's start something." Just fancy some big stuffed shirt's telling me to go out and fight young Kauper!

And that, mind you, was written by a reserve officer.



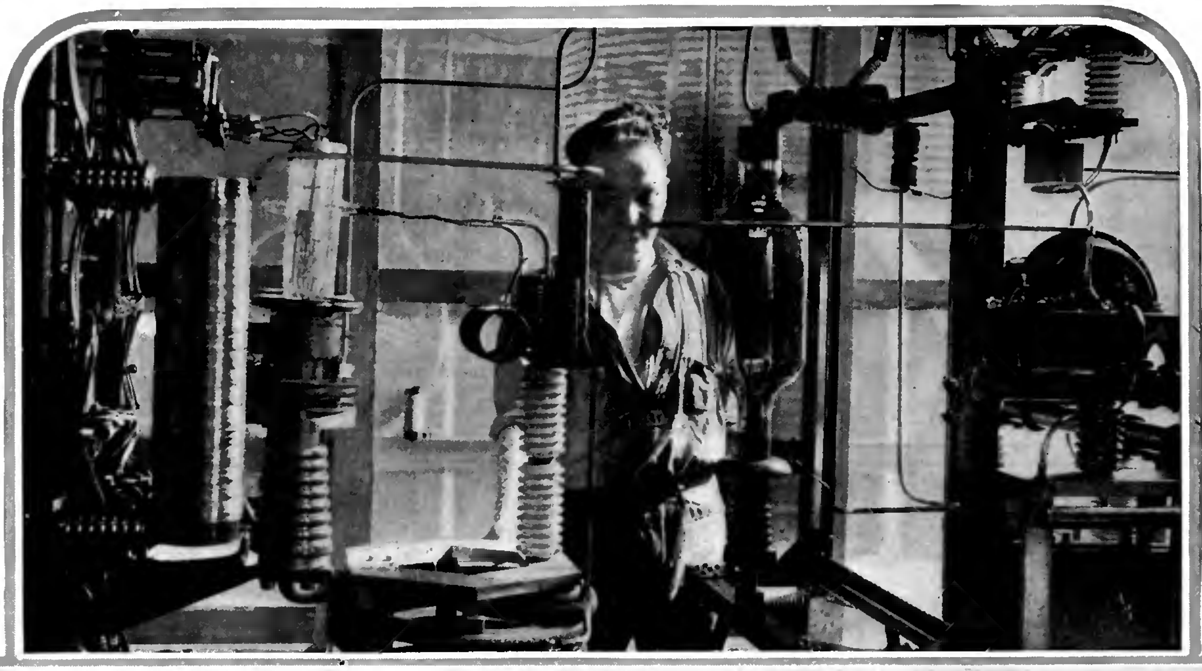
A 500-WATT AMATEUR STATION

Owned by *La T. S. F. Moderne*, a French radio magazine. This might almost be dubbed a superpower station when compared to the "midget" transmitter used so successfully by Colonel Foster

Since the completion of the summer's adventure on Vancouver Island and the termination of correspondence regarding it, Colonel Foster has paid us a visit here in the East. He is as sunny, as breezy, as enthusiastic in person as one would imagine him to be from his letters. A most pleasant, human and companionable man.

He has retired from active participation in all business and is pursuing the radio transmission game as a hobby. Unlike many hobbies, his is useful, not only to himself, but to others. And he is not a one-sided man, as are many hobby riders. He can discourse entertainingly on any subject proposed, for he has led an active life, full of many and varied experiences. He has a wealth of good stories, and he tells them with a merry twinkle in his eye that belies his years.

He has worked hard, borne heavy responsibilities, achieved much; and now, after a useful and successful business career he is really enjoying life—thanks to radio. Colonel Foster represents just one type of man to whom amateur radio has appealed and lifted to a higher plane of enjoyment of life, and what it has done for him, it will do for any one, young or old, who seriously takes up this new and fascinating game.



THE MARCH OF RADIO

By J. H. Morecroft

Past President, Institute of Radio Engineers

Additional Opinions About the Naval Radio Service

OUR comments regarding the Naval Radio Service in the December RADIO BROADCAST brought forth some letters from our readers which deserve presentation with at least as much emphasis as that used in giving our own ideas. Elsewhere in this issue there is printed a communication from Mr. H. A. Halcomb, who was in the radio service at the time when our destroyer squadron went aground on the California coast. He enjoys the distinction of "knowing" that radio was not at fault in this accident, as his log was used in the investigation. Evidently then Mr. Halcomb knows that the radio bearings received by the fleet were correct—and still the fleet ran aground! Does this mean that the radio bearings were considered of so little importance by the navigating officer that he preferred to cruise by dead reckoning? Had the radio compass service proved of so little reliability in the past that a navigator at that time preferred to depend upon his judgment of the effects of currents, winds, etc., rather than plot his position on a chart in accordance with the radio signal? If so (and we can see no other way to reconcile the event with Mr. Halcomb's statements), hadn't radio failed to function properly, to lead up to such a catastrophe? The spirit in which our comments were made was a friendly one, and not one of cynical criticism. We were attempting to answer the question—is radio doing as much for our Navy as it is capable? If not, conditions should be changed either by increasing the reliability and utility of the radio service or in educating the personnel properly to appreciate its worth.

Another letter taking us to task for the article comes from Mr. C. J. Pannill, vice-president of the Independent Wireless Telegraph Company. Mr. Pannill says:

> An article of this kind may do the Naval Communication Service considerable harm, and it is only fair to ask that Professor Morecroft get in touch with the proper authorities in the Navy Department and set the public right through the publication in RADIO BROADCAST of a correction to his article mentioned. My idea in taking this matter up with you is due to my particular interest in the Naval Communication Service, since I had a good deal to do with laying the foundations of the service during the time I served in the Navy.

Now it is just possible that pointing out the way in which radio has not proved itself may do the Naval Communication Service more good than could be accomplished by the method suggested by Mr. Pannill. If misstatements were made, we shall be the first to apologize and retract them, but in spite of some of Mr. Pannill's remarks, it is not evident that our criticisms were in error. The circumstance which brought forth our comments was the dismal failure of radio communication in the *PN-9 No. 1* near-disaster. Referring to the U. S. S. *Honda* affair and the *PN-9 No. 1* failures, Mr. Pannill says that "they are not chargeable to any one branch of the Navy or its organization. These failures may have been the fault of the Navy but the reasons assigned were not sound and were evidently written without adequate knowledge of the facts."

It so happens that as Mr. Pannill's letter came to hand, we were reading further evidence on the *PN-9 No. 1* inquiry and found that "Lt. Byron J. Connell, pilot of the *PN-9 No. 1* said that he was satisfied the *PN-9 No. 1* failed to locate the *Aroostook*, the last of the station boats on the Hawaiian flight, because the radio bearings received were in error. The plane followed the bearings given and landed in the sea to remain there for nine days." In the same hearing, Commander Rodgers said that the

The photograph in the heading above shows one view of the 20-kw. vacuum tube transmitter at the Naval station, NAA, at Arlington Virginia. Note the water-cooled tube. (© Harris & Ewing) failure to reach the *Aroostook* was "due to confusion of radio bearings and possibly an error in navigation."

In contradistinction to the two letters mentioned above, attempting to "soft pedal" radio's performance in the two instances named, the Navy itself sent us a most courteous inqury for suggestions as to what constructive criticism we could offer.

As Mr. Halcomb says, it is easy to sit back and criticize what others have done but how to do better? Well, in the interest of radio progress, we insist again that the *PN-9 No. 1* should have had an emergency radio outfit. Too much weight? Then leave one of the men at home and make the rest of the crew work a little harder. Better have eight overworked men arrive at their destination than nine men somewhat less fatigued drifting helplessly toward Japan.

Unless one has looked at a map of the Pacific in the vicinity of this near-disaster he cannot realize how closely this crew came to perishing. It is almost an accident that they happened to drift into an island. Had the direction of wind changed a little they would probably have drifted clear into the Pacific—forever.

Shouldn't there have been some radio outfit aboard which would keep them in touch with their supply ship when they were forced down? It is doubtful if any sensible man to-day would differ with us.

If such a flight as that to Hawaii is so close to the impossible that even the added weight of an emergency radio outfit would spell failure then it should not be attempted. The Navy is not supplied with so many capable airmen that it can afford to take again chances as it took in that flight. Those responsible for such projects as was attempted by the *PN-9 No. 1* will never be told by their junior officers that the chances of success are too slim to make the scheme worth while—our officers are not of that mind. It remains, therefore. for some rank outsider, such as ourselves, to venture the statement that possibly things should have been done differently.

The Progress of Radio in 1925

PROBABLY the one event standing out more than any other during the year 1925 in so far as the interests of the general listener are concerned, was the spirit in which the questions arising at the National Radio Conference were settled. While the conference could not give Secretary Hoover any power to act, it brought to him so strongly the sentiment of the country on certain of radio's problems that he has been able to act since then with the assurance that the radio public was behind him. It is notable that for some weeks now, not a single broadcast license has been issued. It is hoped that this condition will continue.

All questions arising in the broadcasting realm, said the radio conferees, must be settled in the interests of the broadcast listeners and the establishment of this policy for the guidance of future radio executives will prove to be a real boon to all of us. Any sensitive set to-day gives heterodyne notes in many of the radio channels which are supposed to be without interference and this situation can be remedied only by keeping constantly in mind the policy that the interest of the listener, rather than that of the broadcaster, must prevail. Many of our present stations must soon be eliminated, and this event was certainly predicted by the spirit of the radio conference.

The great attempt being made to furnish the public with a satisfactory battery eliminator is perhaps the next outstanding feature of the radio season just passed. Not yet successful enough to call the problem solved, yet near enough to make us believe that the real solution is at hand, the work of those radio engineers engaged on this problem is probably of more present significance to the broadcast listeners than any other. Of course, as the battery interests maintain, there are many places where 110 volts a. c. cannot furnish power for the radio outfit because there are many houses which do not have it. The number of such homes is rapidly diminishing so that it may truthfully be said that the battery eliminator (for both A and B supplies) is awaited to-day by millions of listeners.

The remarkable popularity of the straight line frequency condenser shows that there was a real demand for such a piece of apparatus. First introduced about two years ago, it has, during the past year, shown itself so valuable that the old semi-circular plate condenser has today a limited sale. The innovation of this specially formed condenser, spreading out the stations on the lower part of the dial, was a decided help to the broadcast listeners.

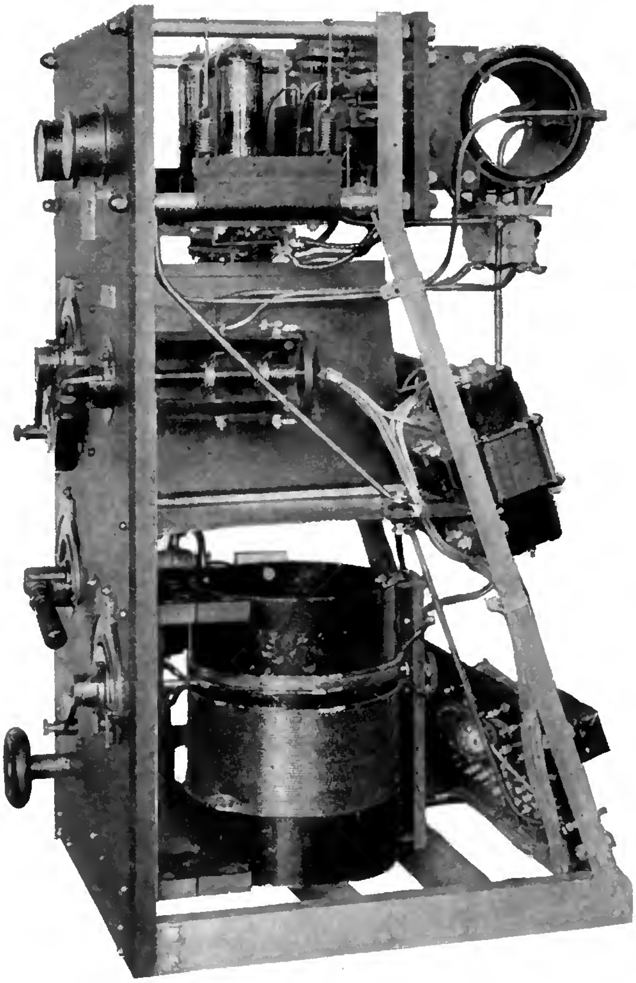
The use of the piezo-electric crystal as a frequency stabilizer will soon be looked back upon as one of the milestones in the improvement of radio transmission. With the present spacing of stations on the frequency scale, some standardization scheme is absolutely necessary and the curiously acting bits of quartz crystal which serve to make a small tube oscillate at an exact and constant frequency, are accomplishing this purpose admirably. Rochelle salt is about one hundred times as active a crystal as is quartz and would probably serve the purpose even better if it were not so fragile, and soluble in water. Piezo-electrically a wonderful material, it is mechanically so inferior to the durable and constant quartz, that the latter will undoubtedly soon be fixing the frequency of all our important broadcasting stations.

Picture transmission by radio secured a large amount of attention during the past year, but so far has become commercially important over only one or two channels. It is sure to develop into a service of immense importance (with the possibility of doing away altogether with our dash and dot communication system) but much development work remains to be done before that is accomplished.

The quality of reception in the average receiving set was much improved during the past year. Great improvements were made in the characteristics of tubes to operate with loud speakers, by the research engineers of the General Electric Company, and several fundamental and important

A CORNER IN THE RADIO CABIN OF A NEW ITALIAN LINER

The *Conte Biancamano*, which is said to be the largest liner flying the Italian flag. The installation is quite modern. A 500-watt tube transmitter for telegraphy can be seen in the right hand corner. Note the position of the transmitting key, just a few inches from the edge of the operating table. This position would be almost an impossible one for an American operator, as practically all of the operators trained here use a sending motion which rests the entire arm on the table



ONE OF THE RADIO DEVELOPMENTS OF 1925

A beautifully compact vacuum tube commercial transmitter with a power of two hundred watts. This outfit has a wave-length range of 600 to 900 meters and is especially designed for radio telegraphy aboard ships

studies of the characteristics of loud speakers themselves were reported to our engineering societies. To some extent keeping pace with the improved quality of reception of the average receiving set, the programs themselves may in general be considered as somewhat better than last year. Most notable among the year's accomplishments in this direction is the series of Atwater-Kent Musical Hours. Not less pleasing, even if less important, are several series of concerts by certain of our well-known trios and ensembles. The "Dinner-Hour" music is a real treat for the average suburbanite, who gets the benefit of good music with his meals without the disadvantage of a cover charge. As one turns from station to station, however, at about eleven o'clock in the evening, he is impressed with the concentration of jazz. It is hard to believe that there really is a demand for the concoctions the average dance orchestra sends out over the midnight radio channels.

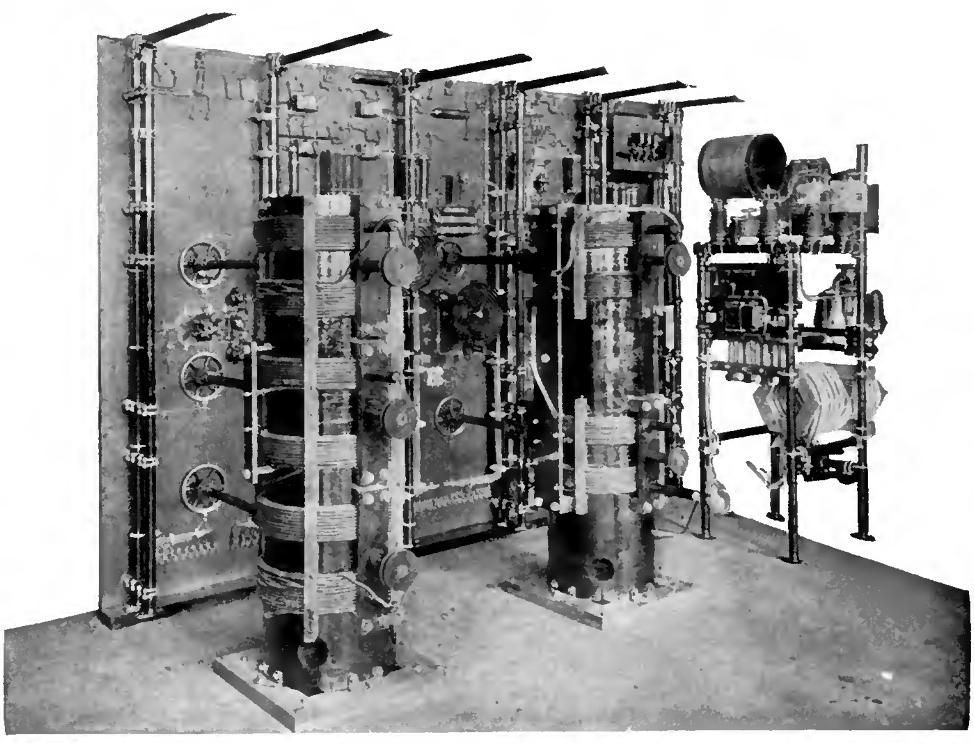
With the advent of two 50-kilowatt stations, WGY and WJZ, the era of international broadcasting seems ready to start. The rebroadcasts which have occurred to date, of programs flung across the Atlantic, haven't been worth while except as a "stunt." But by raising the signal strength ten times or more, the static disturbance may become comparatively unimportant. In general, these high powers have not caused as much disturbance as had been anticipated; those close by (within a few miles) have no doubt been well deluged with the energy of these powerful stations, but by using proper traps to bypass most of their signals, much of the present trouble will disappear. A proper policy for a super-power station to adopt would be to start operation on very low power and gradually to increase the radiation, taking perhaps three months to grow to their normal rated strength. This method of procedure would do away with much of the complaint as the near-by listeners would gradually become accustomed to methods and apparatus for eliminating these powerful signals.

The feeling against the regenerative receiver has steadily grown until the listener is almost ashamed today to acknowledge the ownership of such a set. The man known to operate such a receiver is at once blamed by his neighbors for all the howls they hear and the continued cultivation of this attitude, by those owning non-radiating receivers, will do much to hasten the demise of this undesired member of the receiver family.

A most remarkable study of wave interference and signal distortion was reported during the past winter and it seemed to the writer that Bown, Martin, and Potter, the research engineers responsible for this work, were laying out for themselves a unique problem on which they will probably work alone. It is likely that these engineers will do this work so well that the field becomes theirs and we shall look entirely to them for explanations of transmission phenomena.

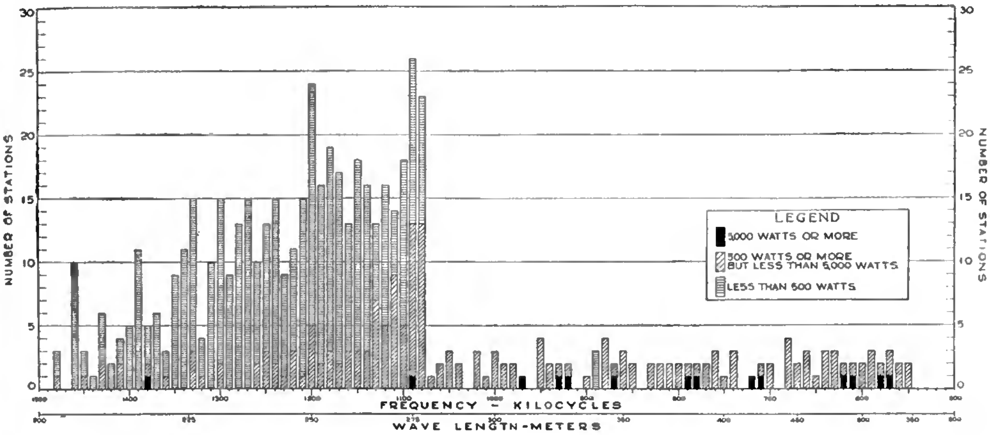
In the patent situation, the granting of the high vacuum invention to Langmuir stands out as the one event of the year. Continued and expensive litigation along other lines points out the entire inadequacy of our present patent scheme. It seems nowadays that the granting of a patent has scarcely more significance than a license to sue others. The overworked staff of our Patent Office is so loaded up that frequently five years or more are required for a patent to be issued. Secretary Hoover may be able to arrange some new method of procedure so that much of the wrangling, which now takes place before a court after the patent is issued, might be heard before the patent is granted, so that the patent is really of some value to the inventor; at present it is worth practically nothing unless he is backed by some powerful corporation.

The year has seen a growing appreciation of the value of scientific research—not the research having as its goal a new receiving set, or more economical triode, but research in the realm of pure science, the kind undertaken to determine the truths of an unsolved problem. Not only has the work of the pure scientist received increasing recognition, but from the highest sources, words of appreciation have been showered upon him.



THE CONTROL PANEL OF A FORTY-KW. TUBE TRANSMITTER

Built by the General Electric Company for use in the station at Kahuku, Hawaii. This transmitter when installed will continue the radio link now in force between Hawaii and California. Another similar radio station competes with the cables to Japan and links Hawaii with Tokio



THE DISTRIBUTION OF BROADCASTING STATIONS IN THE UNITED STATES

On the first of November, 1925. This chart was officially compiled for the Department of Commerce. Note how comparatively few stations there are operating with a power of more than 5 kilowatts. Since the Fourth National Radio Conference, the number of stations has not increased. There are now 536 broadcast stations to supply aërial provender for the estimated four and a half million radio receivers

In a recent talk before the Society of Mechanical Engineers, Secretary Hoover expressed the opinion that Michael Faraday's discoveries were of such value as to "perform for us in one day more service than the whole banking community does in a year." Yet Faraday never received more than five hundred dollars a year, whereas the bank executive to-day never feels himself overpaid with a $50,000 salary. Yet even now so little do we appreciate men with the Faraday point of view, that we spend for research and pure science only one tenth of what we spend for cosmetics. For every dollar the scientist spends to discover the truth, the women of the land spend ten to conceal it. But when such men as Mr. Hoover bring their influence to back up research in pure science then we are well started to fill the position in the world's scientific progress which our country is evidently destined to occupy.

A Note on the Langmuir Patent

A SHORT time ago we made a comment on the "high vacuum patent" which was issued to Langmuir, expressing our idea that Langmuir had not invented anything and that the issuance of the patent was a mistake on the part of the Patent Office. We are in receipt of a letter from Mr. F. S. McCullough, who has been associated with vacuum tube manufacture for many years, in which he agrees heartily with the ideas we expressed. This tube engineer has some old DeForest audions in his possession, he says, which show a higher vacuum than do the present Radio Corporation tubes. As long as facts such as these can be certified to by reputable engineers it is incomprehensible that the Court should sustain the Langmuir patent.

More Millions for Radio

IT SEEMS that some ambitious attorneys have persuaded R. A. Fessenden (well-known for his submarine signalling apparatus and patents on the radio heterodyne principle) that he has been grossly swindled by some sort of monopolistic control in the radio industry and that by due legal process he might collect as damages $60,000,000. It is very interesting to a college professor, with his rather modest income, to see how some of these radio inventors do juggle with millions. Their smallest unit of money seems to be about $100,000, and to judge from the rumors extant, some of them have collected many units.

Fessenden really has been a very prolific worker in the radio field, one of his ideas, for example, being covered by the heterodyne patent. To hear a high-frequency current it must be combined with another current of nearly the same frequency, to produce beats. The first alternator of the type now credited to Alexanderson was built by Fessenden. He now claims that eight of the principal concerns dealing in radio have conspired to do him out of his just rewards and have not offered him a fair value for his invention. The attorneys' claims sound rather flimsy to us, but possibly the men who drew them up feel that there is some chance of collecting a little money for their client.

Who Invented the New Photo-Electric Cell?

IN THE same mail that brought criticism of our naval radio article came a letter from Mr. T. H. Nakken, criticizing our comments on the photo-electric cell which accomplished such remarkable effects at the recent electrical show. The new type of photo-electric cell was shown by Mr. Zworykin, of the research staff of the Westinghouse Company That company claimed the invention was theirs. Mr. Nakken informs us, however, that he patented this device several years ago and that full publication was made in England and France three years ago. "This," according to Mr. Nakken, "made it comparatively easy for the Westinghouse Company to invent the device."

So, with the aim of being fair, we cannot do less than publish Mr. Nakken's claim to this novel piece of apparatus. His patent in the United States was issued about a year ago, but was filed over five years ago. It may be that Mr. Zworykin has added something to Nakken's ideas, but on such a controversial point we can hardly enter in these columns.

Broadcast Listeners Organize

IN THE Middle West, the broadcast listeners have found it to their advantage to organize in order to improve the conditions under which they receive their programs. One such organization, the Broadcast Listeners Association of Indianapolis, reports an extensive program with the purpose of eliminating interference of all sorts. After only a short existence, the membership list has expanded to twelve hundred and the activities become quite diversified. The small membership fee proves sufficient to carry on what paid work appears necessary; certain trouble locating apparatus has been purchased and is regularly used by some of the members in finding out the reasons for poor reception.

According to a report recently released, meetings are held regularly, at which radio engineers generally give talks on interfer-

RADIO PRINCIPLES AT WORK IN THE POWER HOUSE

The so-called "storm detector" used in the power house of the Brooklyn Edison Company at Gold Street. The principle of the device is merely a simple application of the detection of static charges, which is ingeniously employed to ring a bell. With a warning of approaching storms, the power companies can prepare for the increased load that the darkness will cause ence causes and their prevention; from three hundred to five hundred people have attended these meetings. A campaign against the single-circuit regenerative receiver is being constantly waged, while for those who still prefer to use this type of receiver, an educational series of talks on the proper and legitimate use of regeneration has been carried out.

A remarkable degree of coöperation has been secured from the public utility companies in Indianapolis and vicinity. A typical letter, from the superintendent of the Indianapolis Street Railway Company says: "This company stands ready to coöperate with the Broadcast Listeners Association at all times and will remedy any condition of its tracks or cars that might interfere with radio reception. We have already cleared up several bad spots that have been complained of by radio users." The telephone company and the electric power companies have similarly expressed their desire to remedy conditions which are pointed out by the Listeners Association as being detrimental to good radio reception. This association, it appears, is accomplishing a really valuable work for the listeners in Indiana.

The Month In Radio

THE annual report of the Chief Signal Officer brings to light the fact that the army is now regularly using radio channels to carry on its routine business. A net of radio stations all over the country has been built up, the network comprising twelve major stations and sixty auxiliary ones. About eight hundred messages are handled each day over this network. In requesting more appropriation for development, General Saltzman states that if the communication which was effected through his radio chain had been handled by commercial channels it would have cost the government $156,000. It is just possible that it actually cost the government more than that if the proper charges were made, but even so the radio chain is a valuable asset to our country, one that the Army should have available for emergencies in any case, even though it could show no saving at all.

FEW of us know enough about automobiles to care thoroughly for them ourselves; we depend largely upon the service man for inspection or repairs. Without the country-wide service of this character it is sure the automobile industry would not have grown as it has.

Now, in a lesser degree probably, the radio receiving sets of our country need the service man. But few of the listeners know the functions of the different parts of a set, but they would like to know that they are functioning properly. The "radio service man" is due to arrive. A group of repair and maintenance men, thoroughly familiar with all ordinary types of receivers, could build up quite a clientele in almost any sizable town, we imagine. They must know the different sets and what they are capable of and how to remedy faults. It seems as though quite a lucrative business might be built up along this line and we expect to see someone do it.

As is frequently mentioned, the way of the inventor is long and tedious and he never knows whether his idea is safely his own or not. A case in point has to do with the modulation of the output of a vacuum tube oscillator. This scheme is used in every broadcasting station today. In spite of its universal application, no patent has yet been granted. White, of the General Electric Company, Hartley of the Bell Laboratories, and De Forest have been in a three-cornered argument for about eight years. After going through the normal Patent Office routine, the case went to the Examiner of Interferences, who gave De Forest priority. The Board of Examiners in Chief was then appealed to by White and Hartley and this board reversed the interference examiners' verdict and gave the idea to Hartley. Then De Forest and White appealed the case to the United States Court of Appeals and only now have the arguments before this court just been completed.

Even an older matter apparently still has to be settled. The Court of Appeals of the District of Columbia has just reversed a ruling of the Patent Office on Lévy vs. Armstrong, so that now Lévy is permitted to go ahead with interference proceedings against Armstrong, to whom the regenerative patent has already been issued. And in this same line it still remains to be settled, apparently, whether Armstrong or De Forest is entitled to the oscillating audion patent.

EACH year the work of the Bureau of Standards is inspected and reported upon by a Visiting Committee, made up of men not connected in any way with the Bureau but all of whom are closely in touch with the needs of our country as regards development and research. After commenting upon the great value to our country shown by the results of the Bureau workers (the report states that the automobile industry is saving $155,000,000 a year as a result of Bureau studies) the committee emphasizes the great value of basic research—the kind that has no immediate apparent application.

It is the opinion of the committee that the Bureau work should tend in this direction more than it has done in the past. It is pointed out that private research laboratories are generally forced to work on certain questions having to do with special problems of the industry maintaining them and that these laboratories are not generally free to publish their researches. The Bureau of Standards, on the other hand, is maintained by the government for the good of all industries and so can most suitably attack those apparently unremunerative problems out of the results of which industry generally reaps rich rewards.

A. ATWATER KENT

Philadelphia; Radio Manufacturer

"Improved programs, I believe, will feature 1926 broadcasting to an even greater extent than was true in 1925. As a result of the Sunday night programs by world famous artists, that I was fortunate enough to arrange, I have found that the American public likes good music. They will get more of it during the coming year. Perhaps the two greatest fields for the development of radio in 1926, however, are its use on the farm and in education. Steps recently taken by Secretary Jardine to further radio service to farmers will prove of far reaching importance. The time will come when every schoolroom—city and country alike—will have a radio receiving set to supplement the work of the teacher in the class room. The new year will bring a big advance toward that condition."

THE past year's report of the Commissioner of Lighthouses, just received, indicates the gradually increasing importance of radio signalling to the protection of ships approaching our shores. The very first paragraph, which is a long one, deals only with the new radio installations. There are now thirteen radio fog signal stations under his direction, one of them, installed on Lake Huron during the past year, being the first of its kind to be tried out on the Great Lakes. Equipment for fifteen additional stations (all outfits of the vacuum tube type) is ordered, six for the Great Lakes, one for the Maine coast, and the rest for the Pacific. We note that one of these is for Point Arguello, the scene of the Naval destroyer catastrophe. Certain improvements in synchronizing the signals from adjacent stations have been carried out and the fog signal station on Nantucket Light has been operated during the past year for fifteen minutes out of every hour to test the efficiency of the station in giving long-distance bearings for the incoming ships. No comments are made as to whether this service has been of appreciable value.

Important as we may think the radio fog signalling to be, it is actually a very small

GEN. CHARLES MCK. SALTZMAN

Washington; Chief Signal Officer United States Army

"While the technical advance in radio broadcasting apparatus for transmission and reception during the year 1925 has been confined largely to improvement in programs and wider dissemination of those programs as a result of the use of greater power and linked up stations, there has been much development in other fields of the art, principally in long distance telegraphic communication. The most outstanding advance in this branch of radio communication has been in the development of the short wave bands, where it has been demonstrated that on certain frequencies, with an insignificant amount of power and at small cost, communication has been conducted over greater distances that had hitherto been considered only possible of accomplishment with the extremely high power, long wave stations. I predict that in the coming year we shall see many improvements and novelties in the broadcasting activities. In the commercial field and as a result of the short wave developments, we may look for some revolutionary advances in radio communication and correspondingly increased use of radio for international correspondence."

part of the total activity of this government department. For 1926 out of a total appropriation of $9,700,000, only $16,000 is allowed for radio fog signals. Of a total of 1207 fog signals, fog horns, submarine bells, whistling buoys, bell buoys, etc., only thirteen of them are radio stations.

The fog signal on the Ambrose Channel Lightship is a tube transmitter which has been operated close to the metropolitan district since April, 1924; the report comments on the fact that no complaint of interference has ever been lodged against this station. Had a spark transmitter been used, the government would have heard from a great many broadcast listeners, no doubt.

WE GENERALLY like to print reasonably accurate statements in these columns, but it seems that one slipped in a few issues back which hasn't the stamp of dependability. Mr. William Dubilier, who makes a rather good living from mica condensers, was quoted as saying that in America the radio industry has grown so rapidly that it is now equal to the automobile industry.

Mr. Sarnoff estimates the past year's radio business as $350,000,000, and he would not be inclined to understate the matter. *Motor Magazine* tells us that there was an increase in car registration in our country of 2,132,758 last year. So by combining Mr. Dubilier's statement and Mr. Sarnoff's estimate with the above figure we find that the average price of the new automobiles purchased last year was $164.30! We must conclude that Mr. Dubilier's statement was open to question.

A PUBLICATION of the Bureau of the Census, dealing with the Farm Census of New Hampshire, gives the total farms reported as 19,895, of which only 2,366 had radio outfits. Evidently there is still plenty of market for good receiving sets.

Interesting Things Said Interestingly

ALMA GLUCK (New York; former opera singer and still well known on the concert stage): "Since the time a single record netted me sufficient to buy a private house on Park Avenue, receipts from royalties have fallen off precipitously, and all because of radio. The radio is a nuisance. They are perfectly darn foolish things to have around, and, besides the squawks, most of what one hears over the radio is terrible."

HUGH S. Pocock (London, England; editor of *Wireless World*):

"Wireless is still a new industry, and the design of apparatus associated with broadcast reception is passing through a stage of evolution. The steady development which is going on is not entirely the outcome of invention, but is more probably due to the stabilizing of an industry and the establishment of an improved manufacturing organization. It may be said that the manufacturer and the wireless enthusiast have rivalled each other in an endeavor to construct equipments possessing good selectivity, an extensive receiving range, with easy manipulation and the elimination of distortion. It must be admitted that a peculiar position has existed where prospective purchasers would exercise caution and seek advice before selecting a receiving set, and exhibit a hesitancy that would indicate a lack of confidence in the manufacturer. The exhibition this year indicates that a change has come about and that the wireless trade is now taking a lead. It is now possible to select a broadcast receiving set built to a design that will not be rapidly superseded and with which the user will remain satisfied in spite of his technical interest in receiver design."

J. J. WALSH (Dublin, Ireland; Minister of Posts and Telegraphs):

"The science and practice of agriculture and horticulture will hold a prominent place in the items compromising the programs of our broadcasting stations, and it will be sedulously seen to that everything that wireless broadcasting can do will be done to inform and instruct the farming classes and to keep them in touch with current agricultural research.

Market reports, seasonable lectures, weather forecasts, etc., will be regular features of the programs.

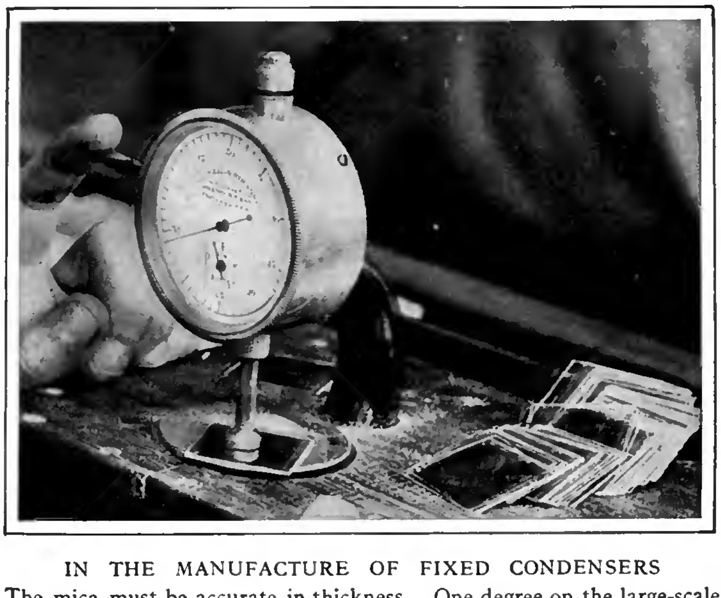
Our news service we propose to make second to none, and how much this will be appreciated by our country people will be understood when it is remembered that they are insatiable gluttons for news. Their salutations are invariably followed by '*Bhfuil aon sceul agat?*' ('Have you any news?')"

REV. DR. S. EDWARD YOUNG (New York; in a sermon delivered at the Bedford Presbyterian Church, Brooklyn):

"We should encourage broadcasting stations and broadcasters to refrain, as far as possible, from conflicting with the usual hours of church worship. Since nothing can really take the place of the assembling of God's people in God's house, the time of their assemblage ought to be protected from needless rivalry or distraction. To be commended is a great broadcasting station for not starting its tremendous entertainment at night until after the sanctuaries have closed.

DR. JOHN J. TIGERT (Washington; United States Commissioner of Education):

"The benefits of hearing the best music are so great that I have always favored making it available to the greatest number of persons possible. Arrangement of programs such as the Atwater Kent series marks the attainment of an important milestone in this direction, because it will make a vastly greater number of Americans acquainted with the best music and the best musicians.



IN THE MANUFACTURE OF FIXED CONDENSERS

The mica must be accurate in thickness. One degree on the large-scale micrometer in the photograph equals one one-thousandth of an inch

Can We Forecast Radio Reception From the Weather?

The Results of Many Experiments Seem to Show That Weather Conditions Influence Radio Reception—Some Rules for the Amateur Radio-Weather Forecaster

By J. C. JENSEN

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"CAN I forecast radio reception as the weather is forecast?" Since the publication of Professor Van Cleef's "Do Weather Conditions Influence Radio?" we have received many inquiries worded like that sentence. Many amateurs who now have radio receivers are anxious to extend their hobby, but still to maintain a distinct radio tinge to their experiments. The investigation of how radio conditions are influenced by the weather can be done with no other equipment than a good radio set and the United States Weather Bureau daily weather map. The map is printed by most newspapers or one can be put on the mailing list of the nearest Weather Bureau office for a small sum. Neither Mr. Van Cleef, or Mr. Jensen would care to say that radio conditions, that is, the strength of signals, amount of static, and the probabilities of fading can definitely be forecast. Mr. Jensen in this highly interesting article does say, however, that, knowing national weather conditions, it is possible to tell pretty definitely and accurately what conditions will be. The author will of course be glad to hear from readers who find interesting facts about the vagaries of the weather, and Mr. F. M. Herrick of the Taylor Instrument Companies, Rochester, New York, would similarly like to hear from experimenters.—THE EDITOR.

MARK TWAIN is credited with the remark that although everyone talks about the weather, no one does anything about it. Thirty years ago when bicycle riding was all the rage among the young people, many a joy ride of twenty miles over country roads was suddenly turned into a weary tramp through the mud when an unfriendly thunderstorm got into action in mid-afternoon. Not long ago the newspapers carried accounts of automobile tourists who were marooned on the top of Pike's Peak by an early snowstorm, and of the loss of our famous dirigible, the *Shenandoah*, in an Ohio windstorm. It would be unreasonable to expect that radio, the latest "indoor sport," should be an exception and escape without any handicaps resulting from weather conditions. Radio reception has the advantage, however, that when J. Pluvius makes its use impracticable, the operator suffers no further inconvenience than the necessity of turning to the trusty phonograph or the piano for his entertainment.

The variations in radio reception may be grouped under three heads:

1. Irregularities in signal strength which persist for hours or even days at a time, resulting in clear reception from a given station on one evening and faint or inaudible response on the next. Such fluctuations are spoken of as changes in audibility.
2. Sharp, noisy, crackling sounds are called "Static."
3. A short period variation in signal intensity, the usual interval from one point of high audibility to the next being from three to five minutes. This is called "fading."

While we may not be able to "do anything about it," our purpose in what follows is to connect these three phenomena up with weather conditions.

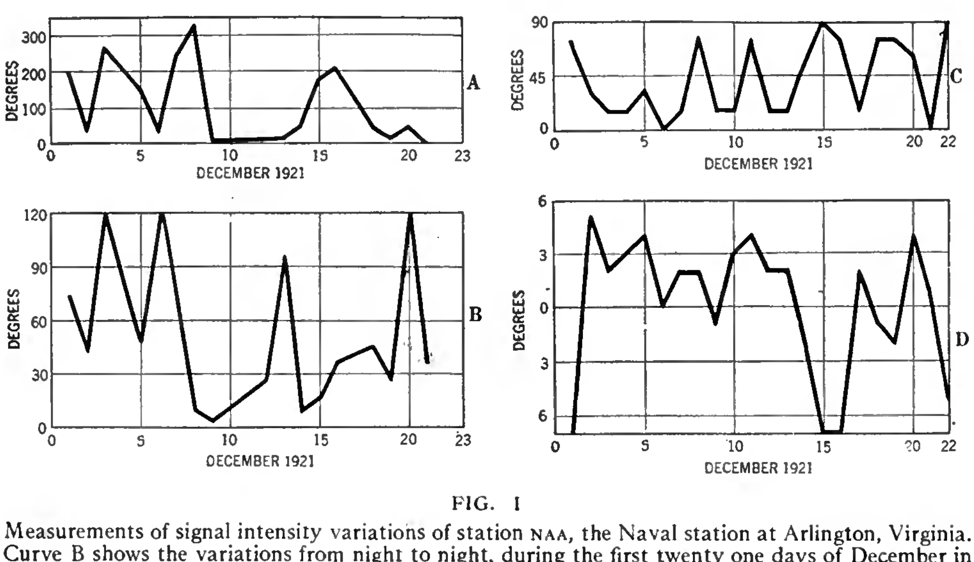


FIG. I

Measurements of signal intensity variations of station NAA, the Naval station at Arlington, Virginia. Curve B shows the variations from night to night, during the first twenty one days of December in 1921. Note that, in B, on December 3rd, NAA's signals were 120 turns audible, while they were only four times audible on the 9th. Curve A indicates the static audibility for the same nights

RESULTS OBTAINED BY OTHER EXPERIMENTERS

ATTEMPTS to explain the variations in radio receiving conditions have been made constantly since the very beginnings of wireless transmission, but the tremendous increase in the number of persons owning receiving apparatus since the advent of broadcasting has resulted in a much more general interest in all problems affecting clearness and regularity of reception. Space will permit the mention of only a few of the most important of these experiments.

Dr. L. W. Austin of the United States Bureau of Standards has been engaged for several years in recording the signal strength of high-power, long-wave commercial stations such as Nauen in Germany and LaFayette in France. His reports show that transmitting conditions are more favorable at night than in the daytime and in winter than in summer. The amount of static disturbance varies greatly from day to day and is worst in the summer months. During the years 1920 and 1921, the American Radio Relay League in coöperation with the Bureau of Standards conducted an extensive series of investigations in which amateurs used their receiving sets to determine the audibility of signals under various weather conditions. They found that stronger signals were obtained when the radio waves from transmitter to receiver pass parallel to the isobars than when they move at right angles to them. [An isobar is an imaginary line connecting or marking places on the earth's surface where the barometric height, reduced to the sea level, is the same at a given time for a certain period.] It was found that stormy weather at the transmitting station does not affect the range or strength of the signals and that an area of clear weather connecting both stations results in less fading. Cloudy weather at the receiving station resulted in much more static than did clear weather. Our British cousins have recently completed a similar investigation and report conclusions in general agreement with those already given. They also found that the nature of the earth's

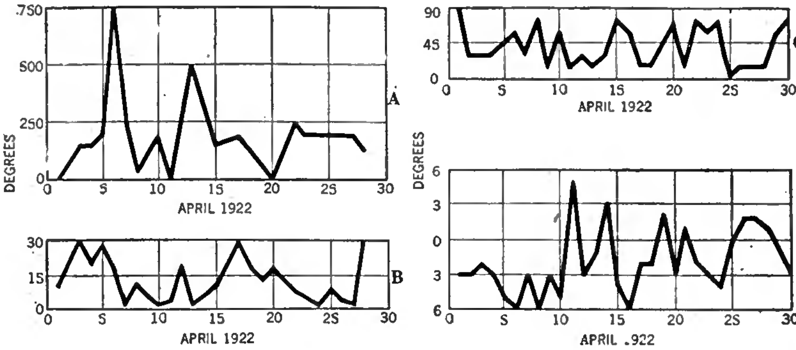


FIG. 2

Signal intensity variations of NAA (operating on 113.1 kc., 2650 meters) for the month of April, 1922. Curve A shows the static audibility and B the signal variations. The maximum signal audibility for this month, as compared with December referred to in Fig. 1 is thirty. In December, the maximum was more than 300, while the static peak record here is 750 (Curve A), more than twice the December maximum. Curve A is static intensity. Curve B is audibility. In Curve B, Fig. 2, maximum audibility is 30 while in Fig. 1 Curve B, the maximum audibility is 120. Curve C, here and in Figs. 2 shows the angles made with the isobars of Fig. 3 and 4, by a ruler connecting Arlington, Virginia and Lincoln, Nebraska, on the map. Curves D (Figs. 1 and 2) give the number of isobars cut by the radio waves in passing between transmitter and receiver

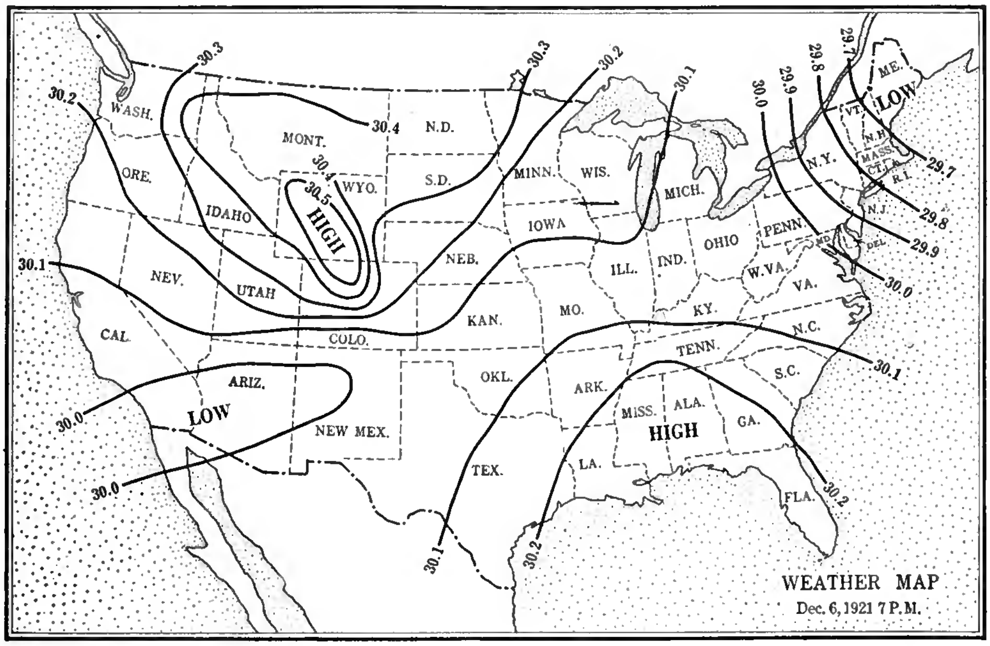


FIG. 3

The United States Weather Bureau map for one of the days covered by the curves in Fig. 1. Mr. Jensen explains the coincidence and relation of reception conditions with weather conditions in the article

surface in a given region influenced the strength of signals, water and mineral deposits being more favorable to good reception than sandy soil and rock. They further maintain that some signal variations attributed to fading are in reality caused by the antenna swinging in the wind and throwing the receiver out of tune.

Early in 1924, Dr. G. W. Pickard published an article on signal fading which presented the first satisfactory method by which the actual signal strength of radio carrier waves may be recorded. The curves obtained with his apparatus show rapid fluctuations in the carrier wave, the time between peaks and the amount of change varying from night to night. The same type of apparatus was used by Doctor Pickard and others in obtaining data concerning the effects of the eclipse of last January on radio signals. The results show a sharp rise in signal strength as the moon's shadow passed over the observer, conditions quickly returning to those normal for daylight work after the eclipse had passed. Further records made at sunset by a considerable number of observers during the summer of 1925, by the use of Pickard's method, show rapid fluctuations in the signal strength just after sunset, conditions becoming steadier and the signals reaching night intensities about thirty minutes later.

One of the most interesting and widely discussed articles dealing with radio and the weather was that of Professor Van Cleef in RADIO BROADCAST for May, 1925. This writer combined the observations of the lay observer of radio programmes with the technical training in weather lore of the climatologist and claims to have found a number of specific relationships between radio reception and weather conditions. The most important of these are that strong signals occur when transmission is at right angles to the isobars, or lines joining points of equal barometric pressure; signals are weaker, and fading is worse, when radio waves pass parallel to the isobars, and reception is weaker when transmission crosses from one pressure area to another. Before discussing these points in detail, let us turn to some recent experiments in the writer's laboratory.

RESULTS OF ACTUAL RADIO MEASUREMENTS

AMONG the most accurate and extensive records of signal strengths yet made are those by Mr. M. P. Brunig, a graduate student in the radio laboratory at Nebraska Wesleyan University, three years ago. The audibility of the time signals from NAA, together with that of static, was measured daily over a period of several months. A local oscillator gave a standard tone whose intensity could be measured by means of a thermocouple and a galvanometer. This tone was then used to measure the sensitivity of the ear

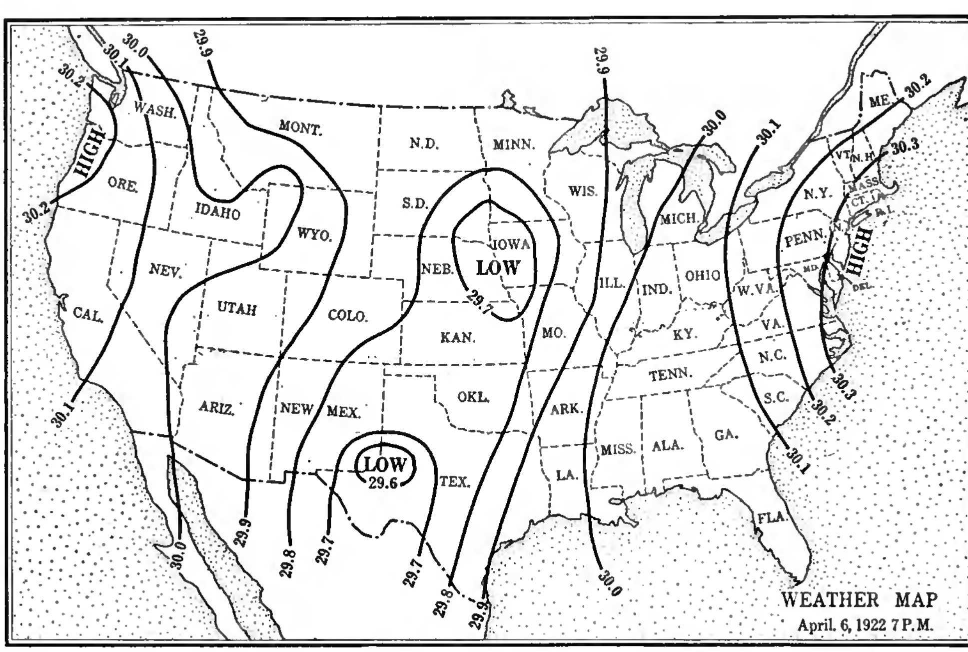


FIG. 4

Another Weather Map for the period covered in the curves of Fig. 2

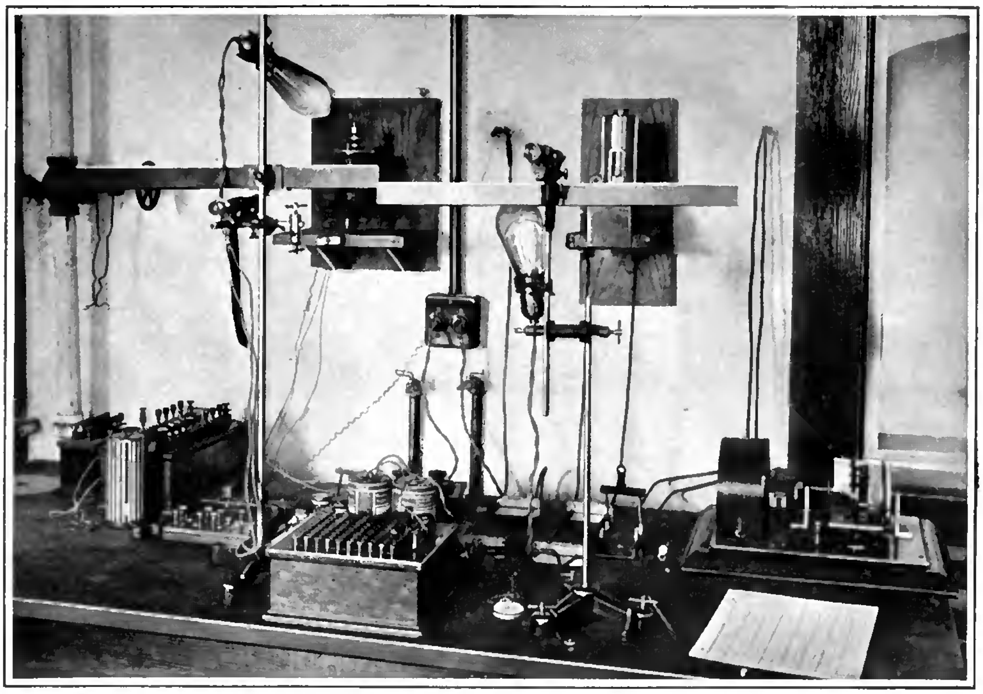


FIG. 5

The apparatus used to make the observations detailed in this article. The signals are received on a six-tube super-heterodyne. In the plate circuit of the second detector is inserted a fifth intermediate-frequency transformer. A head set is shunted across a .002-mfd. fixed condenser in series with the primary of this transformer. Shunted around this condenser is a sensitive wall-galvanometer (seen on the right side of the wall). In series with the secondary are a crystal detector and another .002-mfd. condenser. The field strength of broadcasters is accurately recorded with the galvanometer. The battery and resistance box in the foreground are used in neutralizing the small plate current of the UV-199 tube which has more recently replaced the crystal as a detector. To the right of the resistance box is a recording rain gauge and on the wall to the left of the galvanometer is a Compton electrometer, both of which are used for meteorological research

of the observer and to standardize the adjustments of the receiving set. A simple vacuum tube receiver with the necessary voltmeters and ammeters to check on batteries and filament current, and an audibility meter, completed the outfit. The original report on this research was published in the *Monthly Weather Review* for December, 1922, but since the appearance of Professor Van Cleef's article we have gone over all the original observations together with the corresponding weather maps in order to study the relations of the weather conditions between transmitter and receiver, and the observed signal strength. Curve B of Fig. 1 shows the remarkable variation in signal intensity from night to night, the data covering the first twenty-one days of December, 1921. Signals from NAA were 120 times audible on December 3rd, 6th, and 20th, while they were only four times audible on the 9th and eight times on the 14th. Curve A indicates the static audibility for the same nights and it is very evident that heavy static does not necessarily accompany weak signals, for on the evening of December 3rd, static was 260 times audible yet the signals were very loud. Ordinarily, however, strong and frequent crashes of static coincided with weak signals. Curves A and B of Fig. 2 give similar data for April, 1922. The maximum signal audibility for that month was thirty as compared with 120 for December, while the static peak record was 750, or more than twice the December maximum.

Many newspapers at present reproduce the daily weather map, so that if there is any simple relation between the directions of the isobars and radio receiving conditions, a few moments' study of the map should be sufficient for determining the radio probabilities for the evening. In Figs. 3 and 4 are shown two typical weather maps, chosen from the periods covered by the curves of Figs. 1 and 2. On December 6th, 1921, clear, fair weather prevailed all the way from the high barometer area in Colorado to the Atlantic coast. The entire distance from eastern Nebraska to Arlington, Virginia, lies between the two isobars marked 30.1 inches. Conditions on April 6th, 1922, were entirely different, with a storm area over Nebraska and Iowa and a high barometer region in the eastern states. A radio signal from Arlington to

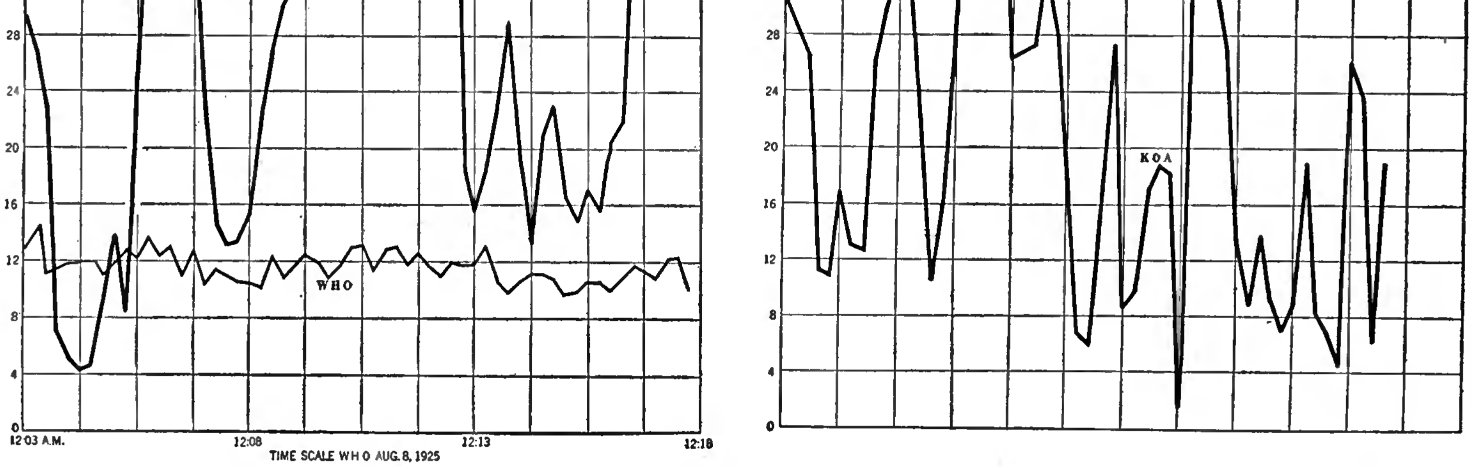


FIG. 6

Several representative curves on different stations, taken from a great many made by Mr. Jensen. Audibility is plotted on the left

University Place, Nebraska, must cross six isobars, pressures dropping from 30.3 to 29.7 inches. Curves C of Figs. 1 and 2 show the angles made with the isobars by a ruler connecting Arlington, Virginia, and Lincoln, Nebraska, on the map. On December 6th, this angle was 0° while on April 6th it was about seventy-five degrees. Curves D give the number of isobars cut by the radio waves in passing between transmitter and receiver, distances above the zero line indicating that the pressure was higher at the receiving end so that the waves must travel "uphill." From these studies, our data shows that *the highest audibilities are obtained when a ridge of high pressure extends from the sending station to the receiver.* Good results may also be expected when the waves travel at right angles to the isobars, provided they do not need to pass over an intervening low and up again. Poorest signals result from passing diagonally across the isobars or through a storm area. While these general rules apply to a majority of our records, it must be clearly understood that they are not infallible, and other controlling forces doubtless should be taken into account.

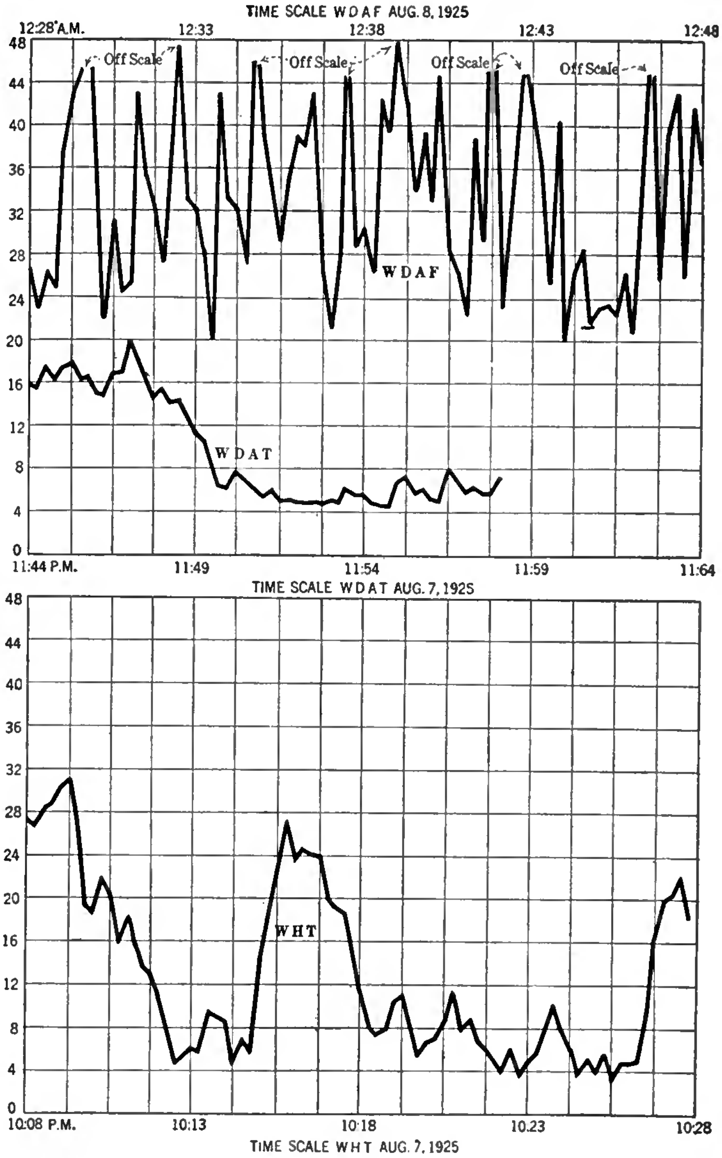


FIG. 7

Time scale plotted against audibility on several stations on the night of August 7, 1925. The Weather Map below, (Fig. 8), shows the general conditions prevailing at 7 P. M. the same day

MEASUREMENTS OF STATIC

THE current in a lightning discharge is of the order of 5000 to 10,000 amperes, hence it is not surprising to find that electric waves produced by these crashes may travel for hundreds of miles. Measurements made in our laboratory show that an antenna or other insulated conductor may become charged to potentials of more than 5000 volts when a stormcloud is overhead and our sensitive apparatus records the smaller charges even before the thunderstorm itself is visible on the western horizon. In the northern hemisphere, thunderstorms are most common in the southeast part of a low area. These conditions prevailed in eastern Nebraska in the map of Fig. 4, and attention has already been called to the very high static audibility for that day. In high winds, and especially with drifting snow, the air often becomes electrified by wind friction, causing an antenna wire to take on a charge sufficient to cause sparks to jump across a lightning arrester to ground. Under such conditions the writer has known charges to accumulate of sufficient magnitude to be heard all over a large room as they jumped across an antenna condenser. The worst thing about these and other forms of static discharges is that the waves produced by them are scattered over a large number of wavelengths so that they are not easily tuned-out.

WHEN SIGNALS FADE

WHILE almost everyone who has used a radio receiver to any extent has noted the gradual variations in the loudness of program, special apparatus is required to measure the actual changes in signal strength. The ear is not a reliable measuring instrument and tone impressions cannot readily be kept in mind for several minutes for comparison. Another difficulty lies in the fact that different parts of a musical program may vary considerably in loudness because of the character of the selections themselves, a change which has no relation whatever to true fading. The apparatus in use for making signal fading records in the radio laboratory of Nebraska Wesleyan University consists of a six-tube super-heterodyne receiver with vernier dials for tuning, and ammeters in the filament circuits. In the plate-circuit of the second detector is placed a fifth intermediate frequency transformer. A telephone head-set is shunted across a .002-mfd. condenser in series with the primary of this transformer, for use as a pilot in tuning and in following programs which are being recorded. In series with the secondary are a crystal detector and another .002-mfd. condenser. Shunted around this condenser is a sensitive wall galvano-

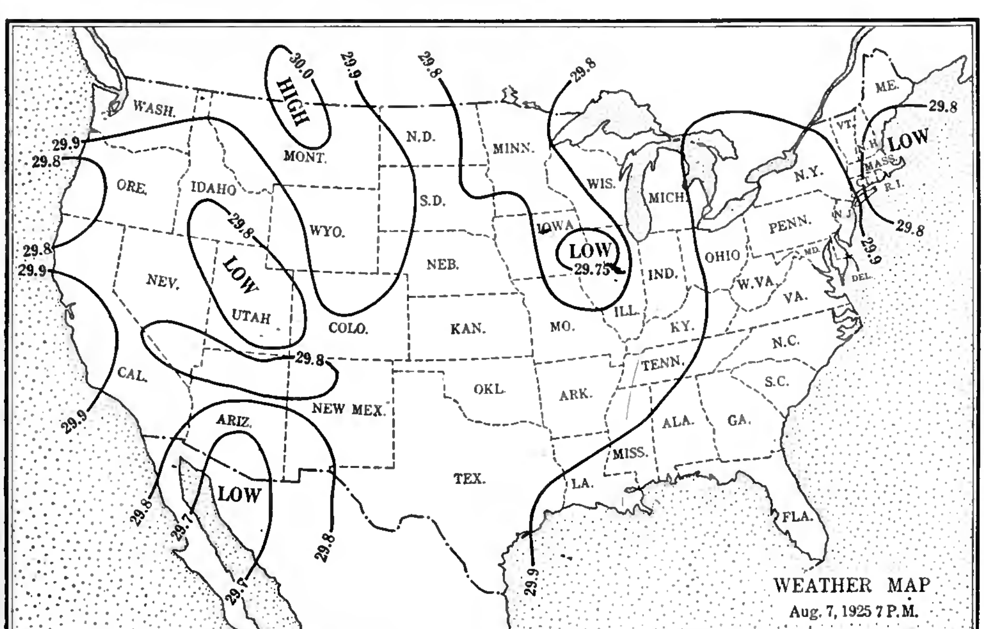


FIG. 8

meter as shown in Fig. 5. More recently we have replaced the crystal detector with a UV-199 tube and have also built up an automatic recording device somewhat similar to the Shaw Recorder used in Doctor Pickard's experiments. With this equipment, galvanometer deflections are proportional to the strength of the carrier wave and are not at all affected by the music or voice modulations heard by the radio listener.

In Figs. 6, 7, and 8, are shown a few typical records, chosen from the large number now on file. Three of the four curves in Fig. 6 are daylight graphs and give conclusive evidence that transmission is much more steady in the daytime than at night. The weather map for May 16 shows a marked storm area in the region of Lake Erie, with clear and settled weather over the great central plains. This accounts for the remarkably regular curve from WDAF at Kansas City. From WCCO at Minneapolis, on the other hand, some effects of the storm to the east are noticeable. The night record for WCX at Detroit is unusually regular, being obtained with a "high" in northern Minnesota, a "low" in Tennessee, and the intervening isobars running almost exactly parallel between University Place and Detroit.

Reference to the time scales on Figs. 7 and 8 will show that these records were all made on the evening of August 7, with the exception of that for WHT on July 30th. The midnight curve for WDAF contains the most rapid and violent changes of our entire series to date. While the period between peaks is commonly from four to six minutes, these are only ninety seconds apart, and continue the cadence with great regularity. This becomes all the more noticeable when contrasted with the records of WDAT at Chicago and WHO at Des Moines taken just a few minutes before. The graphs for WHT at Chicago and KOA at Denver, taken earlier in the evening, are typical midsummer curves. The meteorological map for the evening of August 7th is reproduced in Fig. 9. The weather was hot and sultry, with no well-defined storm area in the plains region, a condition classed as "unsettled" by the meteorologist.

CONCLUSIONS

A DISCUSSION of the application of the data presented above to the Heaviside theory of radio transmission would be beyond the scope of this article. So far as it is possible to formulate an opinion based on actual observations, the Eccles-Larmor theory which requires a refracting upper layer rather than an ionized, reflecting surface, agrees more nearly with the facts. There is strong evidence for definite relationships between weather conditions and radio reception although other factors, such as the earth's magnetic field, probably also play a part. The general conclusions supported by the data presented may be summarized as follows:

1. Signal strength will be greatest with settled weather conditions and transmission parallel with the isobars. (Fig. 3).
2. Good reception may also occur at right angles to the isobars unless a storm center intervenes between sending and receiving stations.
3. Static is most noticeable as a storm area approaches, the crashing noises being audible for several hundred miles; and the hissing noises prevailing only in the immediate vicinity of a "low."
4. Fading is much less troublesome in daylight than at night.
5. Fading is much more noticeable in unsettled weather than when transmission is parallel with the isobars along the ridge of a "high."

With these rules as a general guide, a radio forecast has been sent out daily at 4:30 P. M. from station WCAJ, since October 1st, 1925, While encouraging reports have been received, the project is yet in the experimental stage.

EDITOR'S NOTE

THE conclusions reached by Mr. Van Cleef, in his article, "Do Weather Conditions Influence Radio?" in the May, 1925, RADIO BROADCAST are reprinted below, so that experimenters can compare the findings of the two investigators. Mr. Van Cleef reached his conclusions from his observations without a great deal of study of the radio theories advanced for variation in radio receiving conditions. Mr. Jensen has proceeded from the point of view of the radio investigator. Mr. Van Cleef's first point is in direct opposition to that of Mr. Jensen as he claims strongest transmission at right angles to the isobars. Mr. Jensen has found that loudest signals are to be heard in territories parallel with the isobars, along the ridge of a "high", with no difference in pressure between transmitting and receiving stations. This conclusion is also opposed to Mr. Van Cleef's second rule. With respect to fading, Mr. Jensen thinks that the worst fading is found with a "flat" barometer or large "low" area, while the third rule of Mr. Van Cleef assumes most fading on a ridge or parallel with the isobars.

1. If a line connecting the receiving station with the broadcasting station crosses the intervening isobars at right angles, reception is at its best.
2. The steeper the isobaric gradient (that is, the closer the isobars to each other) the stronger the reception.
3. The more nearly the transmitted waves approach parallelism with the isobars, the weaker the reception. Under these conditions, fading occurs.
4. Reception in a Low pressure area tends to be somewhat weaker than in a High of corresponding intensity.
5. Reception is weaker when the transmitted waves cross from one pressure area into another than when they travel only within one area.
6. The strength of reception for any station is a factor of both its location within a pressure area and its position with respect to the broadcasting station.
7. "Bad weather" does not affect reception, excepting as it may be the index of an unfavorable pressure distribution.
8. Reception can be as good in "bad weather" as in good weather if the pressure distribution is right.
9. Temperature does not influence reception, excepting as it may be the index of pressure distribution as follows:——
   (a) Reception is better in winter than in summer because the cyclones and anticyclones are more intense in the winter period.
   (b) Reception is better when temperatures are low than when high, because low temperatures usually indicate intensive High pressure areas, that is, areas with steep isobaric gradients.
   (c) Low temperatures accompanying poorly defined High pressure areas make reception poor.
10. Shallow or flat pressure areas result in much static-noise in the receiver.

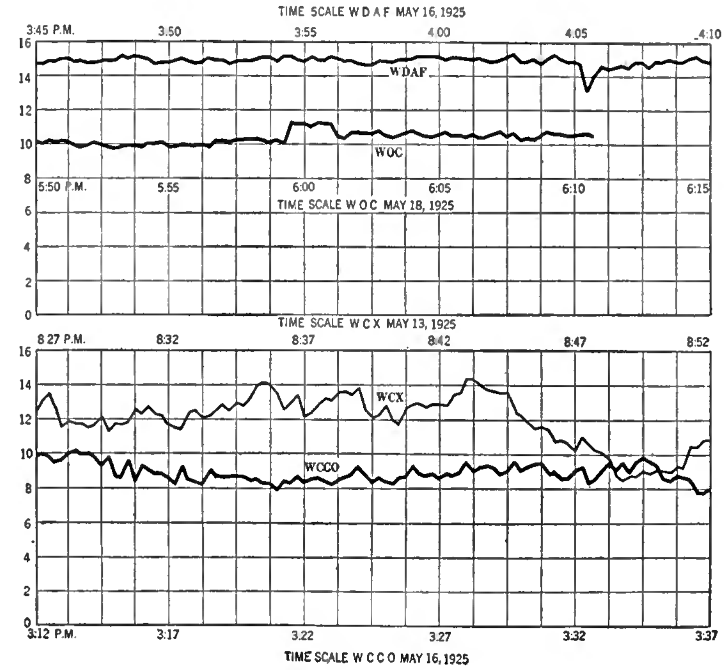


FIG. 9

Some remarkable records of daylight reception during the spring of last year

What Multiple Regeneration Can Do for Your Tuned R. F. Amplifier

Suggestions for Experimenting with and Applying Multiple Regeneration to a Great Variety of Circuits with a Consequent Large Gain in Sensitivity—Details of the Circuit and Operating Suggestions

By V. D. LANDON

Radio Engineering Department, Westinghouse Electric and Manufacturing Company

EXPERIMENTERS in radio have tried for a long time to secure the undoubted advantages in sensitivity that multiple regeneration would give, but always there have been very serious practical obstacles in the way. This article, by Mr. Landon, who is an experimental engineer with the Westinghouse Electric & Manufacturing Company, at present attached to their offices in Springfield, Massachusetts, is in no sense a construction article. The basic principles of the system are o utlined by the author, and they can be applied by the constructor to the particular receiver which he may have. The number of receivers employing tuned radio frequency a plifiers now in use in this country must be much more than five hundred thousand and the Landon method is applicable to all of them—it will add considerably to their sensitivity. The importance of the experimental field opened up by this article can scarcely be overestimated.—THE EDITOR.

A GREAT deal of experiment has been spent in an effort to obtain the full amplification of regeneration twice or more times in the same amplifier. The average experimenter does not obtain the desired result, though the reason for failure is somewhat puzzling unless considerable study is made of the subject.

Take for example the well known Roberts Knockout Receiver. This circuit (with one stage of audio added) is shown in Fig. 5. If a station fifty to one hundred miles distant is tuned-in with this receiver, using zero tickler adjustment, a comparatively weak signal results while a 500- to 1000-mile station is usually inaudibly weak. Nevertheless when the tickler is advanced to the critical point, the gain in signal is sufficient to bring in stations well over one thousand miles distant and with full loud speaker volume. Only on poor nights or on very weak stations is difficulty found in obtaining sufficient volume for satisfactory reception.

On such occasions, however, imagine the thrill of having another tickler control capable of boosting the signal again by the same ratio! It was with this in mind that a great many experimenters tried the effect of unbalancing the neutralizing condenser in an effort to regenerate the antenna as well as the detector circuit. Also many have tried various schemes of feeding energy from the detector back into the antenna circuit by inductive coupling. One such scheme was suggested by the technical staff in the April, 1925, RADIO BROADCAST.

Many of those who experimented along these lines thought they had achieved the desired result when they tried the set because it becomes very critical. An adjustment of the tickler or the balancing condenser or of either tuning condenser, upsets the adjustment of one or more of the other three controls. However, a more critical receiver does not mean a more sensitive one. If a comparison is made between two sets using the circuit of Fig. 5, one of which is well balanced while the other has a variable neutralizing condenser, it will be found that there is very little difference in the sensitivity of the two sets. This is found to be the case in any circuit in which an attempt is made to regenerate the antenna circuit by means of some form of coupling to a regenerated detector. Briefly the reason is this:

When energy is fed back through the tube capacity so as partly to regenerate the antenna, the tickler setting for critical regeneration is reduced, offsetting the gain in the antenna.

In other words, if the two circuits are somewhat coupled, both may be partly regenerated, but both may not be completely regenerated, since the system as a whole starts oscillating before this point is reached.

Before attempting the true solution of the problem, let us reduce the Roberts circuit of Fig. 5 to the equivalent four-tube circuit. This is shown in Fig. 2, Theoretically, the only difference between Fig. 5 and Fig 2 is that in Fig. 5 the first tube does the work of the first and third tubes of Fig. 2. In practice,

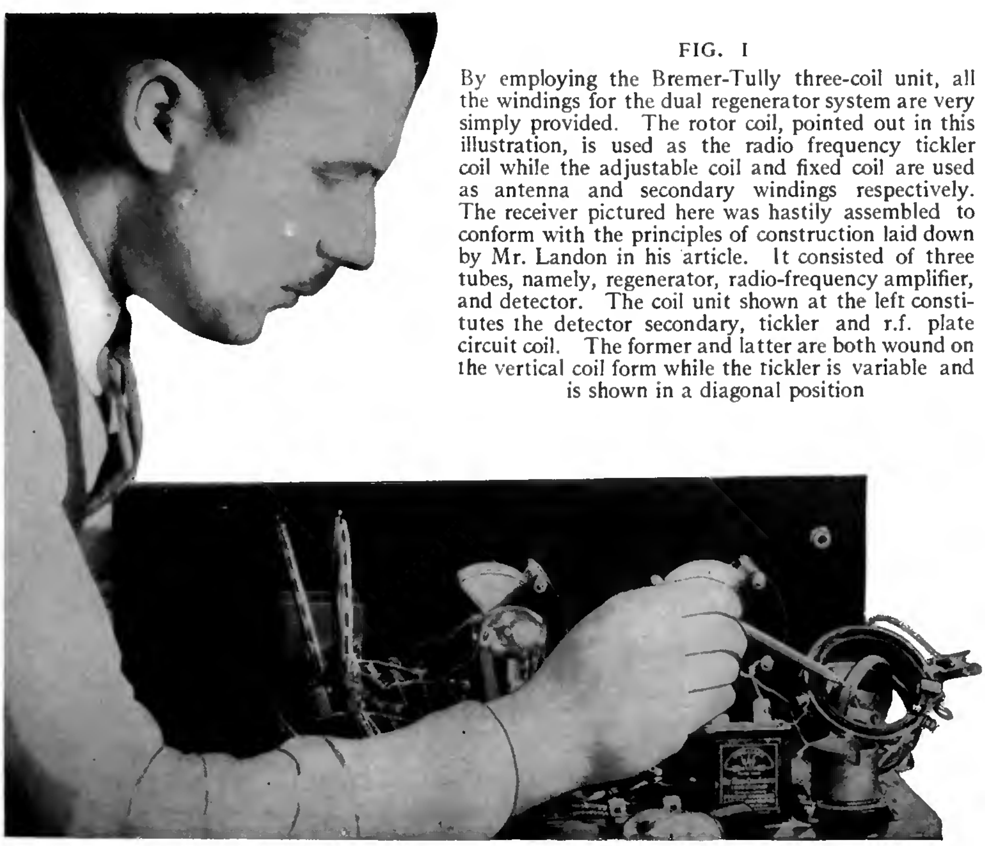


FIG. 1

By employing the Bremer-Tully three-coil unit, all the windings for the dual regenerator system are very simply provided. The rotor coil, pointed out in this illustration, is used as the radio frequency tickler coil while the adjustable coil and fixed coil are used as antenna and secondary windings respectively. The receiver pictured here was hastily assembled to conform with the principles of construction laid down by Mr. Landon in his article. It consisted of three tubes, namely, regenerator, radio-frequency amplifier, and detector. The coil unit shown at the left constitutes the detector secondary, tickler and r.f. plate circuit coil. The former and latter are both wound on the vertical coil form while the tickler is variable and is shown in a diagonal position

RADIO BROADCAST Photograph

the circuit of Fig. 5 can be made equal to that of Fig. 2 only after considerable experiment. In presenting the multiple regeneration circuits, the circuit of Fig. 2 is used as a starting point because it is not subject to certain troubles which a reflex set may develop.

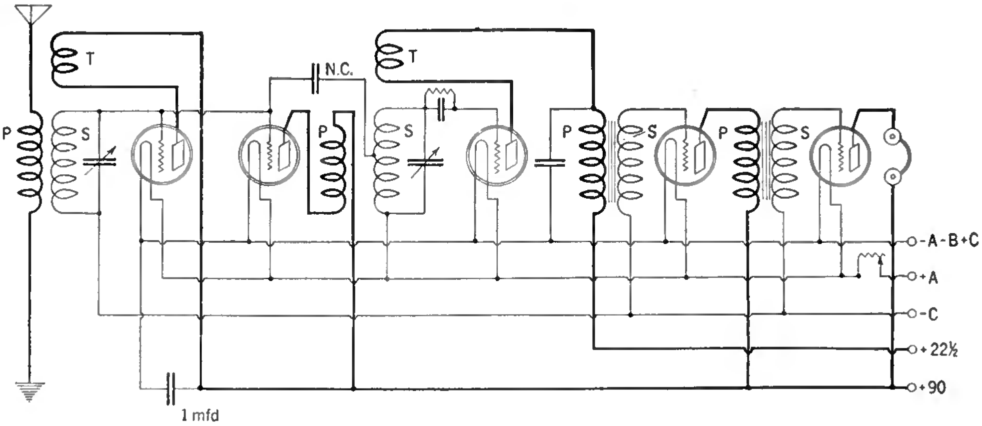


FIG. 3
The Browning-Drake with regeneration added to the radio-frequency amplifier circuit

THE BEST WAY TO ATTAIN INCREASED SENSITIVITY

THE solution of the problem is in regenerating each tuned circuit, all the while keeping the coupling between them to zero. Such a circuit is shown in Fig. 3. It will be found with this receiver that the advantage gained by using two ticklers instead of one depends a great deal on the completeness of neutralization. The more exact the neutralization the greater the gain in signal.

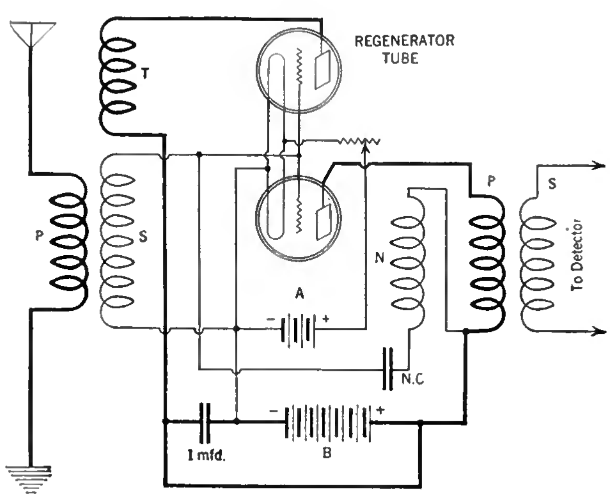


FIG. 4
Here are shown the important parts of the usual radio frequency circuit to which has been added the extra tube whose grid is paralleled with that of the first tube and whose plate return is made through a coil coupled inductively to the first secondary and thence back to the B battery. Notice that in all the circuit diagrams accompanying this article a 1-mfd. condenser connects from the plus B to the minus A lines

Notice that the change from the circuit of Fig. 2 is very slight. Another tube, and a small coil were added. A means of varying the coupling of the coil to the antenna circuit must be provided. The grid circuit of the new tube is the same as that of the first tube, that is, the two grids are tied together. However the plate circuit of the new tube is separate. It consists of the new coil which is used as a tickler.

Another method of controlling antenna regeneration is to use a fixed tickler with a variable resistor in series. A bypass condenser must be provided to bypass r.f. currents around the resistor. When the resistance is all "in", the voltage applied to the plate of the tube is insufficient for oscillation to occur. When the resistance is gradually cut out, the point of critical regeneration is approached until finally oscillation occurs. When the set is properly constructed it should be possible to start or stop oscillation at any wavelength with this resistor. There are several good resistors for this purpose on the market, which have a range of 10,000 to 100,000 ohms such as the Royalty, Bradley, Centralab, and Clarostat.

It is also possible to control the antenna tickler by any of the commonly used methods. A coil having the same value as the secondary coil may be substituted for the variable resistor and a variable condenser shunted around this coil for tickler control. Or the tickler lead may go directly to the B battery terminal with a separate (vernier) rheostat on the first tube for regeneration control. In this latter case the tube filament brilliancy is turned down to the point just below the point of oscillation. This is a very simple and effective system.

For ordinary reception, the first tube may be left out of the socket, the set being used like the standard Roberts Circuit. However, when a signal is found which cannot be brought up to the desired volume,

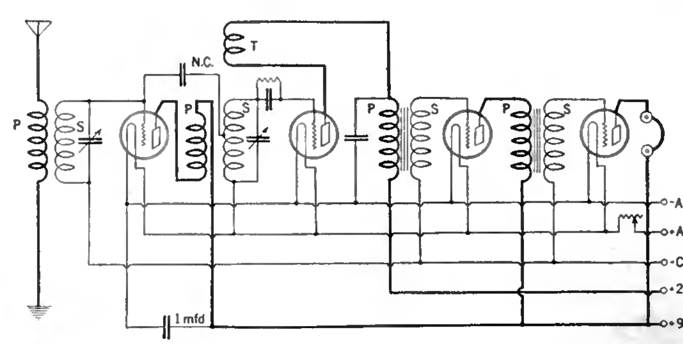


FIG. 2
This is the Browning-Drake circuit, familiar to readers of RADIO BROADCAST as one having excellent tuning qualities

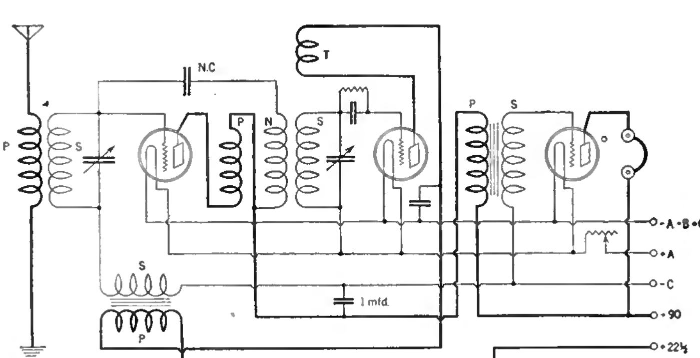


FIG. 5
The regular three-tube Roberts receiver consisting of one stage of tuned, neutralized, radio frequency amplification, a regenerative detector whose output is reflexed back to the first tube and thence followed by a straight audio stage

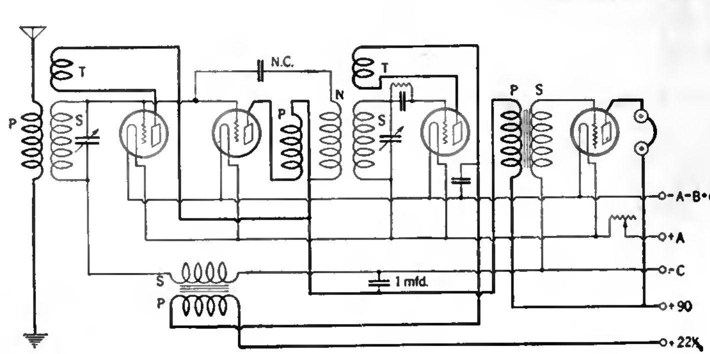


FIG. 6
The Landon system of r.f. regeneration added to the reflexed Roberts circuit. In the article, this is used as a basis for a discussion of the merits of dual regeneration

a great gain in signal is to be had by inserting the tube and adjusting the antenna tickler to the critical point which is just below the oscillating point.

It is also very easy to provide a filament switch to cut in the tube when it is needed, but for those who are not so particular about the filament current used, it is perfectly practical to leave all five tubes lighted whenever the set is in operation. *The extra tube will have no effect on the circuit as long as the antenna tickler is set at zero, and of course, this control should not be used until necessary, since the receiver will radiate when the antenna circuit is caused to oscillate. There is no point in advancing the antenna tickler to the oscillating point since it makes the receiver inoperative as far as the reception of ungarbled, undistorted reception is concerned and, furthermore, interference is caused with neighboring receivers which should be avoided at all costs.*

The extra control simply provides the operator with a reserve of power in case of need. With this type of set it is possible to get down to the much discussed static level except on unusually quiet nights. In other words, those broadcasting stations whose signal intensity is higher, or stronger than the static intensity—otherwise termed static level, have a very fair chance of being tuned-in with the aid of the extra control. Those below the static level have not this possibility. Briefly, a receiver employing this regeneration system has all the sensitivity for which there is any use.

Facts About the Circuit System

Material required for regenerator stage:

One socket, one tube, one tickler coil, a rheostat and filament switch.

Values of parts employed in the Circuit:

No definite values are stipulated as it is desirable for the builder to select for himself the size of tuning coil and condenser he wishes to cover the frequency range in which he is interested. The bypass condenser across the primary of the first audio stage should be .001 mfd. For the tuning coils, the ratio of primary to secondary should be 1 to 4 for the antenna circuit and 1 to 3 for the detector. The tickler coil should have [illegible] the number of turns of the secondary coil to which it is coupled.

Operation:

When first tuning for a station, keep the regenerator tube unlighted. When the distant station is tuned-in and it is desired to increase sensitivity, turn on the filament switch of the regenerator tube and *slowly* advance the coupling between the regenerator tickler and the antenna secondary coil. Do not attempt to regenerate up to or beyond the oscillation point which manifests itself by a raucous squeal. Always employ the regenerator as a reserve of sensitivity and power.

Important points to remember:

A large bypass condenser, such as a 1-mfd. should connect from the B battery terminal of the new tickler coil direct to the minus A; the secondary coils for r. f. stage and detector should be placed at exact right angles to each other.

THIS SYSTEM HAS WIDE APPLICATION

OF COURSE the main idea of Fig. 3 can be applied to practically all circuits employing tuned radio frequency

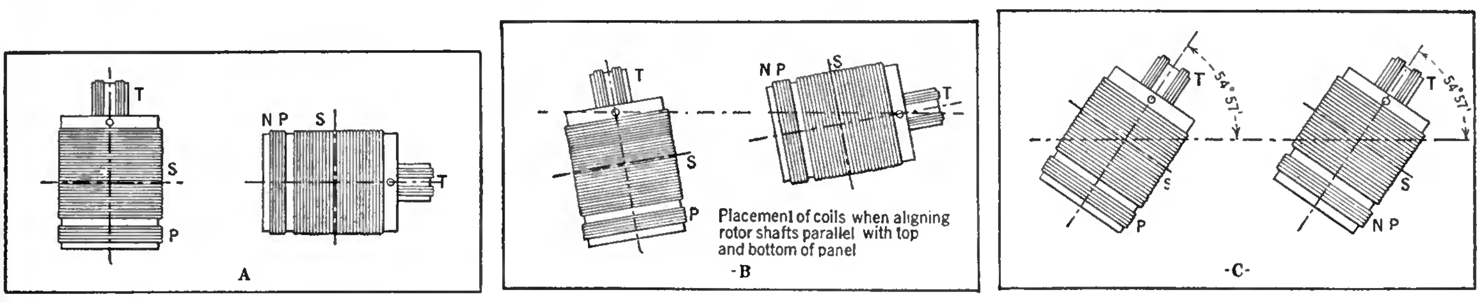
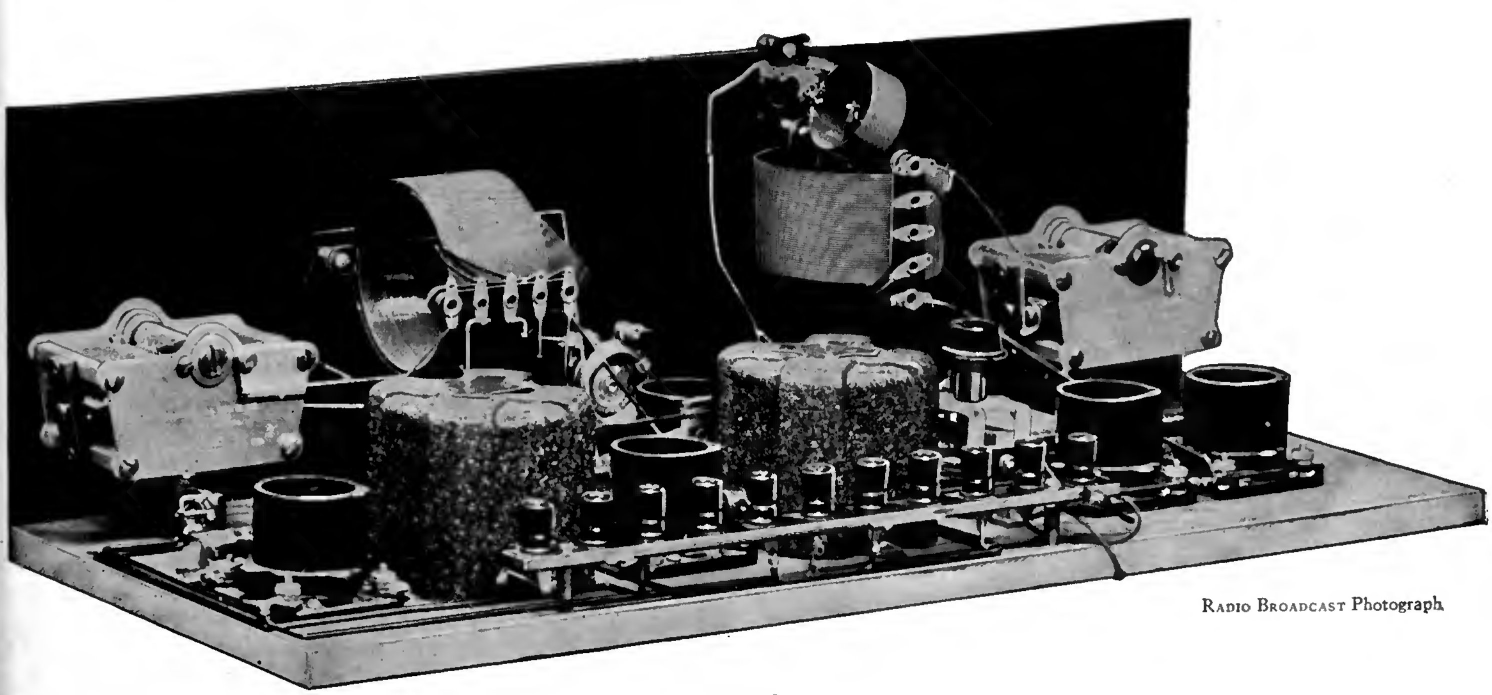


FIG. 7

To obtain satisfactory neutralization of the radio frequency amplifier, it is first necessary to de-couple the tuning coil units to prevent any undesirable feedback or inter-coupling effects which are not helpful. Here are shown several ways of placing the coils to obtain the desired effect. In A, the secondary coil axes are at right angles to each other; in B the condition prevails excepting that the two coil units have been shifted so that the rotor coil mounting holes in the panel are on a straight line parallel with the top and bottom edge of the panel. This is only where uniformity and symmetry of panel layout is desired. In C the angle of coil placement, 54°—57′ made prominent by incorporation in most neutrodynes is shown. Here it is desirable to have the coil centers placed not less than 6 inches apart



RADIO BROADCAST Photograph

FIG. 8

The rear view of a receiver employing dual regeneration constructed solely for experimenting. Note that the secondary coils of each tuning unit have their axes at right angles to each other. This is an absolute necessity where a positive neutralization of the radio-frequency amplifier is to be obtained amplification. For the lovers of reflex, Fig. 6 is given. Notice that the first two tubes act in parallel at both radio and audio frequency. This circuit could easily be made from the Roberts Circuit as the only changes necessary are the addition of a tube and the tickler coil. Then there are the thousands of neutrodyne receivers to which this system is admirably adapted.

Fig. 9 shows a two-stage tuned r.f. amplifier in which regeneration can be obtained in two places. The neutralization of the first stage is variable so that the antenna can be regenerated by capacity feedback. The detector circuit is regenerated by means of a tickler as usual. There is coupling between the first two circuits, but the coupling between the detector and the other two circuits must be kept as near zero as possible.

Fig. 11 shows a two-stage amplifier in which regeneration occurs in three places. In view of the foregoing, the diagram is self explanatory.

In practice, the circuit of Fig. 11 would be extremely hard to balance accurately enough to operate satisfactorily. By using separate batteries on each stage and by separating them by several feet, it could probably be done, though the sensitivity would be greater than is ever necessary, except perhaps for long distance daylight reception. Probably, the most practical circuit employing multiple regeneration is that of Fig. 3.

It is not the purpose of this article to give exact constructional details for this set. Individual constructors will have their own ideas as to what the panel layout should be, since each will incorporate different varieties of apparatus. However, it will be necessary to keep in mind certain points, if the set is to work properly.

The coils must be low loss for good results. The lower the resistance the greater the sensitivity, even when full regeneration is employed. The effect of resistance in the grid circuit of a regenerated system is thoroughly discussed in December, 1925, *Proceedings* of the I. R. E. "An Analysis of Regenerative Amplification" by the writer and K. W. Jarvis.

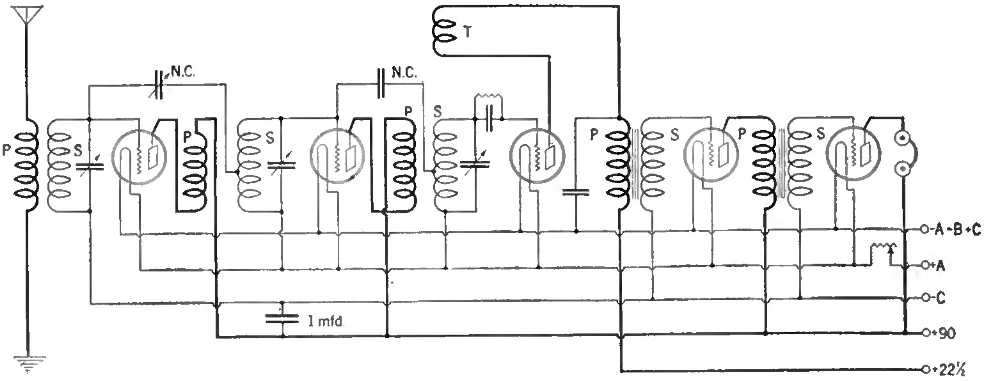


FIG. 9

The standard neutrodyne circuit employing a regenerative detector. To this circuit may be added the radio-frequency amplifier regeneration system shown in Fig. 4

The two grid coils may be any of the well known low loss designs, so long as the broadcast range can be covered with the variable condensers used. The following may help in choosing the type of winding.

CHARACTERISTICS OF THE BEST COILS

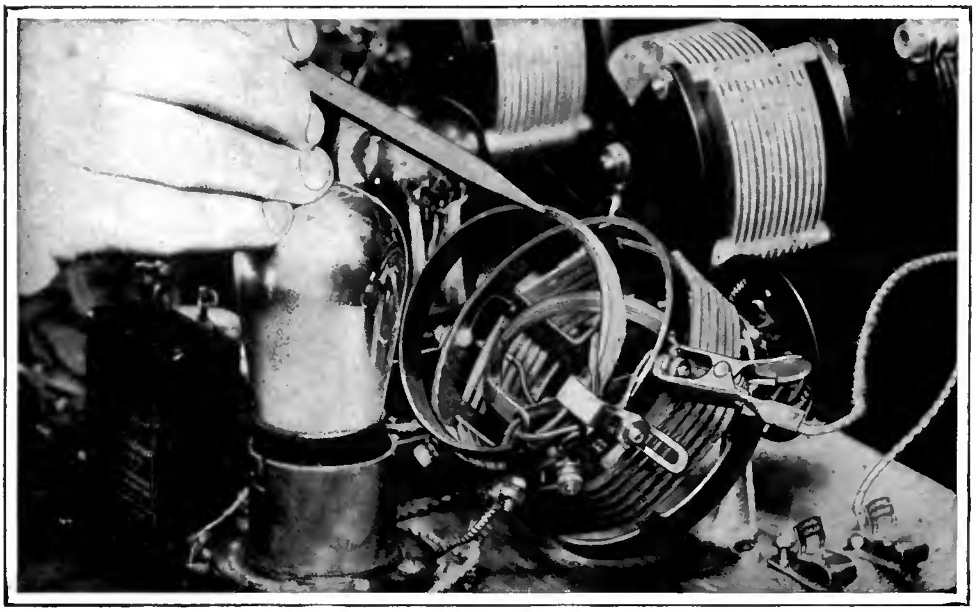
THE Lorenz or basket weave coil has fallen into disrepute among the exponents of low loss lately. Nevertheless it is about as good a coil as can be made in a *given small volume*. In general, however, coils wound on tubing are better *because they are larger*. The chief losses in the Lorenz type of winding are due to eddy currents in the wire itself caused by the magnetic flux from adjacent turns. This loss is reduced to a minimum by using large diameter coils and a spaced winding. The larger the volume which is to be occupied by a coil the larger the wire that may be used with advantage. Number 24 wire (B & S Gauge) is about right for a coil three inches in diameter. No. 16 wire is better if the coil diameter is in the neighborhood of six inches.

The effect of the average type of tubing in the field of the coil is negligible in dry weather or immediately after a coil is thoroughly baked. However, the resistance of a coil may be multiplied by three or four in wet weather if proper precautions are not taken to keep the moisture out. The coil may be made moisture proof by treating it with a good coil varnish such as Sterling Copal varnish. The coil should be baked dry, then dipped in the varnish and baked again. Painting the outside of the coil with varnish is not sufficient, since moisture will be absorbed by the inner surface of the tubing. Of course collodion will do the trick but it is rather expensive. Celluloid sheets dissolved in acetone to a consistency of shellac or varnish also is effective as a coil binder.

All coils, such as primary windings and ticklers, which are not a part of the tuned circuit, should be wound with very fine wire such as No. 35 d.c.c. The resistance of these coils in themselves is not important, but if large wire is used in them the resistance of the tuned circuit to which they are coupled is increased, and this causes a reduction in efficiency.

It is well to remember that this article does not deal specifically with the construction of a receiver but rather explains the application of a regeneration control system to existing receivers.

The ratio of primary to secondary winding should be about 1 to 4 in the antenna circuit and about 1 to 3 in the detector circuit. Each tickler coil should have about $\frac{3}{8}$ the number of turns of the grid coils. Remember that it is necessary to neutralize the coupling between the tuned circuits almost perfectly if any gain is to be noticed from multiple regeneration. This means extreme care to place the coils at right angles or as shown in Fig. 7 in order to prevent inductive coupling. It will be noticed also that any metal in the field of either coil may distort the field so as to cause coupling even when the coils are at right angles. Adjustment of the capacity balance (neutralization)



Radio Broadcast Photograph

FIG. 10

The pencil points to an adjustable antenna coil which aids greatly in obtaining the correct coupling between antenna primary and secondary circuit of the radio-frequency amplifier. The additional tube, which functions in the dual regenerator part of the circuit, is located directly behind the Bremer-Tully coil unit

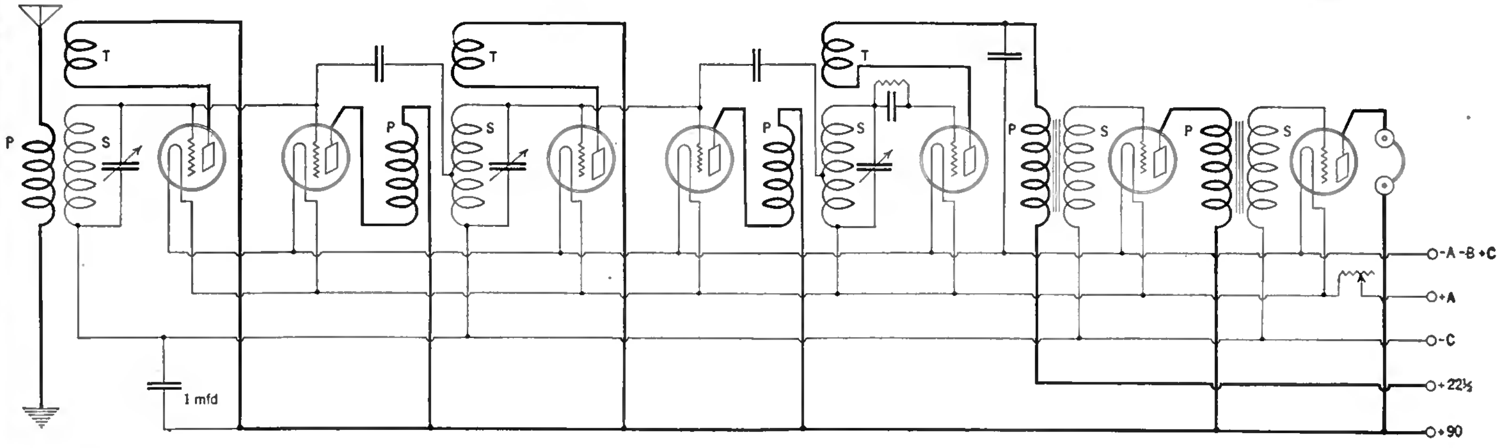


FIG. 11

Three ticklers for two r. f. stages and the detector. An hypothetical case of applying the Landon regeneration system to the neutrodyne receiver. It is unlikely that in this instance much will be gained by its use because of the extremely critical tuning which will result. Two ticklers, one for the second r. f. stage, and one for the detector, would be the more practial application of the Landon regeneration system.

should need no explanation. Let it suffice to say that the adjustment should be made as accurately as possible.

But for those who are incorporating this system in a new construction, it is assumed that neutralization has not been obtained, therefore the following memorandum on neutralization will be helpful.

Maintaining zero coupling between the first secondary and the radio frequency tickler coil, the detector tickler is advanced to cause regeneration in that circuit. Previous to this, the receiver should be tuned to some station which responds at the half-way point on the tuning dials. The squeal produced should not be made too loud. Rotate the antenna-secondary tuning condenser over a small arc. If the pitch of the squeal varies, then the set is not properly neutralized. The capacity of the neutralizing condenser employed in the circuit should be varied a little at a time until the pitch of the squeal does not vary. Then the receiver may be considered neutralized. The constructor should not confuse squeal intensity with squeal pitch.

BEST APPLICATION OF THESE EXPERIMENTAL SUGGESTIONS

A NOTICEABLE gain in selectivity will be obtained if no part of the set is grounded except one end of the antenna coil as shown in all the circuits printed with this article. This is especially effective if all battery leads are kept short.

Of course all the usual precautions should be taken. To avoid apparatus of poor design, buy only well known makes of apparatus when purchasing such items as sockets, rheostats, grid leak, variable condensers, transformers, tubes, etc.

To aid in neutralization, keep all grid and plate connectors as short as possible. Run the leads to the neutralizing condenser in as short a line as possible. Do not omit any of the bypass condensers shown. Those shunted across the primary of an audio transformer should have a capacity of about .001 mfds. The condenser across the B battery should be about 1 mfd.

To avoid bad joints and leakage losses, use rosin core or soft wire solder in wiring the set. All battery leads should be cabled if they are close together for a considerable distance in a set. This will avoid closed loops.

It should be kept in mind that all the multiple regeneration circuits shown in this article are capable of oscillating into the antenna. This is true of any r.f. circuit employing a means for neutralization and where the neutralization is not perfect. Care should be taken not to cause such oscillation at any time, since interference to neighboring receivers is the inevitable result. This is readily accomplished if the receiver is tuned as follows, which is the easiest and most natural method.

Leave the antenna tickler at zero or nearly so, and operate the set in exactly the same way that a Roberts Knockout Receiver is operated. Occasionally a signal will be found which is too weak to be brought to the required volume by this method. The antenna tickler should then be brought up to the critical point, after the other controls are properly adjusted. If oscillation should occur, it will be immediately apparent to the operator who should back off the control at once.

The circuit of Fig. 3 is especially recommended to home builders as it is the simplest and most practical of the circuits shown. It is believed that any one who completes it will be well pleased as it is a wonderful performer.

RADIO BROADCAST Photograph

FIG. 12

Adjustment of the neutralizing condenser is an important procedure in the correct operation of this receiver. John B. Brennan, Technical Editor of RADIO BROADCAST, is shown here making this adjustment in RADIO BROADCAST Laboratory

Drawings by Franklyn F. Stratford

Putting the Listener Under the Microscope

SOME years ago, in a moment of despair, I proposed the establishment of a broadcasting station to be operated for the pleasure of the engineers alone, in vacuum, so to speak. In this way the cares of the program directors, engineers, announcers, artists and other functionaries would be marvellously reduced. They would be kinder to their wives and children, and suicides and murders would be less among them. The ceaseless tension of the broadcasting business would be relieved, and professional broadcasters would become as carefree as shepherds on pleasant summer afternoons. I can see them going around playing joyfully on little pipes, the operators fraternizing with the announcers, all hands looking ten years younger, gaining weight, and enjoying life. And all through the elimination of the listeners. The method I suggested was to run the station without an antenna. Thus no one would have to worry about what went out, nor how it sounded, because no one would listen to it but the station staff, and they wouldn't give a continental.

This is a dream with which I please myself once in a while. For, in the hard world of reality, the listeners crack the whip over me and all my colleagues in the various divisions of the broadcasting business. They make and break us. Please them we must, or we don't eat—unless we give it up altogether and become garbage collectors and hosiery salesmen once more. One should give prolonged consideration to fauna of such importance to one's welfare. Therefore we shall devote a portion of this department, without further delay, to a discussion of the listener, testing his reactions to various acids and alkalies, purifying and educating him, and giving him praise where due, but nowhere else.

In the course of business I recently had occasion to make a journey with a United States Supervisor of Radio, a gentleman who is a philosopher as well as an administrator. During our talk he commented on the remarkable contrast between the perfectly supine reaction of many citizens to the avoidable evils of existence, and the fearful how-dy-do immediately raised when something goes wrong on the radio. An automobilist will sit almost motionless at the ferry landing for four hours, on Labor Day or some other holiday, waiting his turn to get on the boat, with scarcely a murmur. If he lives in a big city, he will submit himself and his womenfolk to the most inordinate crowding in their daily journeys about the town, without batting an eyelash. He allows himself to be robbed by hatcheck boys, abused by the traffic cop when his car slides two inches over the line, and to be told by conventional imbeciles that he must not wear his straw hat after September 15th. None of these injuries is inevitable. Wharves, bridges, and subways may be built to accommodate peak loads, a posse of public-spirited citizens could lynch a hatcheck boy and duck one of the over-eloquent traffic directors, and the bitter-enders among the straw hat wearers could free themselves by marching to the Polo Grounds in a body on September 25th and shooting down the first hoodlum who threw a pop bottle at them. My remedies are a trifle radical, and all the readers of this law-abiding periodical will not agree with them, but there can be no debate about the underlying thesis. In all these situations, and a multitude more, the people stand for anything. But not in radio! Just let some foreign freighter open up on 450 meters during a concert, and twenty irate listeners sit down and write a letter to Secretary Hoover. The more moderate ones get after the Supervisor, but there are always some for whom nothing less than the Secretary will do. The Secretary must suppress the amateurs, brush the cobwebs off an ill-managed station's carrier, stop *XXX* from air advertising, and torpedo the Jugo-Slovakian merchant marine. He must do these things right away, or Richard Roe and John Doe will rise agin the government.

Here is an actual instance. A large broadcasting station was set up at a point 30 miles from New York, the location having been determined by careful tests and calculations. New York has a lot of suburbs, and inevitably some of them were and are (for neither the towns nor the station have been moved) much nearer the transmitter than that. When the station started testing, after only a day one gentleman, a lawyer, sat down and wrote a long petition to Secretary Hoover. He is quite a prominent lawyer and writing 1200 words must have cost him a neat sum in time and energy. It seems he had an *eleven*-tube neutrodyne, which, as he was a lawyer and had made it himself, was absolutely perfect, and with the near-by station going he could not hear one in Chicago which he had to hear, or die, so there was nothing left but to write the Secretary. As a matter of fact, in about half the time he spent in dictating that epistle he could have rigged up a wave trap which would have solved his problem. The company which put up the station knew that a wave trap would take it out in all the near-by towns when it wasn't wanted.

I do not mean that all the listeners are chronic kickers. Most of them are amiable and appreciative souls, or else the martyrs at the broadcasting end of the circuits would all have eaten rat poison by this time. For instance, in the case mentioned above, after a brief period of testing, some 1500 letters were received, of which thirty-eight were protests—some of them justified by special circumstances—while the remainder were favorable and most of them full of enthusiastic praise.

Listeners who desire to help the broadcasting stations to which they write should keep in mind the necessity for being definite in their statements and, if the matter is a technical one, critical in their observations. Some listeners are too prone to imagine things. A while ago one of the stations for whose operation I am responsible technically developed hiccoughs a few hours before an exceedingly important program was scheduled to go on. The cause was obscure, and, supported by the other heroes on the technical staff, I started to wrestle with the thingamajigs and doodaddles. With the kind permission of the local Federal official, we put the carrier on during a two-hour blank period and let an orchestra rehearsal go out. Everything—power, radiation, modulation—remained as usual in the past year and a half, and the only irregularity was an intermittent growl down in the bass. While we were sweating and swearing and tearing things apart, a listener called on the telephone. "I wish to report on your test," he announced excitedly. I didn't want any report, but as the most polite and speedy way of getting rid of him I asked what he had found. "Your station sounds just as usual," he declared after some irrelevancies, "but the wave is *terribly broad!*" Restraining an impulse to reply, "So's your old man!" I thanked our informant and got away, having lost several minutes when I needed them as a squirrel needs acorns during a severe February.

On the other hand, several of our listening customers render us occasional valuable aid with all the precision of observation and expression of trained engineers, although one of them is a physician and others are in similarly detached professions. Out of a spirit of pure helpfulness, they write extensive reports full of valuable technical data. The same thing is true on the program end. Every program manager has a circle of listening friends whose judgment and criticism are important factors in determining the nature of the material he uses. "Applause mail" is necessarily one of the guide-posts in program work. Letters from people who know definitely what they want and don't want, and why, are always carefully read. It is not always possible to answer them individually; if the volume of mail is great, a system of form answers is the only way to avoid running into prohibitive expense, although even then some of the letters must receive special attention.

The more pretentious the writer, the less the value of his letter, as a general rule. Recently I received a report on signal strength from one well-wisher who printed "Radiotrician" under his name. There was not the slightest sign of an address on the letter, and all it told me was that someone in the United States heard us satisfactorily. And in the letter he asked for an answer, and he is probably riled because he failed to get one!

The listeners have their foibles, just as the broadcasters have theirs. And it is hard to please all the people all the time. In fact, as I have had occasion to argue in this place before, to attempt to do so leads directly to stultification. And some members of the audience will always prove unreasonable. All that is true, but in the last analysis the progress of broadcasting is accelerated by the pressure exerted by unsatisfied patrons. The power level is being raised because people object to getting their music mixed with the electrical racket of the vicinity. The programs are improving because people will no longer listen to feeble stuff, and because they want entertainment as good as that of the best theatres and concerts. Not everybody can keep up with the procession. Well, if some of the stations fall by the wayside, the event is proof, in each case, that there is no place for that station. So let the tomahawks fly, and the devil take the hindmost; the time may yet come when Mr. Hoover will be able to separate stations by so many kilocycles that the "dyne" squeals will be lost in the upper reaches of audibility, and for that and other blessings we shall have to thank, in part, the listener-die-hards.

A Jazz Lover Lifts His Voice

COMMUNICATION from a defender of jazz harmony, Mr. Bernard Kelly of Pueblo, Colorado:

SIR:

You are about to solve a great problem for me. I am one of "Those things" that like their jazz straight, and in these times when radio broadcasters are simply drenching the nation with the polluted stuff, I can't seem to bag it. I thought that I might be trying to operate my set without aerial and ground, but this does not seem reasonable, as I can get any number of salon orchestras, coloratura sopranos, and players of Bach and Wagner. Perhaps atmospheric conditions here are so educated as to shut out the barbaric jazz and give asylum to the classics which nobody else can find. Need I add that I was desolated until I read your December article.

Apropos of your statement: "If you want Jazz issuing from your loud speaker, there are certain wavelengths in every locality where you can get it at any time." I am enclosing herewith a little blank of my own arrangement, together with a stamped, addressed envelope, whereon you, being a good sport, will inscribe these various stations. I use a Roberts Knockout set Let this guide you in your choice, and remember, I'm very choosy about my jazz. I would have been satisfied to get it on the headphones, but your added promise of loud speaker volume greatly pleases me, and in return for this favor, I'll give you a tip. KOA of Denver is one of those stations where they specialize in uplift. They have there some very palatable violinists and pianists, together with an array of songsters who have never heard of Irving Berlin. Moreover, they have just begun to give Spanish lessons. Here indeed is a safe refuge from Jazz.

I await your reply most impatiently.

The blank to which Mr. Kelly refers is prepared with, as can be seen, diabolical ingenuity and thoroughness; its general lay-out will appear from the sample which I am magnanimous enough to print above:

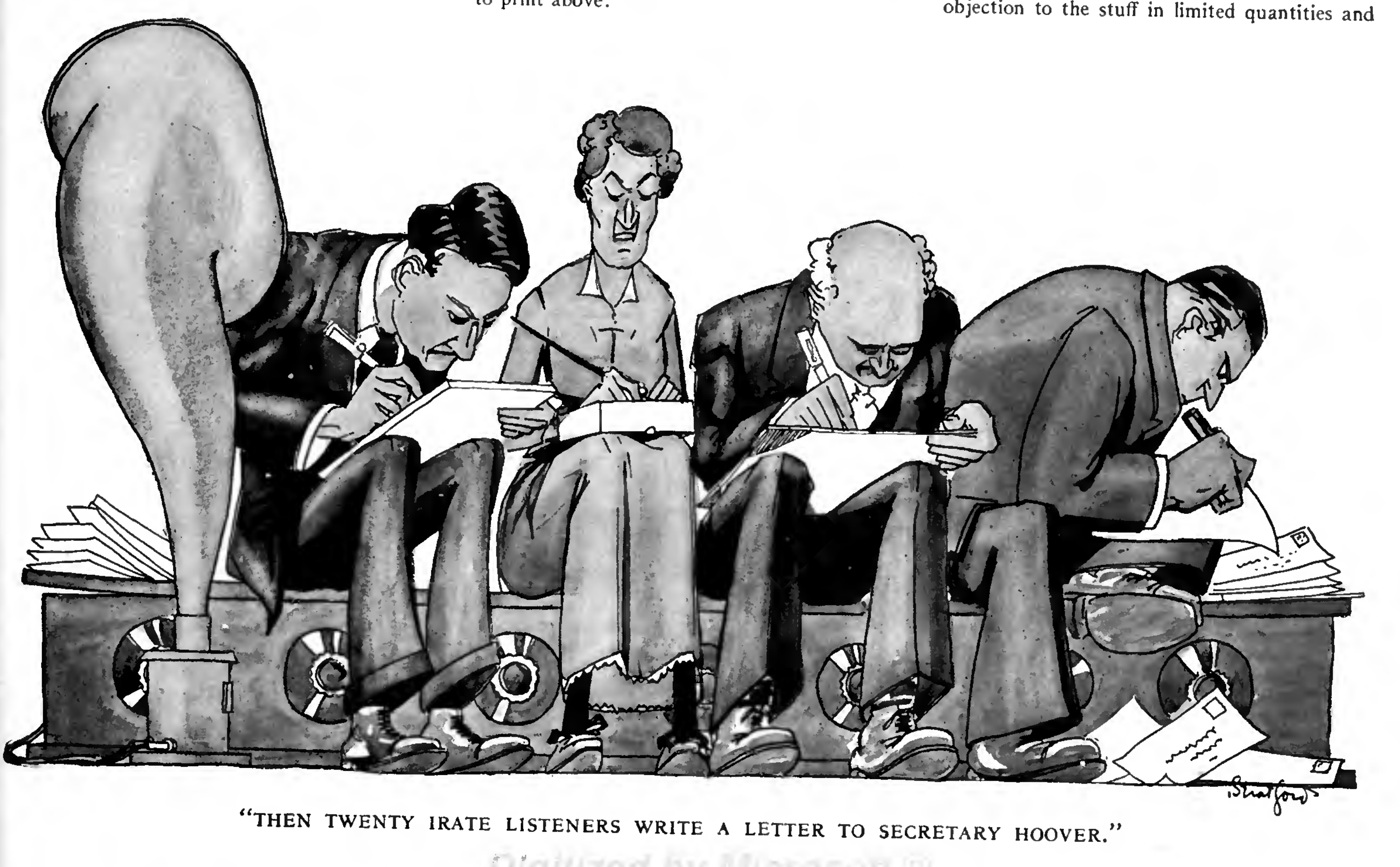
WHERE TO GET JAZZ WHEN YOU WANT IT

Compiled by Carl Dreher

HOURS
Mountain Time

Day	7 P.M.	8 P.M.	9 P.M.	10 P.M.	11 P.M.	12 P.M.
SUNDAY						
MONDAY						

If Mr. Kelly was "desolated" before the appearance of my article "In Defence of Broadcasting" in the December number, by the dearth of jazz on the Colorado steppes, he was in no worse case than I am at this moment. I am not merely desolated, but prostrated, and there is nothing more terrible than to be desolated and prostrated at the same time. In fact, the coincidence of these two acute malaises is so rare and dangerous that I may be able to make some money by exhibiting myself before the annual meeting of the American Medical Association (if they have one), or by travelling with an old-fashioned medicine show (if any still exist). The last time I was so sad was twelve years ago, when my first audion bulb gave up the ghost after two hours of use, leaving me bankrupt and heartbroken. My present grief flows from two sources: first, from hearing Mr. Kelly cry "Jazz! Jazz!" when there is no jazz, and secondly, because I am unable to make good on the sentence which Mr. Kelly has plucked out of my article. It appears that there is a neighborhood where jazz is not always on tap for those who crave its charms. Well, that's certainly too bad. Mr. Kelly might try some suasion on Mr. Talbot, the program man at KOA. If all else fails, he can move to New York, a town which spouts hot jazz as Old Faithful spouts hot water. Above 360 meters one gets it now and then; below 360 meters jazz runs riot. Incidentally, in common with the Hon. Gilbert Seldes, I have no objection to the stuff in limited quantities and



"THEN TWENTY IRATE LISTENERS WRITE A LETTER TO SECRETARY HOOVER."

when it is well done. I would rather listen to a good jazz band than a rotten soloist; there are even times when I'd rather listen to a good jazz band in preference to a good soloist or classical orchestra, depending on my mood. For example, when I write out my income tax check, once a year, I like to listen to jazz; it cheers me up. The only reason I took Mr. Nathan up on this question is that he seemed to think that radio music is practically all jazz, a conclusion with which my battered ears did not agree. And now along comes Mr. Kelly, roasting me by implication, because there isn't enough jazz! I give it up!

Technical Routine in Broadcasting Stations

3. *Monitoring*

THE word "monitor" is one of the contributions of wire telephone practice to broadcasting. Its technical meaning is to listen to what is going over a circuit for the purpose of making indicated adjustments. The principal one of these adjustments, in broadcasting, is the regulation of the amplification, or "gain," as the telephone people call it.

Skillful broadcast monitoring is an art in itself. The necessity for it arises through the fact that radio transmitters cannot be built, at the present stage, to accommodate the extreme ratios in volume of many musical performances. The energy emitted by a symphony orchestra, going full blast, with the conductor sweating like a stevedore and all hands sawing, thumping, and blowing to the maximum capacity of their instruments, is in the ratio of about 100,000:1 to a few of the pieces playing *pianissimo*. This does not faze musicians a bit, but it gives an engineer the willies. The power ratio of machines—the ratio of the maximum power which the machine can handle effectively, to the minimum, is as a rule quite low, probably not more than 10. One cannot build a machine which will have the power of a locomotive, when that is required, and which in the next second can be used to crack nuts efficiently. If it is a good nut cracker, it will not be an adequate locomotive, and if it is a good locomotive it will be lamentably wasteful as a nut cracker. This is from the standpoint of the engineer as a manipulator of energy—raw horsepower. But a broadcast transmitter is not a mere engine. It is a combination of musical instrument and machine. So a compromise becomes necessary. The energy ratio remains large, say of the order 1,000:1, but even so it is only one tenth of one per cent. of the original. The reproduction is not perfectly natural, but it sounds better than it would if the 1,000,000:1 ratio were the basis of operation. In that case the low portions would drop below the noise level, with the result that portions of the performance would be lost altogether. By ironing out the peaks and faint passages to this extent the ultimate quality of reproduction is at its best.

This 1000:1 reduction in ratio is accomplished manually. Of course, in many types of music the actual original ratio is much lower than a million to one, and in that case the reduction should be correspondingly modified, the object of the competent control engineer always being to leave the original alone just as far as the load characteristics and noise level of the broadcasting medium will permit. There are, in general, two types of incompetent control operators. The first is careless; he "lets it ride." Sometimes he lets the level drop so that no one on the outside hears it, and at other times he allows overloading and distortion to mar the performance. The announcements are too high or too low with respect to the music. They should be slightly above the average value of the music, say 60 per cent. amplitude. The second type of undesirable control operation is the over-cautious method, whereby the modulation is ironed out to such a degree that most of the contrast is lost. This fellow constantly pulls down the gain when the music is loud, for fear that it will overload, and brings up the *pianissimo* passages so that the listeners will be sure to hear them. He can't do much to a jazz band, but heaven help the station which lets him loose on a symphony orchestra. A good gain regulator is like a good fighter; he always has something in reserve. He is unlike a fighter in this: he seldom moves fast. Jerky manipulation of the amplification handle is out of order. The movement should be smooth; the only abrupt changes in the music should be those which the composer wrote into it. Of course the whole thing can be gauged better by one who knows the piece being played. He can look ahead and give a more finished performance than the man who has no idea of what is coming next. The gain control should not be moved except when necessary, and then its movement should never be neglected; the competent control operator knows which is when.

HE CRIES "JAZZ, JAZZ," WHEN THERE IS NO JAZZ

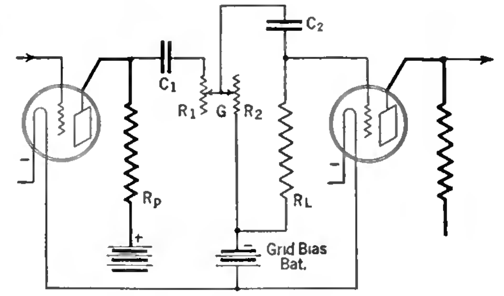


FIG. 1

A "Gain" control in a field control set

On field events, the control should be in the hands of the field technician, he being on the ground and in a better position to judge than the man at the station end of the line. The station engineer sets his gain control once and for all, theoretically, moving it after that only to correct errors on the part of the field man. On studio events the job devolves on the station control operator, necessarily. As a rule, less monitoring is required in the studio, for very large orchestras, organs, choruses, etc., are encountered more in the field.

The usual form of gain control is a potentiometer arrangement carrying only audio frequency and isolated by means of condensers from any d.c. circuits whose variation would give rise to noise. Fig. 1 shows such an arrangement between stages of a resistance-coupled amplifier. Rp is the resistance in the plate of the first tube, C_1 a condenser of the order of 0.5 mfd. separating the gain control and following tube from this plate circuit, G is the gain control, which is so arranged that as one resistance R1 is cut in, the other resistance, R_2, is correspondingly reduced, C_2 is the second isolating condenser, of the same magnitude as C_1, RL is the grid leak of the following tube. Fig. 2 illustrates how, with the contact in one extreme position, C_2 has one side short-circuited to the filament of the second tube, while the resistance R_1 is in series between the tubes, practically blocking the transfer of audio voltages. In Fig. 3, the reverse condition obtains, R_1 being all out, while the total drop of R_2 is available to pass on audio fluctuations to the second triode. This gain control is noiseless, unless the sliding contacts are so bad that they open momentarily,

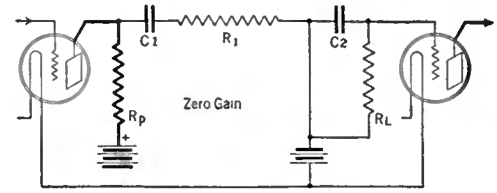


FIG. 2

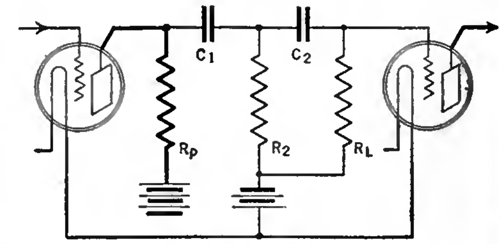


FIG. 3

breaking the connection between the tubes between which the gain control functions.

The crude gain control which is sometimes seen in small stations—a means of cutting down filament voltage on one of the audio amplifiers, is bad because as the emission of the tube drops the impedance rises, resulting in the loss of low frequencies in most cases, as well as other anomalies.

Memoirs of a Radio Engineer

X

IN THE January issue it was related how the Federal legislation of 1912 started to bring order out of chaos in the radio world. The job was not a small one, and now, thirteen years later, it is not yet completed. For as fast as one patch of chaos was ironed out in one place, another, such as broadcasting, bobbed up somewhere else, to keep the authorities busy. That the law was provided with teeth was demonstrated very shortly. A young man who, after the passage of the act providing for station and operator's licenses, had continued to transmit without either, on a wavelength that happened to suit him, was haled to court and fined. This was in 1913, and the incident received considerable publicity. The law had gone into effect December 23, 1912, and by that date about five hundred of the twelve hundred amateurs in New York City had applied for their papers. Those who continued to operate were warned by W. D. Terrell, now Chief Supervisor of Radio, with headquarters in Washington, but then in charge of the New York district. "These amateurs," said Mr. Terrell, "who make it a practice to interfere with business communication, are nearly all known to us. There may be a very few whose whereabouts we have not yet found out, but in a short time, thanks to the efforts of commercial stations and of the vast majority of amateurs, who realize that the delinquencies of these few may call for laws still more strict, we will run them all down." And indeed, after a half year or so, the only unlicensed amateurs left were little fellows with spark coils of limited range; practically all the big fellows had submitted.

I had no transmitting station worth the name, but by this time I was fairly adept at copying and was filling my log book with such entries as the following:

Sept. 10, 1912. 2.27P. Ward liner *Havana*, WH, talking to NY. Distance, 251 miles.
Jan. 11, 1913. 8.00P. MAA, White Star *Carmania*, working MSE.
Jan. 20, 1913. 2.23P. SS *Moltke*, DDM, working MSE. Good sig.
Mar. 1, 1913. 5.15P. KKX, SS *El Occidente*, calling MSE. Comes in well with low tone. Wanted to know if MSE knew where SS *Comus* was.

MSE was the Seagate land station, later WSE, a famous transmitter in its day. It had a 3-kw transmitter with rotary gap.

My log book also contains numerous messages copied from ships and the few land stations around town. Besides WSE, the principal transmitters in the New York district at this time were FNK, the Bush Terminal station of the National Electric Signalling Co., and TWT, operated by the Atlantic Communication Company at 111 Broadway. The latter two had beautiful notes around 1000 cycles, which they maintained with remarkable purity of tone for weeks at a time. Their flute-like whistles enraptured all the amateurs, half of whom would cheerfully have killed a man for a 500-cycle alternator and a quenched gap.

"Wireless telephony" was not unknown, but it was as yet no more than a curiosity. The principal hope of its proponents was that it might supplant wireless telegraphy; its application in broadcasting apparently occurred to no one, as yet. The following report in the New York *Times* shows how radio telephony was regarded toward the end of 1912:

VOICES HEARD BY WIRELESS

Marconi Operator Picks Up Conversation 150 Miles Away

SAN FRANCISCO, Dec. 18.—A demonstration that wireless methods may be used for transmission of the human voice was made on the recent trip of the Pacific Mail liner *San Jose*, which reached here to-day from Panama. Last Monday, while off the Lower California coast, C. H. Kessler, the ship's Marconi operator, distinctly heard conversation while he was taking a wireless message. The conversation was a test of wireless telephones between Catalina Island and the mainland of California, and was carried on 150 miles from Kessler.

At noon, when R. H. Shimek relieved Kessler, he also heard scraps of conversation, as well as music from a phonograph. As several passengers were around the wireless room he gave them individual receivers, and they heard ragtime music distinctly, and even danced around the deck to the tunes. The Captain was called in and heard the music.

This experience was said to be the first of the kind ever recorded, and it suggests that the wireless at sea may yet be handled like the telephone, which would be a great economy in time of transmission, especially in the case of vessels in port.

Antique stuff! Even the words—"wireless," "ragtime," are out of date. And the speculation in the last paragraph was on the wrong track. By far the best way to communicate with vessels in port is by the simple expedient of hauling a telephone cable aboard and hooking up the ship to the nearest exchange. The big ocean liners all have telephone switchboards, and when

". . . THE ENERGY EMITTED BY AN ORCHESTRA GOING FULL BLAST. . . ."

they are at their piers you call up the various extensions just as you call up the local delicatessen dealer or the town dog-catcher. And when they are at sea, the radio telegraph provides a faster and more reliable service than telephony can give. The code cuts through static and interference where telephony would only yield a jumble. Even now only a few ships carry radio telephone transmitters, and they are considered a luxury, although presumably the time will come when the great liners will carry extremely powerful radio telephone sets providing a ship-to-shore service linked up with the land telephone. But the wireless phone did not have to await this development before it could come into its kingdom. Broadcasting supplied that.

Broad Waves and Sharp

ONCE an error has taken firm root the only thing to do is to wait a few centuries until it is forgotten, for you will certainly not get rid of it in any quicker way. Thus, probably a majority of the population still believe that blondes are treacherous, that no one with brown eyes can ever become a great man, that touching a toad will cause warts, and that Aaron Burr was a villain while Alexander Hamilton was an angel. There is no law against believing what one pleases, even though it is wrong. This is likewise true of the almost universal belief among radio listeners and newspaper critics that in some mysterious way the engineers of a broadcast station can sharpen its wave, as if it were a pencil which can be whittled down with a jack knife. Everybody believes it, although it isn't so. It is true of a spark station emitting a decadent wave train, and that is no doubt the origin of this radio superstition. But given a broadcasting station of P meter-amperes modulating a continuous wave of a certain radio frequency Y, modulated at audio frequency X with per cent. modulation Z, the only factors influencing the broadness of tuning in reception are (1) The signal strength at the point in question, and (2) The kilocycles admittance of the receiving set at the said frequency Y. In other words, when people talk of a broadcasting station as having a "broad" or "sharp" wave in the abstract they are emitting nonsense. It becomes sense only when a particular receiving location with known signal strength from the station in question, and the tuning characteristics of the receiving set, are definitely specified. When a listener declares that a certain broadcasting station has a "broad" wave, it usually means that he gets a very strong signal from that station, or that he has a badly designed receiving set, or both. If he says that the wave is "sharp" the conclusion is that the signal is relatively weak, or that the receiver tunes sharply, or both. Assuming the power of the station as fixed, it has no control over either condition.

The Lingo of Radio

Onomatopoeia

THIS disagreeable looking Greek word is applied to those terms which through their sound imitate the thing described. There are a few such words in radio, most of them not of radio origin, however. "Buzzer," for example, and "howling," "squealing," for uncontrolled audio frequency oscillation, as of an amplifier. The older telephone term for this phenomenon, "singing," has not broken into radio to any extent.

The only original radio names which exhibit the tendency toward sound imitation in word formation appear to be the words describing certain kinds of strays: "Clicks," "crashes," and "grinders." "Clicks" are the short sharp impulses, "crashes" are somewhat longer and more bothersome; "grinders" are still longer and may consist of a succession of shorter impulses.

Imported Words: Foreign Influences.

Except from the English, American radio is indebted very little to foreign languages for its radio terminology. The only instance I can recall offhand of a word borrowed outright is the German "litzendraht" for stranded high frequency conductor, and this has been modified into "litz."

It is interesting, however, to note how widely British and American radio terminology differ. The divergence, of course, is by no means confined to radio. Again, a Britisher talks of "ordinary" and "preference" stock, where an American says "common" and "preferred." The following is a comparison of a few British and American radio terms:

BRITISH	AMERICAN
Anode, plate	Plate
Ebonite	Hard rubber
Gear	Apparatus
Components	Parts
Maker	Manufacturer
Factor	Jobber
Earth	Ground
Basket coils	Spiderweb coils
Pile winding	Bank winding
Valve	Bulb, tube
Reaction	Regeneration
X's, atmospherics	Static
Note magnifier	Audio amplifier
Accumulator	Storage battery
Frame aërial	Loop
Jigger	Oscillation transformer spiral helix
Anode (of a tube)	Plate
Low frequency (l.f.)	Audio frequency (a.f.)
High frequency (h.f.)	Radio frequency (r.f.)
Terminal	Binding post
Telegraphist	Operator

The curious term "listen-in," incidentally, appears to be of English origin. Why the "in" was added is as much of a mystery as the appearance of the same preposition in the British slang phrase, "do him in"—"kill him." Whatever its origin, it has led to some horrible compounds, like "listeners-in," which is about as far as one could go if one sat down to invent the most awkward phrase possible.

Why do we speak of an air-core transformer? The case is really one of the absence of a core, and we might better call it a "coreless transformer" or an "air transformer." Of course air is something—witness the trouble we take to get it out of our electron tubes, but is it solid enough for a core? However, we all talk of it in that way.

Why "variometer" to denote a continuously variable inductance? The instrument does not measure anything, so the "meter" part of the name is out of place, and the "vario" is too vague to mean anything. In a less aggravated form, "potentiometer" has the same or similar faults.

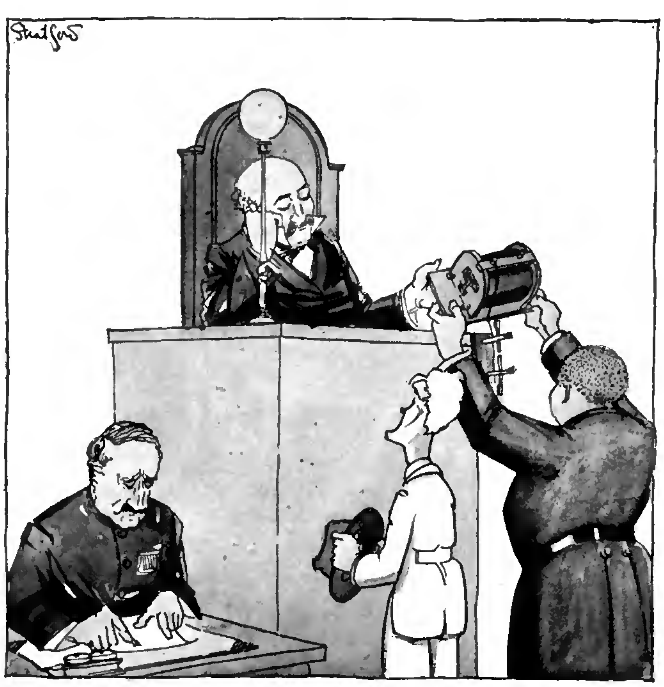
The only thing that can be said in favor of the terms "A," "B," and "C," batteries, for plate filament, and grid bias, respectively, is that they are brief. Such arbitrary designations are very puzzling to beginners. These terms, incidentally, date back to the invention of the three-electrode tube.

Of late years, some effort has been made to achieve uniformity in the use of suffixes in speaking of the common electrical properties. On this basis it is not correct to speak of "resisance" coupling in an amplifier; one should say "resistive" coupling. An "induct*or*" is the physical object or coil possessing the property of "induct*ance*"; its effect is "induc*tive*." Likewise "resistor," "resistance," and "resistive"; "capacity," "capacitance," and "capacitive." However, no one will be arrested for using the wrong suffix.

Proper Names

THE Alexanderson alternator, the Poulsen arc, the Heaviside layer, are instances where the name of a man of original ideas has become attached to a machine or theory. The common electrical units, also commemorate the names of great scientists, as the *farad* (Michael Faraday), the *ampere* (after André Marie Ampère), the *volt* from (Count Alessandro Volta), and the *henry* (Joseph Henry—an American physicist, incidentally). Then there is poor Pierre Vernier, who died in 1637 after inventing an attachment for indicating accurately parts of divisions in linear measurements, and never conceived of a radio set—and his name is applied to the fine adjustment of variable condensers three centuries later!

Radio terms derived from the various older engineering arts are too numerous to mention. Such words as "decrement," "eddy currents," "secondary," "primary," etc., are of old standing in electrical science. The various prefixes which denote magnitude, such as "meg" (one million); "kilo" (one thousand); "milli" (one-thousandth); "micro" (one millionth); and their combinations, are all in general scientific use and not peculiar to radio.



"A YOUNG MAN WAS HALED TO COURT"

Standards for the Home Laboratory

How the Home Experimenter Can Build and Use the Necessary Standards of Inductance, Capacity, and Resistance—Essential Tools for All Kinds of Experiments—More Suggestion for the Ambitious Home Experimenter

By KEITH HENNEY

Director, Radio Broadcast Laboratory

THERE are two stages in the life of any experimenter whether he be inclined toward chemical, mechanical, or electrical pursuits. The first stage may be represented by the desire to do something of an experimental nature, it matters little what, as long as something happens. The second may be marked by the experimenter's desire to know what has happened, if anything, and how much of it has happened. Any one can hook a condenser across the antenna and ground of a receiver and note what happens. Any one can attach a coil across that condenser and have a wave trap. But after a few preliminary bouts with a tricky device of this nature, the experimenter will probably plot a curve of the thing, showing what happens to certain frequencies when the condenser is varied.

This business of wanting to know what happens, and how much, when the condenser is tuned, signalizes the entrance of the radio experimenter into the second stage of his career. Lord Kelvin, one of the world's greatest experimental and mathematical scientists, is credited with saying that any research enters upon a scientific basis when actual figures are put down on paper, when the experimenter knows how much, and when, and begins to get some idea of "why."

Just as building radio receiving sets palls on most any one after the dozenth is completed, so will endless and aimless experimenting get to be stale sport unless there is something to look forward to.

The staff of RADIO BROADCAST Laboratory has prepared a number of experiments for those who are interested in the more serious side of radio research, and the essential apparatus will be described from time to time. The first article of this series, in the September RADIO BROADCAST, described a simple vacuum tube oscillator for the home experimenter that in the Laboratory has proved to be of endless service. It consists of a radio-frequency oscillator, a miniature broadcast station in fact, which is modulated with an audible tone. The uses of this oscillator were described in the December magazine. The present article will deal more with the uses of this device and mention a few lines of experiment along which the home constructor should work.

MORE than one satiated home constructor has written us that this series of articles by Mr. Henney, the director of our Laboratory, has caused them to renew their subscription to RADIO BROADCAST *and to take a new interest in the technical side of radio. Dust that has collected on soldering iron and pliers is shaken off, and unused parts in the miscellaneous pile of odds and ends owned by every constructor worthy of the name are assuming a new value. There are many among the amateur radio folk who have the feeling that if they could just learn a bit more about what could be called the laboratory fundamentals of radio, they would be able to make considerable progress in the art, and perhaps even make a discovery of some importance. We believe that these articles, of which this is the third, will be of great value to these inquisitive souls. Those two valuable Government radio books,* Bulletin No. 74 *of the Bureau of Standards, and* Principles Underlying Radio Communication, *published by the Army Signal Corps are used as bases in the present article. Every radio enthusiast who really wants to learn more about the art should own these volumes, which can be had from the Government Printing Office.*—THE EDITOR.

WHAT ARE THE ELEMENTS OF RADIO?

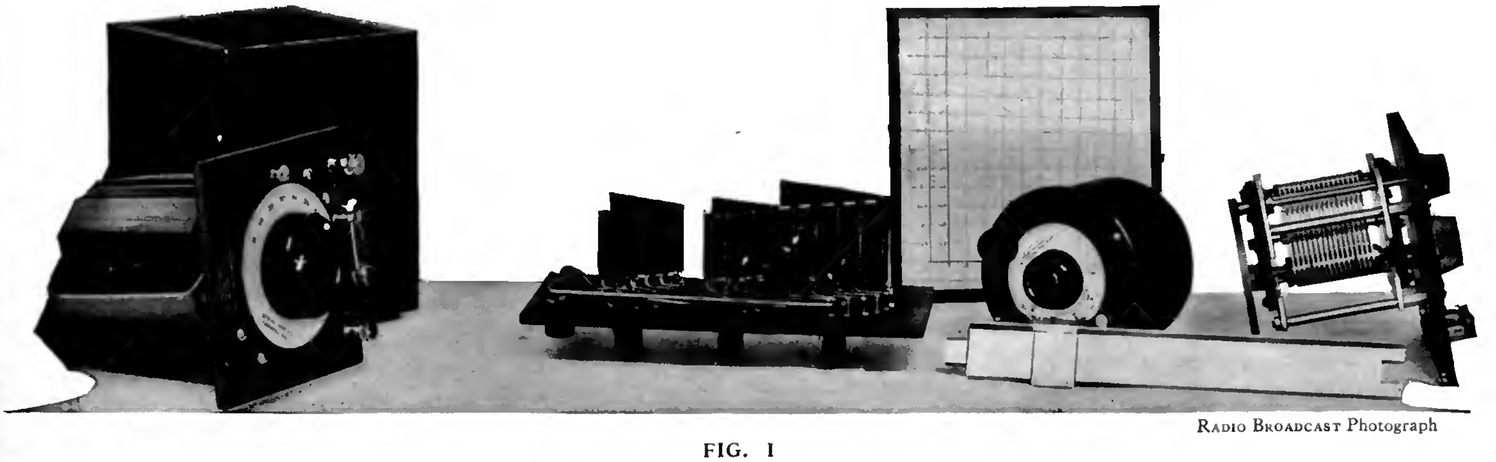
THE apparatus used in radio consists largely of two simple elements, inductance and capacity, that is, coils and condensers. Each of these components of oscillating circuits has resistance, so the experimenter has to deal with three important electrical quantities, inductance, capacity, and resistance, and for practically all of his work he uses these quantities in varying proportions and in various relations to each other. He winds a coil and finds that it will tune to a certain frequency band with a .0005-mfd. condenser. He may feel that tuning is broad. He knows then that there is resistance in the coil, too much resistance perhaps. But he wants to know how much, how to reduce it, and what is the practical limit of reducing resistance.

In other words, he wants to know "how much?"

To do exact or even approximate work, the research engineer and the home experimenter alike must know to a certain degree of precision the constants of the apparatus with which he works. To know that one's apparatus is correct to within a certain per cent. is to know that one's results will be valuable to that extent. Accurately designed equipment, carefully calibrated, inspires a degree of confidence in the worker that will be one of his best assets.

In any well equipped Laboratory, the question "how much?" is answered in one of several ways. The simplest method and the one most often employed is a comparison of the apparatus under test with some high grade standard. For instance, one builds a coil. He wishes to know its inductance and perhaps its resistance. By a complicated series of experiments he may arrive at both of these values, but by a simple comparison with a coil already measured he may arrive at the answer in a short time.

Among the first acquisitions to a home laboratory, then, are standards of inductance, capacity, and resistance with which all unknown coils, condensers, and resistances may be compared.



RADIO BROADCAST Photograph

FIG. 1

Some of RADIO BROADCAST Laboratory's standard apparatus. Note the peculiar construction of the "inner works" of the resistance box. The other apparatus is a standard variable condenser and a variometer which is used as a standard of inductance. An idea of the size of the equipment may be judged from the ever-useful slide rule which is just 10 inches long

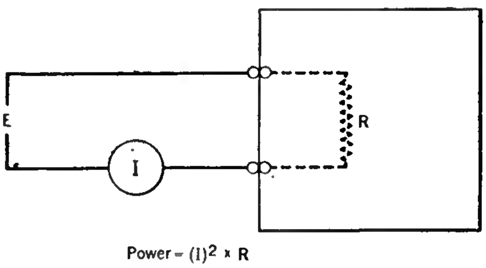


FIG. 2

This represents a source of direct current energy feeding a load which is in the box. If the ammeter is not accurate, the amount of power used cannot be correctly computed

These standards must be carefully made and accurately measured. Fortunately, the construction of a coil is sufficiently simple that anyone can do it, and thanks to the work of the Bureau of Standards physicists, the home worker can calculate its inductance with sufficient accuracy for all ordinary work. Fortunately, too, he may construct a standard of capacity, or at small outlay he may purchase a variable condenser equipped with a dial calibrated in micro-microfarads, such as the General Radio No. 247.

The importance of knowing the accuracy of one's equipment may be illustrated by the following experiment. Fig. 2 represents a source of direct current feeding a certain "load" which is in the box. We desire to know how much power in watts it required. Knowing the resistance of the box and having an ammeter in the circuit, it is a simple matter to compute the power for

$$\text{power} = (\text{current})^2 \times \text{resistance}$$

where power will be in watts provided the current is in amperes and the resistance is in ohms. If the resistance is one ohm and our ammeter says that ten amperes are flowing, we get from our formula $(10)^2 \times 1 = 100$ watts. But if our ammeter reads ten per cent. too low, in other words it is only 90 per cent. correct, 11 amperes will actually be flowing and the power will be 121 watts, an error of twenty one per cent.

Or suppose that we want to design an inductance that will tune to 1000 kilocycles (300 meters) with a condenser of .00025 mfd. capacity. At this frequency, the product of the capacity in microfarads and the inductance in microhenries is .025331, so that the inductance value must be 101.32 microhenries. If we design such a coil and our measurements show that it has this value when it is actually ten per cent. greater, that is, 111.45 microhenries, the frequency will be about 950 kilocycles (315 meters). These values come from the relation between frequency, inductance, and capactity.

$$F = \frac{1}{1.884\sqrt{LC}}$$

Such errors are discouraging to any worker, and to one who wishes to make accurate experiments or apparatus, they are hopeless.

Examples of some of RADIO BROADCAST's standards of inductance, capacity, and resistance are shown in Fig. 1. They are made by the General Radio Company. Similar apparatus may be obtained from Leeds and Northrup, the Cambridge Instrument Company, and others. The list numbers and prices for the General Radio Equipment are given below:

Resistance Box,	Type 102-K .1-, 1-, 10-, 100-ohm units . .	\$47.00
Capacity	Type 239-E .001 mfd. .	19.00
	Type 247-E .0005 mfd. .	5.50
Inductance	Type 107-G 100 to 6000 microhenries . . .	24.00

A standard fixed capacity is a good addition to any laboratory and may be constructed of metal plates with air dielectric. Neglecting minor corrections, the capacity of such a condenser may be calculated by the following formulae

$$\text{Cmmf} = \frac{.0885\,S}{T}$$ Where S is the area of one plate in sq. cms. Where T is the distance apart of the plates in cm.

$$\text{Cmmf} = \frac{.225\,S}{T}$$ Where S is as above in square inches Where T is as above in inches

If some other insulator than air separates the plates, such as mica, or glass, the formula will not hold, and the home constructor is not advised to stray from the use of air in his standard condenser. It has the advantage that it is of constant "dielectric" value. Its use makes it possible to calculate the capacity fairly accurately, and like all apparatus supplied by nature, it is free. As an example, two square plates 10 cm. on a side, separated by one mm. of dry air will have a capacity of 88.5 mmf. as shown below

$$\text{Cmmf} = \frac{.0885 \times 10 \times 10}{.1}$$

$$\text{Cmmf} = 88.5$$

A good variable condenser may be any of the commercial types. The General Radio Type 247 is specially valuable if provided with a calibrated dial. The standard should have a capacity of about .0005 to .001 microfarad, should not be equipped with a stop so that the plates may be rotated through a full revolution without bringing up against a metal pillar with a thud sufficient to move the plates on the shaft. This would invariably spoil the calibration of the instrument. It should be of the old fashioned straight line capacity variety since the curve of such a condenser will be a straight line as is shown in Fig. 3 which is the calibration of the Laboratory's standard.

The ordinary small bypass condensers are not at all suited for laboratory standards. They have been known to depart as much as 50 per cent. from their rated capacity and are not independent of external conditions such as moisture and temperature. Sangamo fixed condensers, however, have been found to be within 10 per cent. of their rated capacity and are usually within 5 per cent. It is probable that manufacturers of similar condensers will furnish ones of measured capacities at slightly increased cost. Variables with calibration curves may also be obtained from well-known manufacturers, or they may be sent to RADIO BROADCAST's Laboratory where they will be calibrated at a nominal cost.

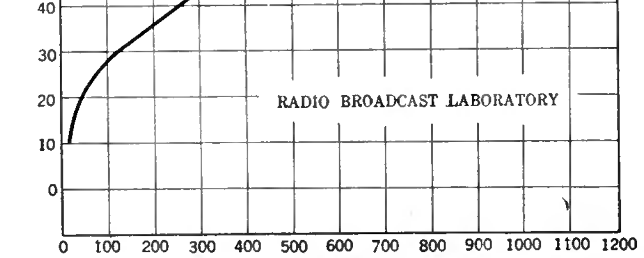


FIG. 3

A calibration curve of the standard condenser shown in Fig. 1. It is of the "straight line capacity" type and is an excellent standard

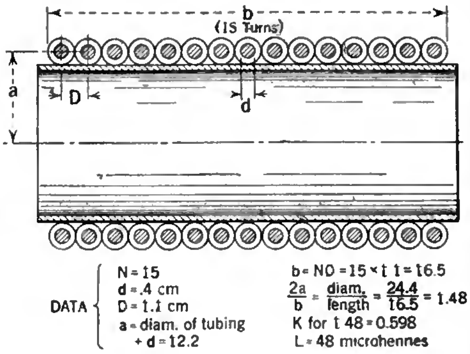


FIG. 4

Essential dimensions for a coil whose inductance will be 48 microhenries. The dimensions are those that are to be fitted into the formula given in the text

INDUCTANCE STANDARDS MADE AT HOME

THE construction of an inductance standard should present no difficulties to the experienced home constructor. He should procure a coil form, bakelite, hard rubber, glass, cardboard soaked in paraffine, or some other insulating material, wind it full of No. 18 d.c.c. wire, attach the ends of the wire to small binding posts at the ends of the tubing, and calculate the resultant inductance. Fig. 4 shows the essential dimensions of an inductance in centimeters and gives the values to fit into the inductance formula below, which may be found in the Bureau of Standards Circular No. 74, and the Signal Corps Book, *Principles Underlying Radio Communication*

$$\text{L in microhenries} = \frac{.0395 A^2 N^2 K}{C}$$

The method of applying the data to the formula is shown below. The constants are taken from Fig. 4.

$$L = \frac{.0395 \times (12.2)^2 \times (15)^2 \times .598}{16.5} = 48 \text{ microhenries}$$

These values may be found on Page 386 of the Signal Corps Book already mentioned and a drawing of such a coil is shown there too. As another example a single layer coil on a five-inch form 11 inches long and having a total of 150 turns will have an inductance of a little over one millihenry. This is too large for ordinary radio measurements over the broadcast band of frequencies, since the coils ordinarily used have an inductance of from .1 to .5 millihenries, or 100 to 500 microhenries.

The factor K in the above formula varies as shown below. The inductance may be more accurately calculated if the coil is somewhat longer than its diameter. Attention is also called to the coil inductance chart published in RADIO BROADCAST, May, 1925, Page 46.

DIAMETER / LENGTH	K	DIAMETER / LENGTH	K	DIAMETER / LENGTH	K
.10	.959	1.25	.638	3.00	.429
.25	.902	1.50	.595	3.50	.394
.50	.818	1.75	.558	4.00	.365
.80	.735	2.00	.526	5.00	.320
1.00	.688	2.50	.472	6.00	.285
				8.00	.237

After the coil is wound it should be given a coat of collodion, a performance that will cause many eyebrows to lift. Collodion, so it is said, increases both capacity and resistance of a coil. This is true, but for a standard of inductance one must have a coil that once calibrated will not

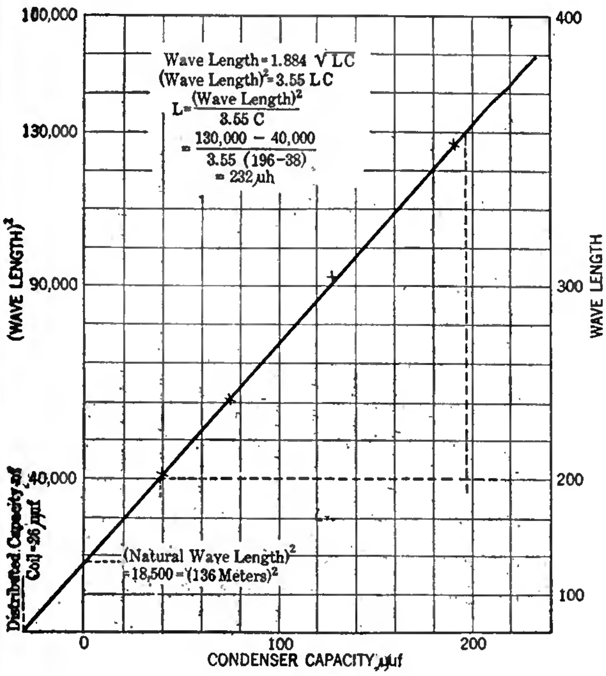


FIG. 5

An interesting experiment that any one with a calibrated condenser and a source of radio frequency voltage—an oscillator, or signals from broadcasting stations—can perform. This curve was made from data on a rather poor coil, poor in that its distributed capacity is higher than is desirable

vary. A coil whose wire is firmly held together and to the form and made moisture proof will have fairly fixed constants. The fact that its resistance and capacity are somewhat greater than desirable for a tuning coil need not bother us at all since it is only to be used as a means of comparing inductances.

INDUCTANCE-CAPACITY EXPERIMENTS

HERE is an interesting experiment that any one can perform provided he has a calibrated condenser, a coil, a source of oscillations variable over a certain range of frequencies, and a simple receiver. The source of oscillations may be broadcasting stations whose frequencies are known, or the radio part of the modulated oscillator; the receiver can be anything that oscillates, from a single-circuit blooper to the detector circuit of a Roberts, a Browning-Drake, or any similar receiver.

The coil is shunted by the condenser and tuned to various frequencies. To tell when it is tuned, the inductance should be brought near the tuning coil of the receiver. When the coil-condenser unit is accurately tuned to the incoming frequency to which the receiver is already in resonance, a sharp click will be heard in the telephones indicating that enough energy has been substracted from the oscillating detector by the tuned circuit actually to stop oscillations. A different frequency is then chosen and a new point determined. After several of these points have been found, a curve is made, plotting the wavelength squared against the shunt capacity as shown in Fig. 5. This should result in a straight line which is really a picture of the formula,

$$(\text{wavelength})^2 = (L \times C) \times 3.55$$

The chart in Fig. 5 shows the method of ascertaining the inductance of the coil, its natural wavelength, and its distributed capacity. This experiment does not give accurate results, but it will give the home constructor several hours of enjoyment. He will find that some coils will have large distributed capacity—which is bad—and that when this capacity is large that the coil will not tune to the higher frequencies (lower wavelengths). He will be able to compare the value of inductance determined in this manner with that calculated from the formula already given. He will begin to see how coils and condensers perform when they are in a receiver.

The data for Fig. 5 is as follows:

Cmmf	FREQUENCY	WAVELENGTH	(WAVELENGTH)²
75	1,224 KC.	245	60,000
125	985	305	93,000
190	845	355	126,000
250	736	407	166,000
325	674	452	205,000
380	605	495	245,000

L from curve = 232 mh.
" as measured on bridge = 210 mh.

Now that descriptions of both capacity and inductance standards have been given, and it is assumed that the home constructor has added such apparatus to his laboratory, it is necessary to have some method by which they can be used to measure other unknown coils and condensers. The simplest method is by the use of a slide wire bridge as shown in Fig. 6. It consists of a straight piece of wire of uniform thickness, preferably of one of the high resistance alloys such as manganin, advance, nichrome, or similar wires and about two feet of No. 24 will make a very good bridge.

The exact resistance is immaterial, although it should be as high as is consistent with mechanical strength. Too fine a wire will not last, and too large a wire will not have sufficient resistance. No. 24 seems to be a fair compromise. A scale divided in some convenient manner is fixed below the wire so that the ratio between A and B may be easily read.

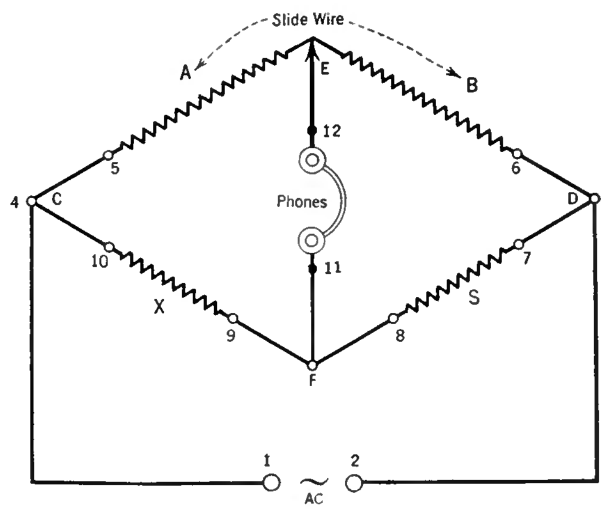


FIG. 7

The principle of the slide wire bridge. When no sound is heard in the telephones, there is a simple ratio which exists between the various "arms" of the bridge so that the unknown may be calculated

Binding posts are provided so that telephones, the a. c. voltage, and the standard and unknown inductances, or other apparatus, may be attached. Extra binding posts should be provided so that fixed known resistances may be added to the two arms of the bridge to increase its usefulness as indicated later.

The principle of the bridge is shown in Fig. 7. Here are four arms, A, B, X, and S. These arms may be resistances, capacities, or inductances, or they may be combinations of these three variable quantities. Usually, and as in this case, A and B are pure resistances with a variable tap X represents the unknown being measured, S is the standard.

An alternating voltage is placed across the bridge as shown in Fig. 7 and a pair of telephones

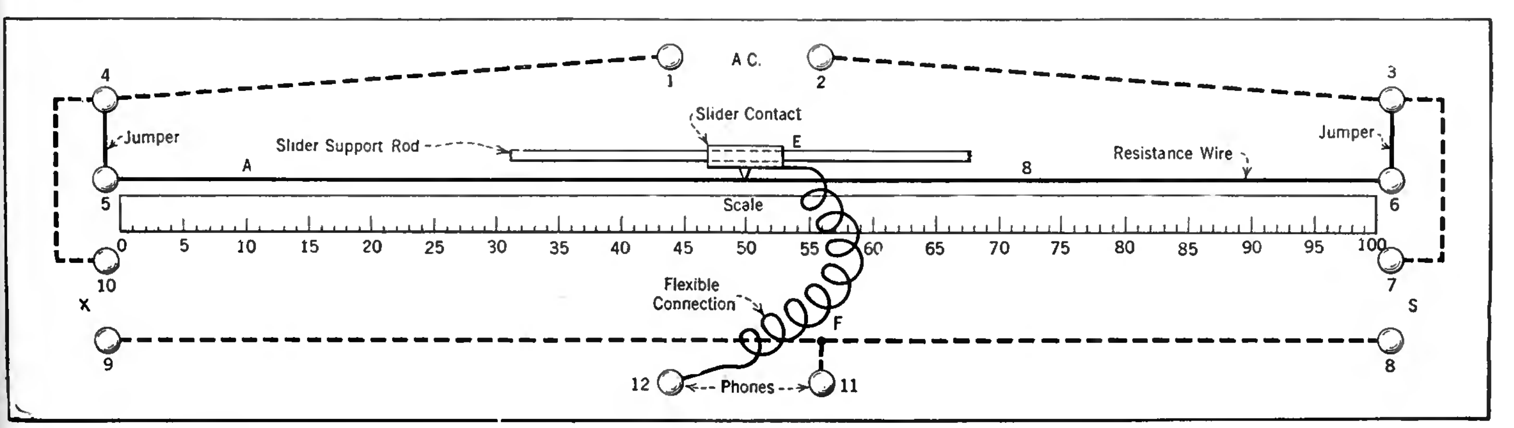


FIG. 6

A simple slide wire bridge by means of which comparisons may be made between unknown capacities, resistances or inductances and laboratory standards. In a home or commercial laboratory such a device is extremely useful are used to indicate a balance. The a c. voltage may be supplied by a buzzer, or better by a vacuum tube oscillator, such as the audio part of the modulated oscillator already mentioned.

In practice, the unknown is placed at X, the standard at S, and the variable slider moved along the slide wire until the sound in the phones is balanced out. At this point the voltages at the points C and D are equal (no voltage difference across the receivers) and the following relations hold:

$$(1)\ I_1 A = I_2 X$$
$$(2)\ I_1 B = I_2 S$$
$$(3)\ \text{Divide (1) by (2)}$$
$$\frac{A}{B} = \frac{X}{S}$$

The result is that the same ratio between X and S exists that holds for A and B, and this latter may be easily read from the graduated scale below the slider. For resistance and inductance it means that X may be found by substituting in the above equation and for capacity the inverse relation is the true one. That is, for capacity:

$$\frac{A}{B} = \frac{S}{X}$$

For example let us suppose that we have placed our standard inductance at S and an unknown at X and that when no sound is heard in the phones, or a minimum sound, the slider lies at 40. Then A=40, B=60 and

$$\frac{40}{60} = \frac{X}{500} = 334 \text{ microhenries}$$

provided the standard is known to be 500 microhenries. If we were measuring capacity and the standard S was equal to .001 when the slider read 40 and 60 for the arms A and B the ratio would be

$$\frac{40}{60} = \frac{.001}{X} = .0015 \text{ microfarads}$$

MAKING RESISTANCE STANDARDS

THE construction of high frequency resistance standards presents a more difficult problem to the average constructor. Such resistances should have neither capacity nor inductance, and that's the trouble. They should also be independent of the current passing through them; in other words their resistance should not vary as they warm up.

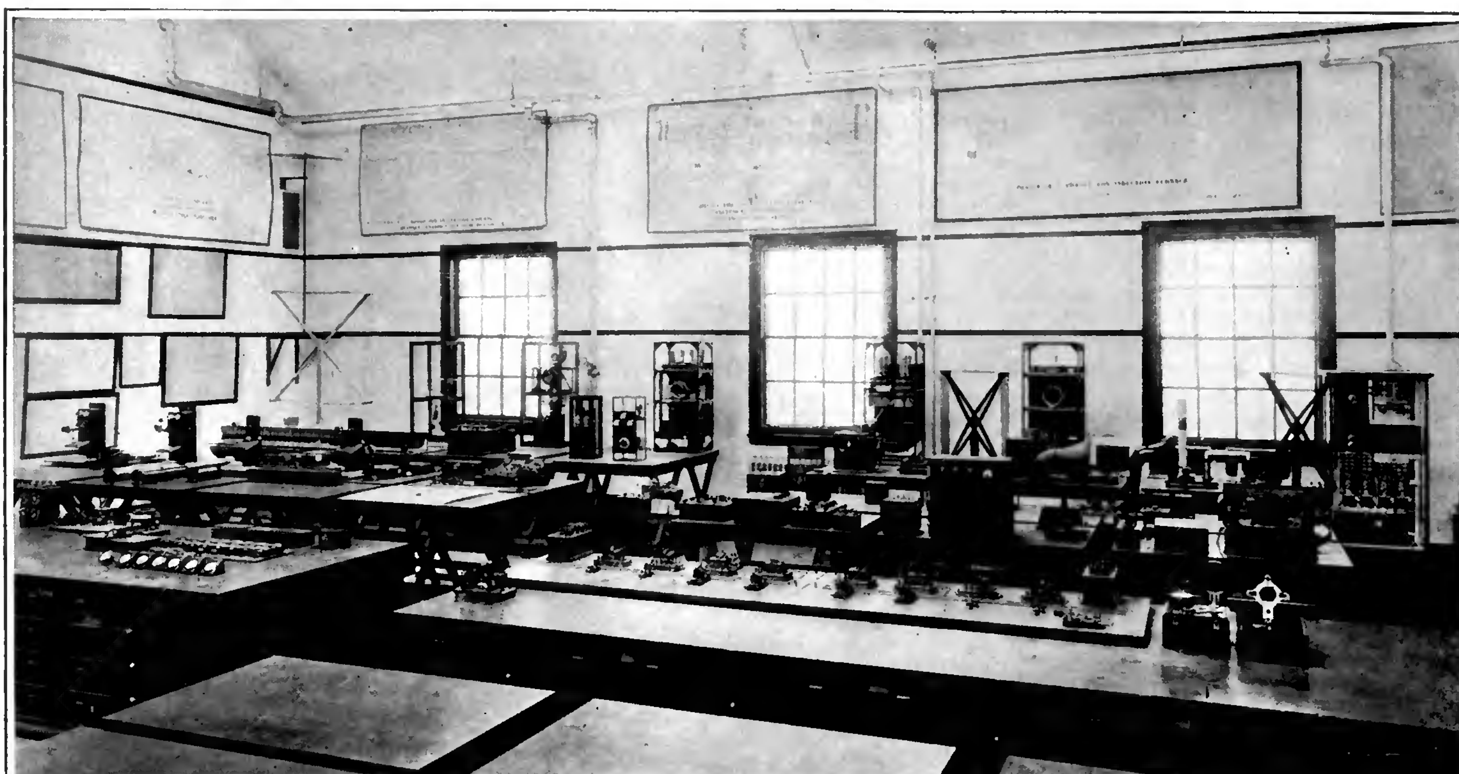
For high frequencies there is no resistance unit that will be better than a single straight wire as short as possible. It has negligible inductance at ordinary frequencies. Until the construction of such units are described in RADIO BROADCAST the reader is referred to the Bureau of Standards *Circular No. 74*, sixty cents, or to an article by John M. Clayton in the October, 1925, *QST*.

Mr. Clayton uses maganin wire, B & S gauge No. 38 to 44, and for resistances from .1 to 30 ohms, the wire will be one quarter to 2½ inches long. The ends are soldered, with a minimum of solder, to heavy copper wires and the resistance part of the unit sealed into small glass tubing so that it will be protected. After these units are constructed, they must be measured on some sort of bridge and that is where the average home constructor will have the greatest difficulty—for he must have a standard resistance to begin with.

The process of making such a set of resistance units will be described soon, and at the same time the proper procedure to have them measured will be outlined.

With the modulated oscillator, inductance and capacity standards, and the simple slide wire bridge the home experimenter can do many interesting things. He may investigate the distributed capacity of coils, he may neutralize his receiver which may be built from coils whose constants are known and whose tuning range may be calculated in advance. He may measure the inductance and capacity of home made or manufactured material. When he buys a by-pass condenser he may actually find out what its capacity is, and many will be his surprises.

Throughout his investigations, the home experimenter should keep a careful notebook. Everything should be put down that seems to have any significance at all. The worker can never tell when his data may be useful in the future. It may save him considerable time to be able to turn to page so-and-so in his note book and find an exact calibration of this condenser, or variable inductance, or the frequencies a certain combination of coil and condenser will tune, or the capacities of certain fixed condensers that are about the laboratory. And if unexplicable happenings take place, let the experimenter put down as nearly as possible what he believes is taking place, circuit diagrams, the constants of all apparatus—perhaps at some future time such data may be useful in patent cases. One can never tell in these busy days of radio invention.



A WELL EQUIPPED RADIO LABORATORY

A view in the electrical engineering laboratory of Rennsselaer Polytechnic Institute at Troy, New York. The home experimenter can never hope to attain an expensively equipped laboratory with all the various instruments found in such laboratories as Marcellus Hartley at Columbia and Cruft at Harvard and in other Universities. But much of the equipment can be made, and not very expensively at that, by the constructor in his own laboratory. As much constructional material of that sort as possible has been and will be described in this series of articles

The Listeners' Point of View

Conducted by ...... John Wallace

Wanted: A Radio Shakespeare!

FROM Mr. Edgar H. Felix of New York City we have received the following pregnant theme, upon which he has invited us to improvise variations:

"One of the problems which vex radio program managers is the discovery of suitable text for dramatic recitations. More frequently than not, the broadcast listener finds the efforts of would-be dramatic artists a program of confusion because so much that is essential is either missing or requires the bolstering of tedious announcement. One outstanding exception is found in the prolific works of Shakespeare, which offer a repertoire to meet the needs of every conceivable kind of dramatic talent.

"Shakespeare contended with the very problems which make broadcasting performances fail. He, too, was practically limited to the sense of hearing in his presentations, because stage lighting and scenery were not developed in his day. A few uncertain candles, which hardly served to guide the almost unseen actors to their position on the stage, were the only sources of illumination. There was no scenery; colored drapes indicated the surroundings; green a field, blue a sea, and so forth.

"Appreciating these handicaps, Shakespeare always worked into the actor's lines all the essential information which makes an aural rendition both understandable and enjoyable. There is a wealth of description which performs the function now served by stage setting, scenery, and illumination, and which permits of complete appreciation through the medium of the microphone."

By way of checking up on Mr. Felix's very interesting point, we picked up a volume of Shakespeare—it happened to be Hamlet—and found in the first ten lines examined a demonstration of the truth of Mr. Felix's suggestion: "Shakespeare always worked into the actor's lines all essential information."

HAMLET

ACT ONE SCENE ONE

Elsinore. A Platform before the Castle
Francisco at his post. Enter to him Bernardo.

Bernardo. Who's there?
Francisco. Nay, answer me: stand and unfold yourself.
Bernardo. Long live the king!
Francisco. Bernardo?
Bernardo. He.
Francisco. You come most carefully upon your hour.
Bernardo. 'Tis now struck twelve; get thee to bed, Francisco.
Francisco. For this relief much thanks: 'tis bitter cold, and I am sick at heart.
Bernardo. Have you had a quiet guard?
Francisco. Not a mouse stirring.

This play was probably first presented in broad daylight, in a circular, roofless building (as this sort of theater preceded the walled in, candle-lit type). Doubtless a hot noon-day sun was beating down on the actors while they recited their lines. Probably there was no scenery. Yet all necessary information was conveyed to the audience of London citizenry, and not in an obvious and uncomfortable manner. First they were told the names of the characters. Secondly they were informed that it was twelve o'clock at night. Thirdly they learned that it was bitter cold. And fourthly, that the death-like silence of midnight prevailed (though probably the theatre was echoing with the noise of boisterous late comers).

Mr. Felix's immediate point, and a well taken one, is that Shakespeare be drawn on more frequently for dramatic recitations. As a matter of record this has occasionally been done. We have happened on a couple of instances. The "To be or not to be" soliloquy was recited by Basil Sydney, the star of *Hamlet—In Modern Dress* over WOR some time ago. This station also presented a group of readings, by whom we've forgotten, from *The Taming of the Shrew* and *Macbeth*. Station KOA had a program in which one John Connery portrayed the various characters in the grave-digger scene from *Hamlet*.

However, even at best, it seems unlikely that recitations will ever make an astounding success with radio audiences. The most potent idea suggested by the above letter, we think, is that all aspiring radio-playwrights be required to read and assimilate in their entirety each and every one of Shakespeare's dramas.

For the radio play has, to date, proved to be an utter and complete washout. Of the many we have heard we know of no one we would call a complete success. Several were fair. The large majority were terrible. Once we thought we had

THIS
Gentle reader, is not the culinary staff of WGY broadcasting recipes for home brew but the Players of said station putting over a one-act play called "Danger" and having to do with lovers buried in a coal mine

a good one: it had held us breathless, spellbound, and so forth, for fully ten minutes —but just then a shooting occurred and we spent the rest of the play trying to figure out who in thunder had been killed.

Now if recollection immediately rushes to your mind of some radio play which you heard and thought was a wow, we plead guilty to an occasional absence from the loud speaker and protest that that must have been one we slipped up on. Dwelling upon those we have heard, we are unable to decide whether, as an average, the plays or the actors were worse. We're inclined to hand the palm to the latter.

But in fairness to the radio Thespians it should be observed that theirs is a more difficult task than that of their brethren on the visible boards. The stage actor is assisted by props, costume, action, gesture, and makeup. If all these accessories are of high standard, his cerebral and vocal deficiencies may be partly overlooked, or at least not seem quite so glaring.

Not so of the radio actor. His ability to put over his part is exclusively dependent upon his ability correctly to understand and interpret his lines and upon his natural vocal endowment. We advance this point, not because we think it to be an obscure one, in the ferreting out of which we have exhibited great acumen, but because, obvious as it is, it does not seem to have occurred to radio play producers. Their radio players are made up, for the most part, of second rate hams who would in no wise add to the glory of a third-rate stock company.

As a matter of fact, nothing short of an all-star cast culled from the headliners of the legitimate stage would be able to put across a flawless radio play, so difficult is the chore. Such a cast we may not expect; but at least we may ask the station directors to come a little closer to it. High school dramatics may be endured while we are waiting for little Oswald to go up for his diploma, but they are likely to be tuned-out when they come via radio.

When, occasionally, we have heard a genuinely competent and experienced troupe of players perform, they have almost invariably been weighted down by some impossible stage piece that defied their most valiant efforts to transmogrify it into a radio-piece.

Drama is one of the most difficult of all forms of writing, and, perversely, of all forms of writing the most easy to criticize. Easy to criticize because we need rely on no objective standards or canons of judgment; our personal reaction is the final criterion. We may know nothing at all of the craft of acting, yet we are justly entitled to pass on acting. If the actor succeeds in creating the illusion of reality (or of unreality, as the case may be) we declare him to be a good actor. If he creates no illusion but simply remains an "actor" we call him a bad actor. Simple!

So we feel encouraged to state dogmatically that we have never heard a radio play worth two bent pins and war tax. For we don't recall having ever been completely absorbed in, or carried away by one. We have never experienced any difficulty in getting "back to earth" after listening to a radio play; to us at least, every radio play has remained just a "radio play" from start to finish. The reason for their unsuccess has been stated so often it has become banal: "Radio is an entirely new medium and requires an entirely new and distinct type of play." Yet, in spite of the frequent reiteration little has been done about it.

Now comes news of a new radio play contest, and our hope perks up. Perhaps something may come of it. Station WLS, of Chicago, and the Drama League of America are its joint sponsors. It is press agented as the first radio play contest in the world, which is not entirely correct. The General Electric Company opened a similar contest in 1923 which continued about six months, closing on December 31 of that year. In this contest a $500. prize was offered for the best play, and ten additional prizes were given for manuscripts thought to be satisfactory for radio presentation. WGBS, New York, conducted one last year, and several others of purely local import have been held. But at any rate the WLS contest is a pretentious undertaking and should bring interesting results.

The prizes are sizable if not munificent; first award is $500. And the judges are George Arliss, Augustus Thomas, and James O'Donnell Bennett. Doubtless by the time this appears in print, the prizes will have been long awarded and the plays will have been aërially presented. But the rules governing the contest may be still of interest and we quote some of them, as outlined by George Junkin, field secretary of the Drama League:

Radio will not allow any sly stage business. Glances, asides and business with props cannot be put over, to the radio audience. Entrances and exits must in some way be told in the action of the play. Just as the movies brought about the new drama and a new way of presenting it, so will radio. Sounds will be the principal vehicle. Bells of all sorts, church, dinner, telephone, house and others can be used to advantage. Rain, storms, musical backgrounds, horse, airplanes, automobiles, all have sounds which can be duplicated and will lend life to the words and action of the radio play.

Any play submitted must be original and not have been printed.

Original one-act plays, eighteen to twenty-five minutes in length.

Few characters—maximum, five principals.

Accompany action with appropriate sounds.

Farce, comedy, drama, melodrama, tragedy and mystery plays.

Plays must be clean, wholesome material.

Plays should not have material which would be objectionable to any sect or nationality.

Write plays as though they were to be produced for the blind.

Everything necessary in the action must be made plain.

With due appreciation of Mr. Junkin's suggestions, we hope that too many contestants will not go in for the clanging bells, galloping hoofs, and wailing wind effects. Little gain can come from such-like trickery. In the final analysis it's the words, words, words that count. Just as the radio actor has to have a better command of his voice and inflection than the legitimate actor, so the radio playwright has to have a better command of the President's English. With neither scenery nor action to fill in his gaps of thought he is up against a problem even harder than Shakespeare had to face. So it would seem that the radio playwright who would do his job in the best possible manner will need to possess slightly more ability than Shakespeare. Here's hoping such a man comes to light!

CYRIL MAUDE

The famous English stage star, familiar to many theatregoers who saw him in "Are'n't We All?" and "These Charming People," shown here listening to an American radio receiver in use in his apartment in New York. Mr. Maude has, so far, ventured no authoritative opinions on a comparison of English and American broadcasting

Dinner Orchestras: Excellent Radio Features

ONE of the pleasanter features of radio is the dinner orchestra. As radio standards go, the dinner orchestras occupy a lofty position on their respective programs. This is particularly true of some of the smaller stations. Located, as they often are, in towns where there is a decided dearth of

FREDERICK STOCK
Conductor of the Chicago Symphony Orchestra, which was heard some time ago through WMAQ of that city

available talent (and where there should never have been a radio station) the best broadcast material available is often the orchestra at the local hospice. In larger cities the membership of these bands often includes recruits from first rate symphony orchestras.

It is safe to guess that some hundred thousands of our citizenry dine nightly to radio music. And if a careful job of tuning has been done, and a mild pianissimo applied, these radio strains wafting in from the front parlor, add considerably to the relish of home cooked victuals—to say nothing of the delightful possibility of an occasional healthy obligatto of static, under cover of which one may really enjoy one's soup or celery.

Among the dinner bands we have listened to, we give the KDKA Little Symphony Orchestra a class A position. This is one of the few stations that, itself, supplies the orchestra. Next comes to mind the Commodore Hotel concerts from WJZ and the Waldorf Astoria Rose Room orchestra heard through WEAF. Close to the top of the list come the Drake Concert Ensemble and the Blackstone String Quintette heard through WLIB (or WGN). These two orchestras are picked up so as to alternate numbers.

The Brown Palace String Orchestra at Denver, offered by KOA is very good. KGO relays the dinner music of a caravansary called Roberts-at-the-Beach, which comes in a bit later than our customary dining hour. From Detroit comes Jules Klein's Hotel Statler Orchestra, via WWJ. WSM, at Nashville, offers Francis Craig's Hermitage Hotel orchestra on alternate nights and KGW at Portland, Oregon, presents a first rate trio from six to seven.

Will Broadcast Stations Ever Specialize?

ONE of the planks in the platform of this polite if not pertinent purveyor of program piffle is that radio stations be constrained to specialize. Specialization will eventually overtake the radio industry just as surely as it has the magazine business, and every other entertainment dispensary. At some future date we shall rant on at great length in these pages in an attempt to prove this point, which, since it is transparently obvious, should not be too much of a chore. For the present we shall be content to record joyfully the advent of two stations whose announced policy is to specialize.

WBAL at Baltimore, operated by the Consolidated Gas Electric Light and Power company of that city, broadcast the following manifesto on its opening night:

> In its desire to be known as the radio station of good music rather than merely "another station of the air," WBAL hopes to attain an enviable distinction. If this station gives Baltimore a reputation for broadcasting good music, well performed, in a distinctive manner, it will serve the city better than if it tried to compete with the general run of stations by doing exactly what they do.

WBAL has a definite weekly program schedule: Sunday night, Twilight music (whatever that is!) Monday, Concert night; Tuesday, Ensemble night; Wednesday, silent; Thursday, Concert night; Friday, Novelty night; and Saturday, silent.

A slightly different policy is that announced by WHAP, New York:

> The intention of the founders has been to establish an institution through which high ideals and standards can be expressed in the fields of education, musical art, and good citizenship. In matters of current opinion and in civic and social questions, WHAP will depart from the neutral and passive attitude generally maintained by broadcasting stations, as it has definite convictions, which will be expressed on the air.
>
> Believing that those who favor jazz music and vaudeville songs are already receiving an ample volume of this material from other stations, WHAP will not broadcast any music of this type. Without making its musical programs at all heavy or academic, WHAP plans to arrange radio concerts that will have artistic merit, as well as entertainment value. Education is also to have a prominent place on the program, and several courses of half-hour talks are to be given by noted university lecturers. American history, English literature, and other subjects will be treated.

Of course we don't want all stations to specialize thusly, in highbrow manner—let it be in any manner they chose, as long as it is specialization. For this reason we are inclined to regret the passing of WTAS at Elgin, Illinois.

WTAS, catering to "Willie, Tommie, Annie, and Sammy" was frankly a lowbrow station—and proud of it. WTAS had thousands of devoted and enslaved listeners. If you didn't particularly snap for its offerings (nor did we) you doubtless carefully memorized its dial markings and learned to trip lightly past them. Meanwhile, your next door neighbor sought them out and enjoyed his fill of peppy pieces and flip announcing. So no harm was done.

MADAME TAMAKI MIURA
Japanese Soprano and well-known and praised interpreter of "Butterfly" who was heard in recital recently from WEBH, Chicago. We can't say who the evil genius who butted into the picture, is, but of one thing we are moderately certain. He is not an announcer

Consistency in Programs

O DEAR! O DEAR! The way of the reformer is hard! Possibly a couple of our gentle readers will recall that we towered to heights of what we considered to be righteous wrath in these columns last month in a diatribe against the "hodge-podge" program that jumps from one offering to another quicker than a nervous flee in a litter of pups.

And what was our reward? No sooner had we laid down our flaming pen than we were slapped in the face by the following notice in a local (Chicago), journal:

> Symbolic of the variety which has marked the daily broadcasts of WBCN since its inception, the twenty-four-hour program which will mark the first anniversary of the station will include a creditable representation of practically every kind of talent on the air to-day. Everything from a whistler to a brass band will be offered.
>
> There is great variety, as among the acts booked are a brass band, two dance orchestras, pipe organist, male vocal octet, male vocal quartet, mixed vocal quartet, male vocal and instrumental quartet, three female vocal duos, two male vocal duos, a saxophone trio, a banjo trio, violin duo, harmonica duo, guitar duo, mandolin-guitar duo, four violin soloists, a cellist, a bagpiper, pianologist, musical reader, monologist, two dramatic readers, four speakers, an operatic soprano, an operatic tenor, three classical piano soloists, a blind tenor, three jazz piano soloists a trombonist, one harmonica soloist, three piano-accordionists, two mandolin soloists, one "song and patter" duo, a Scotch harmony duo, a mixed harmony duo, a Scotch soloist, a French barytone, an English soprano, seven other sopranos, a Swedish tenor, fourteen other tenors, a dialect singer, a negro barytone, two blues singers, a children's entertainer, two whistlers, two xylophone soloists, a basso, three classical barytones, two contraltos, one popular barytone, a girl barytone, harmonica-guitar player, eleven song writers, a barn dance fiddler and a tipple-player.

Stories By Air

COSMO HAMILTON, the scriviner, read a specially composed radio novel over WJZ recently, and since, regularly at 8 P.M. each Saturday evening, accompanied by sundry and droll remarks on the possibilities of the new medium. On the first night, he said in part:

My radio novel idea, which is not the condensation of an already written full-length novel, but of one written newly for the radio, which must take no longer than fifteen minutes to read, anticipates the time when, very shortly, the few people who still buy novels—and they are very few—will have joined the vast majority who look and listen but are physically and mentally unable to stop.

But equally entertaining was F. P. A's comment the following morning in "The Conning Tower" of the New York *World* which we cannot refrain from quoting:

Mr. Cosmo Hamilton, having said that the radio would put the spoken drama out of business, advances a parasang and predicts that the radio will make unnecessary the written novel. Novels, Mr. Hamilton forecasts, will be broadcast. And a jolly idea, too. Perhaps in a day or two we shall revise, for radio audiences, some novel or other. It would have been a glorious thing to do in the old days. There is a scene in *Ivanhoe*, for example, that goes something like this:

"*My grandsire drew a good bow at Hastings.*"

"*The foul fiend on thy grandsire and all his generation! In the clout! In the clout! A Hubert forever!*"

The radio audience would listen in on this:

"*Hello, folks! This is Walt Scott, from* WEAF, *broadcasting. Well, here we are in Sherwood Forest. The boys are having a contest in archery. There they are, folks, all lined up. Now, let's see. Well, Sir Reginald steps up and starts boasting.*

"'*My grandpa was a curly wolf at this game,' he says. 'He won a cup at Hastings Field.'*

"'*So's your old man!" cried they all.*

"*And now, folks, while they're shooting, Miss Elsie O'Brien, who takes the part of Rebecca in the novel, will sing, 'I've an Eye for Ivanhoe.' If you like this little lady, folks, send a postal to her in care of the Waverley Length Radio Corporation, Newark, New Jersey. The Waverley Length Radio Corporation, Newark, New Jersey.*"

A Leader Explodes

WE ARE in receipt of the following letter addressed to our worthy predecessor in this department:

PUEBLO, COLORADO

MR. KINGSLEY WELLES,
Editor, "Listeners' Point of View"

SIR:

The only thing that avoided a conflagration in the local post office last night was the fact that I had the mental and moral strength to contain my wrath over a period of hours before putting it on paper.

It's all about Jazz. It seems to me that you and most of your fraternity of critics are wearing yourselves down to mere shadows over an evil which does not exist. Much as it may astound you to know it, there are those of us who prefer jazz to the more profound type of program, and oddly enough, our radio sets cost just as much to run as do those of the listeners who like the classics. Yet where is all this Jazz coming from? Out here in the great open spaces, I twirled the dials of our Roberts Knockout one night last week (it was not Sunday) and brought in fifteen stations without a single Jazz orchestra among them. I got sermons and speeches; sopranos and bassos; cornetists, pianists, and violinists; organs, bands, long-winded announcers, and a pain in the neck. Conditions must be a lot different in New York.

It has come to the point where a person who wishes to listen to a jazz concert must wait around until ten or eleven o'clock before his wish can be fulfilled, and even then he may be disappointed. In fact, you mention a station in New York which forbids dance orchestras the air until ten-thirty. Fine! And now, let us close the air to sopranos of the coloratura variety, and to Hungarian Rhapsodies from ten-thirty on. Apropos of this discussion, I have sent a stamped, addressed envelope to Carl Dreher, who says in part: "If you want jazz issuing from your loud speaker, there are certain wavelengths in every locality where you can get it at any time." I confidently expect Mr. Dreher to solve my problem for me, with the added assurance of loud speaker volume.

For your information, may I state that KOA of Denver seems to fulfill your ideal of a broadcasting station? Twice a week for short periods they have genteel dance orchestras on the air. I pass them by rather hurriedly for the "Packard Six" of KFI which is unashamedly a dance orchestra. Incidentally, I always set my dials for KFI on Sunday night and turn on the juice afterward. They always have a program of lighter numbers for those who do not wish to go to sleep with their headphones on.

Very truly yours,
BERNARD KELLY.

If we may be permitted to rally to the defense of Mr. Welles (and incidentally to our own, as one of the "fraternity of critics" indicated above) we will hazard the guess that Mr. Welles never desired to bring conditions to such a sorry pass as Mr. Kelly seems to have found them.

On our own behalf, we sympathize entirely with Mr. Kelly's point of view the while rejoicing that he has found jazz so difficult to find. Rather too little jazz than the vast too much that prevailed until recently. With the demand for jazz bands and artists slightly greater than the supply the quality was bound to suffer. When jazz is good it is very, very good; but when it is bad it is horrid.

JULES KLEIN'S HOTEL STATLER ORCHESTRA
Which plays dinner and noon-day music from WWJ in Detroit. Left to right, standing: Eric Ernst, Raymond Epstein, Erick Wyle, Benjamin Culp; seated: Jules Klein, and Frank Hancock

Broadcast Miscellany

THE broadcasting of the autumn's football games was, by all odds, the best piece of work done by radio during the last half year. The broadcasting of basketball, hockey, and such-like games, that has been prevalent during the last few months has proved to be an unmitigated fizzle. The success of a sporting event broadcast is dependent on the listeners' ability to visualize the progress of the contest. If it is a tax on one's optics intelligently to follow the plays of a fast hockey match, it is a considerably greater strain on the mind's eye to turn the same trick. Football is fundamentally adapted to broadcasting: the game is essentially a spectacle—a series of clear cut and well defined pictures. Basketball is far from picturesque. It is all action. And the action is too rapid to be delineated by the radio reporter with any degree of interest. We are no better able to picture the progress of the game than we are when we read a newspaper report of it.

NOT a bad idea, WOR's, of celebrating a writer's birthday with a program of his brain children. On Rudyard Kipling's birth anniversary, December 30, this station broadcast a program made up of readings of his best known verse with orchestral accompaniment, and several solo renditions of poems which have been set to music. There was also a speech by Mr. Russell Doubleday, one of the members of the firm which is his American publisher. The excellent Eveready Hour over the WEAF chain, on the following Tuesday, prepared as usual by Mr. Paul Stacey also reminded listeners throughout the eastern United States of Kipling's greatness.

KSD, at St. Louis, has a Thursday afternoon feature that may or may not be of interest to club women. Not being one we can't say. At any rate, the Wednesday (!) Club of St. Louis, throws its meetings open to the ladies at large every Thursday from 4 to 5 o'clock (P.M). The program is known as the "Women's Hour." Among the subjects so far treated at its sessions are: "The Newest Things in Dramatics" and "Home Hygiene and Public Health."

THE Atwater-Kent concert programs through WEAF and its chain of some fifteen stations continue to be about the best thing on the radio bill of fare. Not the least factor in their success is the fact that the series has continued so long now, and so regularly, that ninety per cent. of all listeners know its day and hour by memory and can thus plan their Sunday evenings to listen-in if they desire. The occasional almost equally excellent program from many another station is all too often lost in the shuffle.

DURING the period from January 1 to November 30 (1925), WEAF was on the air almost 2800 hours; the Plant Department or technical delays caused by unavoidable equipment trouble in this time totalling slightly in excess of five hours; the studio delays or time lost between program presentations, 12 hours and the delays occasioned by SOS calls from vessels in distress 17 hours.

WE DON'T want to boast about the receptive qualities of our receiver, but we are here to state that we have listened to broadcasts of the New York Philharmonic Orchestra, from WJZ, out here in the wilds of Illinois, from which we have derived almost as much pleasure as from our seat in Orchestra Hall, which, to us, seems saying quite a bit for radio. And it needs kind words!

OLIVER M. SAYLER'S "Footlight and Lamplight" talks over WGBS are worth attention. Mr. Sayler relates current gossip of the stage, and reviews, in a brief and entertaining manner, recent books. The talks are on Thursday evenings at 8:30 P.M. Eastern time.

IT WAS WHAS (Louisville) we think—though we tuned-out so fast we might have got its letters wrong—that jangled our nerves like bells out of tune the other night by stating that it was "radio-casting."

CHICAGO programs are evincing a slight improvement. WJAZ has an excellent program of music Thursday nights from 10 to 12. Efforts to make some arrangement whereby the productions of the Chicago Civic Opera company could be broadcast have so far been unsuccessful. The broadcasting of opera involves a myriad complications. To mention only two of them: many artist's contracts prohibit broadcasting and some opera's copyrights prohibit broadcasting.

THE Cincinnati Symphony Orchestra is on the air once a month during a series of twenty community radio concerts being broadcast in the name of the community of Cincinnati through WSAI. Fritz Reiner is conductor of this orchestra. Its engagement was in response to a popular demand among listeners throughout the country, nearly 3000 letters having been received after its first concert urging repititions.

NOT an habitual peruser of the comic sections, and likewise by no means a faithful listener-in on the "kiddie" (Ouch!) programs, we found ourself, nevertheless, completely absorbed in Uncle Walt's (WGN) broadcast of the comics on a recent Sunday morning. Stumbling accidentally on this program, we picked up the funny paper, as instructed by the speaker, sat ourself down, and didn't get up until he had finished reading all eight pages!

BUT, withal, from Chicago comes the high-spot in programs since last writing. The Chicago Symphony Orchestra, which has never before consented to broadcast its concerts at last agreed to furnish a two-hour program, which was picked up by WMAQ for the opening program of its new 1000-watt apparatus.

The concert was one of a regular series conducted by Frederick Stock. As a musical offering it was the equal of anything that has yet been tendered us by radio. Of course there was the inevitable muffling of some of the instruments, especially during loud passages—but on the whole a good job for non-studio broadcasting. To date no promise has been made of further concerts.

THIS year of grace 1926 was ushered in by the ringing of Liberty Bell at the stroke of midnight on New Year's eve. Station WIP broadcast the historic gong at the conclusion of an official ceremony inaugurating Philadelphia's Sesquicentennial year.

THE KGW DINNER CONCERT TRIO

Who are heard nightly from station KGW of the Portland *Oregonian*. The personnel and instrumentation reading from left to right: Gladys Johnson, 'cellist; Julius Walter, pianist; Abe Bercovitz, violinist. They are presented through the courtesy of Olds, Wortman & King, of Portland

An All Purpose Coil Winder

How to Make and Use a Simple Coil Winder for Solenoid and Lorenz Type Coils Together With Useful Inductance Tables

Radio Broadcast Photograph

By EDWARD THATCHER

As long as radio constructors assemble sets, there will be those who want to make the coils they use in the set with their own hands. There are, of course, plenty who have no desire to wind their own coils any more than they care to make an audio transformer or wind a set of bobbins for head telephones. So many of our readers write in for information on how to wind this or that sort of coil that the information contained here should be of wide interest. Practically every common type of coil can be made with this simple device, from the simple solenoid to the more complex diamond and basketweave types. The inclusion of an ingenious turn-counter makes the device of great practical value. Many examples of Mr. Thatcher's work in other, non-radio, lines, have appeared in The Ladies' Home Journal *and other publications. He is especially known for his excellent amateur ship models.*—The Editor.

Most of us who tinker with radio know the bother of keeping count of the turns of wire on a coil as it is being wound, or of counting the turns after the coil is finished, particularly with such coils as the basketweave type or other coils of a similar nature.

With the simple coil winder and counter shown in Fig. 1, and some simple forms which are easy to make, you may wind practically any type of continuously wound coil very easily, and enjoy a smoke at the same time if you care to. You may stop winding to light your pipe and resume operations sure that the turns will be counted correctly, and if you should accidentally wind on too many turns, you may easily unwind them. The counter will always show the number of turns on the coil.

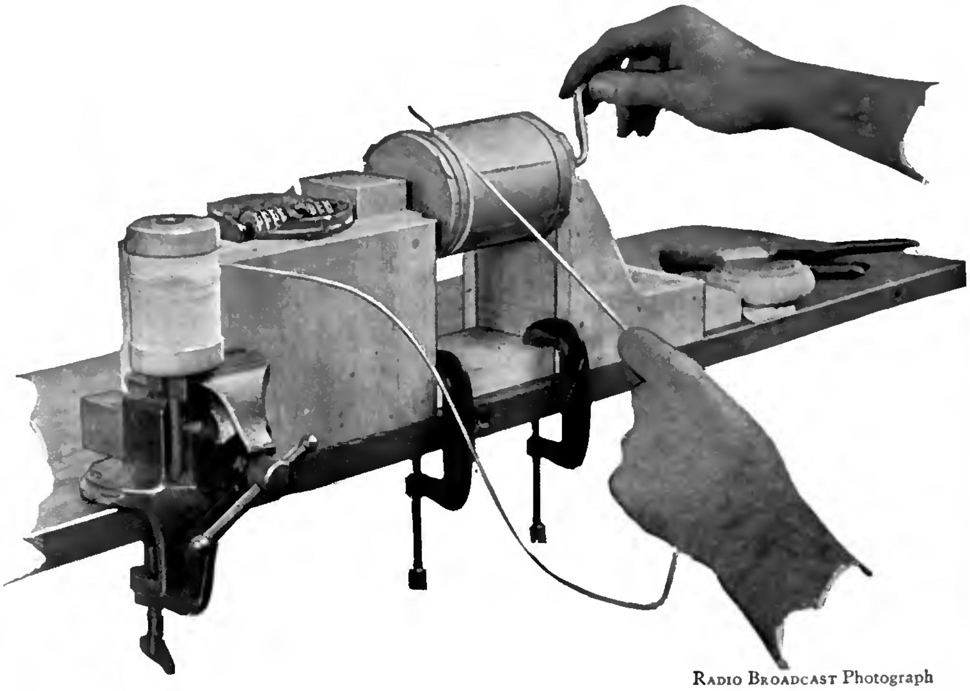
This coil winder and counter is in the form of a very simple lathe, the counter being nothing more than part of an old discarded auto speedometer, which may be purchased for about a dollar at most auto junk yards. Perhaps a search of the home garage may result in finding one. A bicycle cyclometer may also be used, if a few slight alterations are made. Fig. 2 shows such a cyclometer mounted. This one cost 85 cents at a mail order house.

The various forms used with the simple machine are shown in Figs. 4, 5, 6, 7, 8, and in the top illustration on this page. These will be described in detail later on. It might be well to mention here that these same forms may be found very convenient for hand winding if you do not care to make the machine.

In Fig. 3 may be seen the coil winder and counter unassembled. The hook J, is exactly similar to the one used to make the handle I.

It should be understood that the dimensions given for the coil winder and counter may be made to suit individual needs, those given being found convenient for most of the coils which have come to the writer's attention.

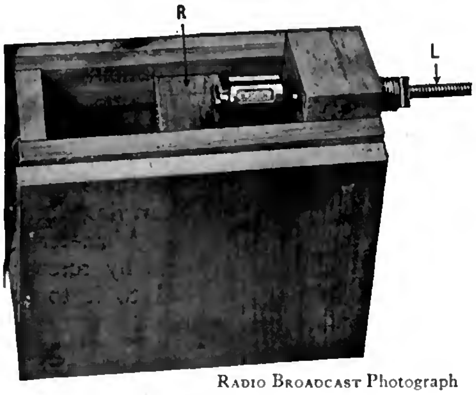
The frame is made from soft pine wood taken from a packing box. A saw, plane, drills, and a hammer, are the only tools necessary for this part of the work. All the parts should be very carefully marked out and squared up before cutting them out.



Radio Broadcast Photograph

FIG. 1

The inexpensive, easily made coil winder and counter is illustrated "in action" here. With the aid of this device high grade coils are within the reach of all home-constructors and experimenters



RADIO BROADCAST Photograph

FIG. 2

A cyclometer type of turn-counter which may be satisfactorily used. Your local hardware or bicycle store can supply you with a similar one

In Fig. 3, A is the baseboard or bed of the winder. This is ¾ inch thick, 2⅝ inches wide, and 18 inches long. B–B are two pieces which are used to support the counter. Each piece is 7/16 inch thick (⅜ or ½ inch will do as well), 4½ inches high, and 6 inches long. These pieces are glued, nailed, or screwed to one end of the baseboard.

C is the base of the sliding tailstock, and is ¾ inch thick, 2 11/16 inches wide, and 5¼ inches long. A slot G ¼ inch wide and 3½ inches long is centered in this base. The screw F passes through the slot G into the baseboard A, and is tightened up to hold the tailstock in position. The two pieces E-E are made of wood 7/16 or ⅜ inch thick, and each piece is 5¼ inches long. Each of these pieces is sawn out to make room for turning the handle I, a coping or compass saw being used for this purpose. These two pieces, E–E, are glued and either nailed or screwed to pieces D and C, the end of piece D resting on top of piece C.

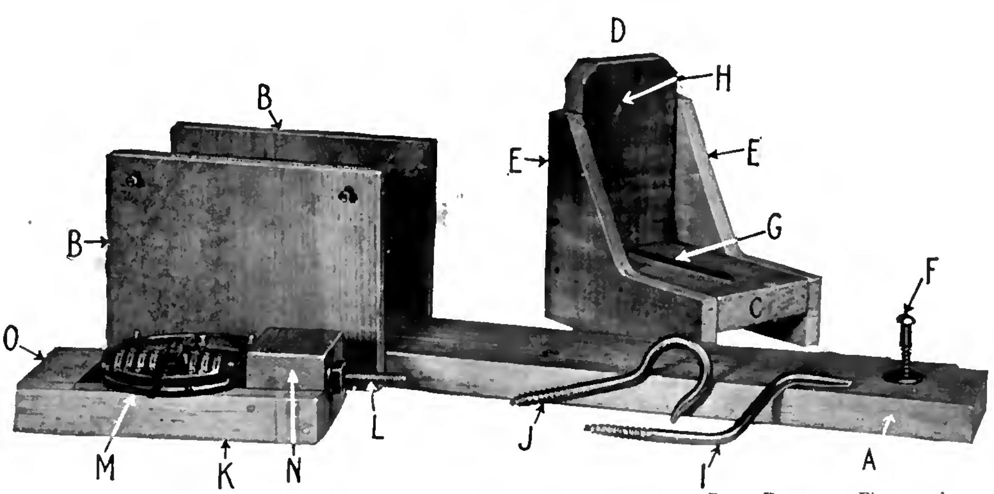
Piece D is ¾ inch thick, 2 11/16 inches wide, and 4¼ inches high. In this piece is drilled the hole H, into which the handle may be pushed and allowed to turn easily. The position for this hole is best found by sliding the tailstock along the bed until the end of the stovebolt used to make the counter shaft, rests against D, when the counter is mounted in position between the pieces B–B.

The handle I is made of a common screwhook. This is 4 inches in length and made of stock about ¼ inch in diameter, a common size obtainable at most hardware and 10-cent stores. To transform the screwhook into a screw handle, place it upright in the vise jaws, the hook end uppermost, with the bend just above the top of the jaws. Use a monkey-wrench to grasp the hook and bend it out roughly into the shape of a handle. The handle is then removed from the vise and straightened up a bit by hammering on some sort of an anvil, such as the bottom of an old flat iron, taking care not to injure the screw thread.

The screw end of the hook will be found rather blunt. This may be much improved for our purposes if the threads are filed down so that they barely show at the point, tapering up gradually to the full thread at the end, next to the handle, so that the thread is much like the threaded end of a polishing spindle. A tapered screw of this kind will enter the wood more easily, and the further it is screwed in the tighter it will hold.

THE COUNTER DEVICE

NOW for the counting head M. It is quite easy to remove the counting device from a common speedometer. Pry off the glass cover and you will usually find that the counter may be removed by taking out a screw or two, when it may be lifted out and separated from the speed indicator. The counter probably registers a number of miles and these may be set back on the "trip" by the device found in most indicators. The total mileage however, must be turned backward if you wish it to register 0000. Unless you wish to wind coils of more than 99 turns, the total mileage indicator may be disregarded. However, it may be turned back after the counter is mounted in its frame by attaching a hand drill to it and turning it backward, or fastening the counter shaft to the chuck of a lathe head and running it backward this way. Then you will have a counter which will register up to 9999, quite enough for most experimenters. The trip and season counters are usually connected by a simple clutch arrangement, which may be thrown in or out as you like. In the counter shown in Fig. 10, the set device is not made use of, it being a simple matter to turn the counter backward to 000 after the coil is round and before the form is removed.



RADIO BROADCAST Photograph

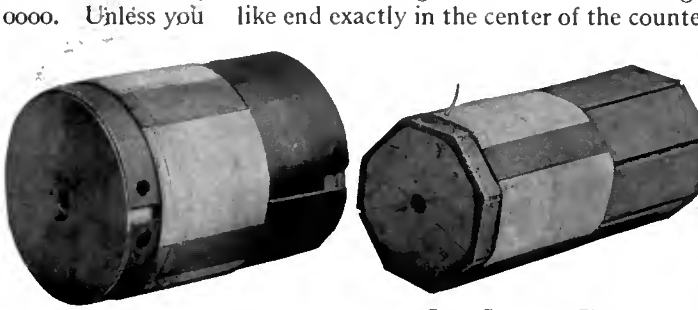
FIG. 3

The coil winder partly assembled. Box wood, screw hooks, screws and a turn-counter are the requirements for the construction of this handy laboratory apparatus. The lettered parts are for identification with the Material List and refer directly to the description of the preparation of the material in the text

The counter M, Fig. 10, is supported by a simple wooden frame which is made as follows. There are two pieces like K, each piece being ½ inch thick, ¾ inch wide, and 6 inches long. These two pieces are fastened together at the head end by a block of wood N, 1½ inches thick or high, 1¾ inches wide, and 1½ inches long. The block is glued and nailed, or screwed, to the side pieces. Through this block is drilled a hole to accommodate the stove bolt L, which should turn easily in this hole, the head of the stovebolt connecting with the end of the counter shaft, as will be described later. The exact position of this hole may best be found by experimenting with the counter resting in position, so that the hole through N is exactly in line with the center of the shaft of the counter.

The piece O is ¾ inch thick, 1¾ inches wide, and 1¼ inches long. It should be understood that the dimensions of all the pieces may be changed to accommodate any particular type of speedometer you may have. If a cyclometer is used follow Fig. 2.

Now look at Fig. 11. The stovebolt L is ¼ inch in diameter and 3 inches long. This should be provided with two nuts and one or more washers. The end of the counter shaft P, on the counter M, is filed to a flat shape like the end of a screw driver, care being taken to have the wedge-like end exactly in the center of the counter



RADIO BROADCAST Photograph

FIG. 4

Here are the cylindrical and pickle-bottle coil forms with a very good example of coil binding utilizing gummed paper. Note that just below the center hole in the end piece of each coil form is situated the pin which engages in the nut on the turn-counter shaft

shaft, as this is to slip easily in the slot in the head of the stovebolt, so that the latter may turn the counter as it is turned around by the coil form, which in turn is turned by the handle. A small hole is drilled in one corner of the nut on the stovebolt as shown at Q, with a twist drill about $\frac{1}{16}$ inch in diameter. A pin or brad driven in the end of each coil form fits in this hole to prevent the coil form from turning on the shaft without turning the counter, thereby causing a wrong count.

When you have the counting head ready to assemble, slip the stovebolt through the hole in N, place a washer on the threaded end, and then screw on the nut with the hole Q in it until it is fixed very tightly on the end of the thread, taking care, of course, that the stovebolt turns easily without undue play. The counter M should then be mounted on its wooden frame and screwed to it, so that every time the stovebolt makes one revolution the counter will register. Remember that the red figures on the counter are tenths and the black figures on the wheel next to the red figures will count one for every turn of the shaft.

Radio Broadcast Photograph

FIG. 5

End pieces, coil form, and screws are all that is required to make up the cylindrical form for the sample of solenoid coil shown at the right. The wood strip indicated at A is employed as a backbone for the coil form

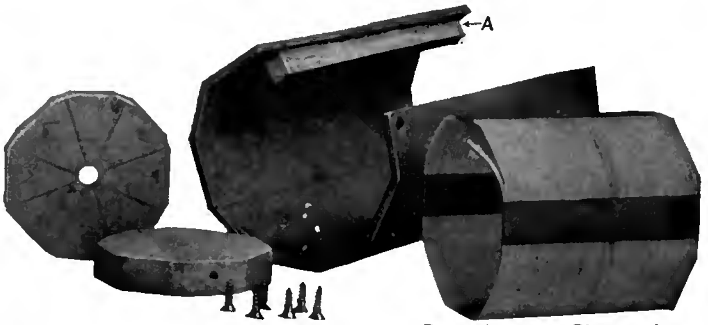
ADJUSTING A CYCLOMETER

A CYCLOMETER also makes a very good counter. It will have to be tinkered with a bit, however, before it will count one for every turn of the shaft. The cyclometer shown in Fig. 2 was treated as follows. The disk-like end opposite the star wheel was removed by placing the points of a small pair of round nosed pliers in the two holes found in this end, and unscrewing it. Inside this disk were several washers which were removed and left out. On the end of the star wheel shaft thus exposed, will be found a small brass disk. To this disk is attached a small pinion which engages a ring or internal gear attached to the first row of figures. The pinion should be soldered fast to the disk which is on the end of the star wheel shaft. It will then be locked in the ring gear turning this with the star wheel shaft, one turn, one count. Care must be taken with this soldering, and only a small amount of flux and solder are necessary.

Two small holes about $\frac{1}{16}$ inch in diameter are then drilled about $\frac{1}{4}$ inch apart and equidistant from the star wheel shaft, these holes being drilled in the disk attached to the end of the shaft, to which the pinion was soldered.

A "U" shaped piece was then bent out of a piece of thin steel wire taken from a paper fastener, the points of the "U" being $\frac{1}{4}$ inch apart. The U shaped piece is then soldered in the center of the slot in the head of the stovebolt L, Fig. 2. The ends of this soldered piece of wire engage the two holes drilled in the disk at the end of the star wheel shaft. The whole should be a rather loose fit to prevent binding.

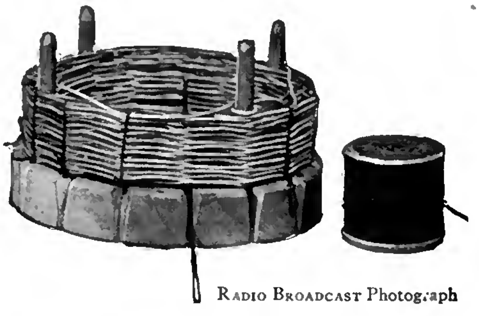
To solder steel to steel you may find that your regular soldering flux used for bus bar work will not work very well. "Killed" acid is best for this purpose. This is made of muriatic acid in which as much pure zinc as possible is dissolved. To make this flux pour a small quantity of muriatic acid in an old cup. Set this cup in a pan of water to keep it cool, taking care that no water gets in the acid. Cut up a number of pieces of pure zinc (the zinc covers of old B or A battery dry cells are excellent), and put a small quantity of the zinc clippings in at a time and add to them from time to time until no more zinc will dissolve. Allow the acid to stand for a time, strain through muslin, and it is ready to use. The parts to be soldered are painted with it. Never use this flux for radio or electrical work as it is very corrosive for such work. It is well to coat the solder which you are using with this flux. The flux will be found excellent for steel, iron, copper, brass, etc., when these metals are not used for carrying electric currents. The cyclometer is held to its frame by screwing the lug attached to it to the block R, Fig. 2.



Radio Broadcast Photograph

FIG. 6

Here are the parts for the pickle-bottle coil form. Low loss coils of this type of winding may easily and speedily be wound for use in the many Roberts and other circuits described in past issues of Radio Broadcast



Radio Broadcast Photograph

FIG. 7

The Lorenz or basketweave coil is more difficult to wind, but when finished, is one that any experimenter would be proud to use in his receiver. Substantial, well-wound coils do much to insure proper operation of one's receiver. The spool of thread also shown above is for binding the coil turns together

COLLAPSIBLE COIL FORMS

FIGURE 1 shows the coil winder and counter in use, starting to make a low loss self-supporting solenoid coil.

The spool of wire is held by a large nail which is placed between the vise jaws, the head of the nail being tapped with a hammer until the coil of wire may be turned with just the right amount of tension.

The form used to make a solenoid coil of low loss design is shown in Fig. 5. This particular coil is of 50 turns wound over a 3-inch form. The form is partially collapsed to remove the coil when it is finished. The form may be reassembled and used over again as many times as it is desired. The outer or cylindrical part of the form shown is made out of a section cut from an ice cream container which was originally $3\frac{1}{2}$ inches in diameter. The two wooden disks used as the ends of the form are cut to such a diameter so that when the cardboard covering is put in place over these wooden disks, the outer diameter of the whole form is 3 inches. As the thickness of the cardboard is $\frac{1}{32}$ inch, it will readily be seen that the diameter of the wooden ends is $2\frac{15}{16}$ inches.

The section cut from the ice cream container is planned so that when it is screwed to the wooden ends there will be a space of from $\frac{3}{16}$ to $\frac{1}{4}$ inch left open between the ends, on the side, as shown in Fig. 4. Directly underneath the edges are glued narrow strips of wood about $\frac{1}{4}$ inch square, as at A, Fig. 6. These strips of wood support the pasteboard which might otherwise be drawn in by the tension of the wire when winding a coil. These two strips should be placed in such a manner that the edges of the form may be easily pushed inward when the coil is wound and the wooden ends removed, to allow for the removal of the finished coil.

Forms for coils of practically any diameter may be made up in this manner, using such cylindrical forms as oatmeal boxes, mailing tubes, and the like.

Figs. 4 and 6 show the form used to make the pickle-bottle type of coil. Like the cylindrical form the pickle-bottle form may be used any number of times. The pasteboard used to make this form was approximately $\frac{1}{8}$ inch thick (strawboard taken from the sides of a packing carton). The wooden ends are then 2 inches in diameter across the flats. A pattern should first be made for these wooden ends, which are cut from soft pine about $\frac{3}{8}$ inch thick. The outside of the form is made in one piece divided into eight equal parts, each dividing line being scored on the outside with a sharp knife to allow the pasteboard to fold down sharply over each angle of the wooden ends to which it is screwed. A strip about $\frac{1}{8}$ inch wide is cut off one end to prevent the edges interfering when the form is collapsed, and a strip of wood A, is glued and tacked to one or both edges at the end of the form as shown in Fig. 6. The piece (or pieces) A are just long enough to fit between the wooden ends when these are in place. The corners formed by the angles on the outer edges of these wooden forms are cut off slightly to allow for the bends in the pasteboard.

RADIO BROADCAST Photograph

FIG. 8

When this double-wedge rectangular form is mounted in the coil winder, it is possible to wind a long strip of coil with a square cross-section, so that it may be bent into a circular form, thereby making up the much discussed toroid coil. On page 600 of this issue, Mr. John L. Lee shows in detail the constructional steps in making up such a coil

A $\frac{1}{4}$-inch hole is drilled in one of the wooden ends, this end being slipped over the threaded end of the stovebolt connected to the counter. A short brad is driven in this end and the head of it cut off so that it may be pushed into the hole drilled in one corner of the nut which is screwed on the stovebolt. By changing the diamater, or rather, building a similar form of any desired diameter, pickle-bottle coils may be wound as called for.

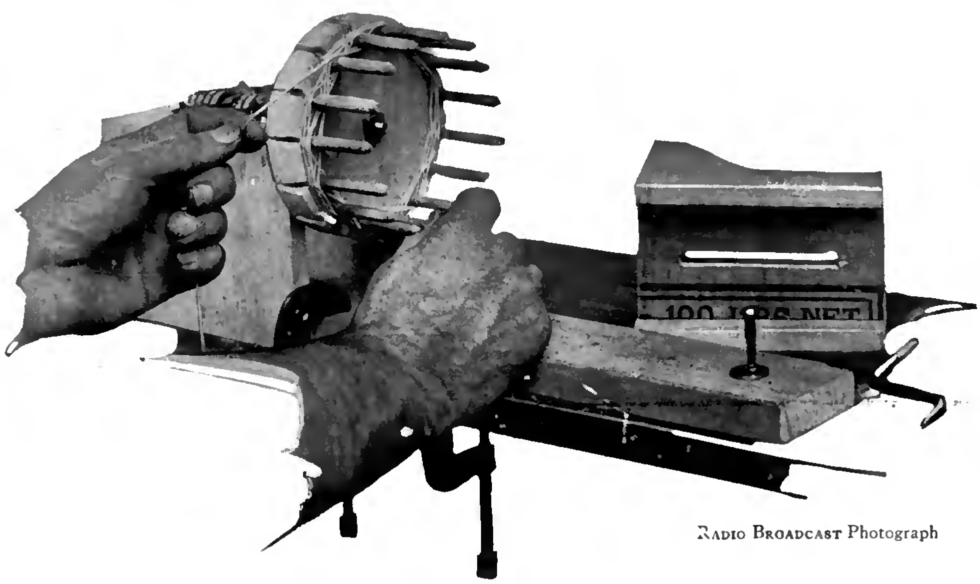
When a simple solenoid coil is to be wound, and the form is to be left inside, circular pieces of wood are sawed out to fit inside of each form and these are held with screws while the coil is being wound. Holes are of course drilled in each disk, one hole to fit over the stovebolt and in the second disk a suitable hole is drilled into which the screw end of the handle is inserted.

WINDING A LOW LOSS SOLENOID COIL

THE coil forms shown in Figs. 4 and 5 are mounted in the winding machine as shown in Fig. 1. Four strips of gummed tape are held, gummed side up, to the form with rubber bands. The handle is shown firmly screwed into one end of the form so that it may be turned against the tension likely to be put on the wire, without slipping.

Fig. 1 also shows how the winding is started. A pin is pushed through the side of the pasteboard form where it is desired to start the winding, and the end of the wire wrapped once or twice around this pin to hold it.

The gummed side of each strip of tape is moistened with water before the winding is started. After this, the winding may be proceeded with, and if everything is right, it should go very rapidly. The speed and accuracy with which coils may be wound on this simple machine with an occasional glance at the counter, will be only too apparent.



RADIO BROADCAST Photograph

FIG. 9

"Spiderweb coil forms may be mounted in the same way as the basket-weave coil form shown here," says Mr. Thatcher. The sliding tailstock is removed when such soils are wound

When the required number of turns are wound on, stick another pin through the coil form to wrap the wire on at the end of the winding while the paper tape is pasted about the coil.

Moisten the ends of the gummed paper tape which extends beyond the winding, first removing the elastic bands and proceed to fold the ends of the moistened tape over the winding, pressing each strip firmly in place.

Taps may be made in coils of this kind by lifting up a short loop of wire at the desired turn, twisting it, and then going on with the winding. Another winding, such as a primary, may be wound over the first coil, after this is wound, and the tape stuck to it as usual, by wrapping a single layer of Empire tape or even gummed tape, about the first coil and then winding the second coil on this, this second coil being held together with strips of gummed tape as the first one was, the form being left in place until both coils are wound on and the gummed tape is dry. To remove the form, the screws are taken out, after the handle is unscrewed, and the coil removed from the counter head. Then the wooden ends are removed, and the pasteboard form is pressed in at the joint until the coil may be easily slipped off.

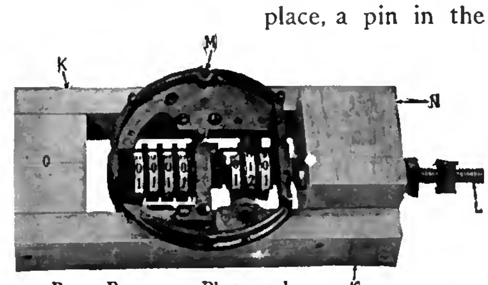
MATERIAL LIST FOR COIL WINDER

PART	PART LETTER	DIMENSIONS	NUMBER REQUIRED
Baseboard	A	$\frac{3}{4}$" x 2$\frac{3}{8}$" x 18"	1
Counter Supports	B	$\frac{7}{16}$" x 4$\frac{1}{2}$" x 6"	2
Tail Stock Base Support	C	$\frac{3}{4}$" x 2$\frac{13}{16}$" x 5$\frac{1}{4}$"	1
Tail Stock Face	D	$\frac{3}{4}$" x 2$\frac{11}{16}$" x 4$\frac{1}{4}$"	1
Tail Stock Sides	E	$\frac{7}{16}$" x 5$\frac{1}{4}$" shaped as shown	2
Tail Stock Screw	F	1" x No. 6 Wood Screw	1
Tail Stock Slot	G	$\frac{1}{4}$" x 3$\frac{1}{2}$"	1
Handle Hole	H	$\frac{1}{4}$"	I
Handle	1	$\frac{1}{4}$" x 4"	1
Counter Base Sides	K	$\frac{1}{2}$" x $\frac{1}{4}$" x 6"	2
Stove Bolt	L	$\frac{1}{4}$" x 3"	1
Turn Counter	M		1
Counter Head Block	N	1$\frac{1}{2}$" x 1$\frac{3}{4}$" x I$\frac{1}{2}$"	1
Counter End Block	O	$\frac{3}{4}$" x 1$\frac{3}{4}$" x 1$\frac{1}{4}$"	1

No dimensions are given for coil forms as the constructor must use his own judgment in selecting the forms for the coils he wishes to wind.

WINDING BASKET-WEAVE AND DIAMONDWEAVE COILS

THE form for winding a basketweave coil is shown in Fig. 9 mounted on the counter shaft. The extra nut provided with the stovebolt is used to hold it in place, a pin in the



RADIO BROADCAST Photograph

FIG. 10

Another use for the automobile speedometer—only here it tells you how far you've gone and not how fast. However, with practice, the home constructor becomes quite efficient in making the coil turns lay side by side at an exceeding high speed. For an explanation of the lettered parts, the constructor should refer to the text

SIZE WIRE	NUMBER OF SPOKES	NUMBER OF TURNS	INSIDE DIAMETER	FREQUENCY RANGE
SPIDERWEB COIL				
No. 24 d.s.c.	15	52	1¾ in.	1761–500 k.c. (170–600 meters)
No. 20 d.c.c.	17	46	2 in. (no form)	2540–565 k.c. (118–529 meters)
No. 24 d.c.c.	11	50	1½ in. " "	2630–565 k.c. (114–529 meters)
BASKETWEAVE				
No. 18 Enamel d.c.c.	13	58	2⅝" between peg centers	2361–500 kc. (127–600 meters)
No. 18 d.c.c.	14	60	4⅛" between peg centers	2290–550 kc. (131–545 meters)
No. 24 d.s.c.	15	64	2½" between peg centers	2054–495 kc. (146–605 meters)
DIAMONDWEAVE				
No. 26 d.s.c.	15	57	2¼ inches	2040–495 kc. (147–605 meters)
No. 20 d.c.c.	21	36	2⅝ inches	2650–694 kc. (113–432 meters)
No. 24 d.c.c.	15	44	2⅜ inches	1764–560 kc. (170–535 meters)

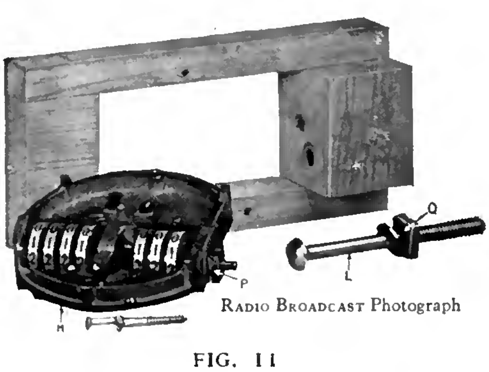
other side engaging the hole in the first nut. Spiderweb coil forms may be mounted in the same way, except that a common pin may be pushed through the form, and through the hole in the nut, before the second nut is screwed in place.

It will be noticed that opposite every peg in the form shown in Figs. 7 and 9 is a deep groove, the top of which extends into the hole for the peg.

These grooves are made by first making a cut with a saw and then enlarging this with a three cornered file or a sharp knife.

The reason for these cuts is as follows: After the winding is finished, a flexible needle, about 3 inches long is used with string to sew the coil together as each peg is removed.

The flexible needle is made of a piece of copper wire about No. 20 gauge, bare or enamel covered, it being doubled to form a loop at one end. The other end, or ends, are held together by a drop of solder which is rounded over with emery cloth to remove any sharpness. The needle thus made, being very soft and flexible, may be bent to a suitable shape to be passed into the slot in the side of the form and up through the top of the winding, after each peg is removed. Black thread is used in the pictures to show up better, but plain uncolored cotton string is usually recommended for this purpose.



Radio Broadcast Photograph

FIG. 11

An unassembled view of the turn counter and support frame. With care, the shaft P should be filed so that it engages the slot in the head f the bolt L on which the coil for m is mounted

On the right of the top illustration on page 582 will be noticed a form for winding a diamondweave coil. Grooves are shown in the face of the central part of this form. After the wire is wound on the form, the flexible needle is used to thread the string up through the winding as each peg is removed.

DATA ON SPECIMEN COILS

THE data in the table shown elswhere on this page will serve as a guide to those constructors wishing to wind coils for use in tuned circuits. In the first test to determine the correct number of coil turns, a .0005-mfd. variable condenser was employed.

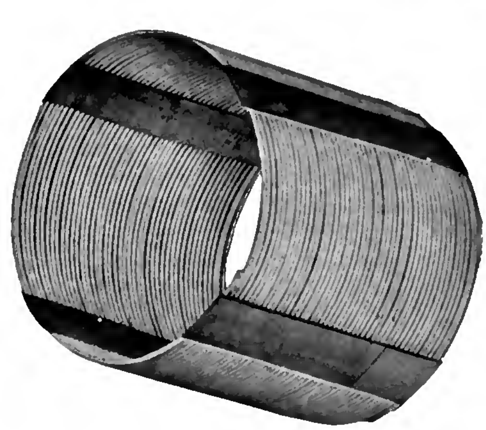
From the table it will be noted that for each type of coil the wire size, number of spokes, number of turns, and coil diameter is different for each three examples, yet the frequency spectrum (wavelength range) does not differ greatly.

With a .00035-mfd. variable condenser, the secondary sizes for the above types of coils will take not more than 80 turns. Usually .77 is correct. The correct value varies slightly with changes in coil diameter and wire size. If the tuned circuit is found to tune to frequencies below the range desired, then remove a turn at a time until the lowest frequency (longest wave) you wish to tune to is tuned-in somewhere near the high end of the condenser scale, usually between 90 and 100.

The primary and tickler coils for use with these secondaries should have about one third the number of turns as the secondaries. For a tuned radio-frequency amplifier circuit, employing no neutralization system, it will be well to reduce the primary turns to from six to ten, otherwise oscillation in each stage will be uncontrollable.

It will be observed that the number of turns for a coil, tuned with a .0005-mfd. condenser, is approximately 60, and conforms to a certain degree with the Inductance chart prepared by Mr. Homer Davis on page 587.

With this coil winder it is also very easy to make up such coils as are shown in Fig. 12, which represents the latest design in space wound solenoids. An ordinary cylindrical form can be used, such as is shown in Fig. 5. A piece of heavy thread is wound in parallel with the wire so that all the turns are separated, and when the coil is finally completed, the thread separator is removed leaving a space wound solenoid very well adapted for use in tuned radio frequency circuits. Adhesive tape is employed to keep the coil together. By referring to Fig. 12 it will be clearly seen how the tape is arranged.



Radio Broadcast Photograph

FIG. 12

For the experimenter who desires the last word in low loss, Mr. Thatcher offers this space wound coil, which he wound on his indispensable coil winder. A thread is wound with the wire, separating turn from turn. When the coil is completed and fastened together, the thread is removed

In order to obtain the same inductance, a coil of this type will require a few more turns than are necessary for a solenoid that is not space wound. Because of its low loss features and low distributed capacity, due to the spacing between turns, the wavelength range of this coil is, in general, somewhat greater than that obtained with an unspaced winding.

KIND OF INSULATION

B. & S. GAUGE	DCC	SCC	DSC	SSC	ENAMEL	ENAMEL AND SCC	ENAMEL AND SSC
14	13 7	14.6	14 7	15 0	15 2	14 2	14 7
15	15 0	16.2	16.4	17 0	17 0	15 8	16 5
16	16 7	18 0	18 2	19.0	18.7	17 6	18 4
17	18.5	20 0	20 0	21.2	21 4	19 5	20 5
18	19 6	22 3	22.3	23.6	24 0	21 7	22 9
19	22 5	25 0	25.2	27 0	27 2	24 2	25 8
20	24 5	27 5	27 5	29 5	30 1	26 5	28 4
21	27 5	30 8	30 8	32 8	33 6	29 6	31 5
22	30 0	34 0	34 0	36 6	37 7	32 7	35 0
23	32 7	37 5	37 5	40 7	42 3	36 1	39 0
24	35 5	41 5	41 5	45.3	47 2	39 7	43 1
25	38 5	45 7	45 7	50 3	52.9	43 7	47 9
26	41 8	50 2	50 2	55 7	59 0	47 8	52 8
27	45 0	55 0	55 0	61 7	65 8	52 1	58 1
28	48 5	60 0	60.0	68 3	73 9	57 0	64 4
29	52 0	65 5	65 5	75 4	82.2	61 9	70 6
30	55 5	71 3	71 3	83 1	92 3	67 4	77.9
31	60 0	77 3	77 3	91 6	103 0	72 8	85 3
32	62 7	83 7	83 7	101 0	116 0	79 1	93 9
33	66 3	90 3	90 3	110 0	130.0	85 6	103 0
34	70 0	97 0	97 0	120 0	145 0	91 7	112 0
35	73.4	104 0	104 0	131 0	164 0	98 8	123 0
36	77 0	111 0	111 0	143 0	182 0	105.0	133 0
37	80.3	126 0	126 0	155 0	206 0	113 0	146 0
38	83.5	133 0	133 0	168 0	235 0	120 0	157 0
39	89 7	140 0	140 0	181 0	261 0	128 0	172 0

FIG 13

This table, giving the number of turns per inch of various kinds of wire, is to be used in conjunction with the capacity-inductance data table printed on the following page

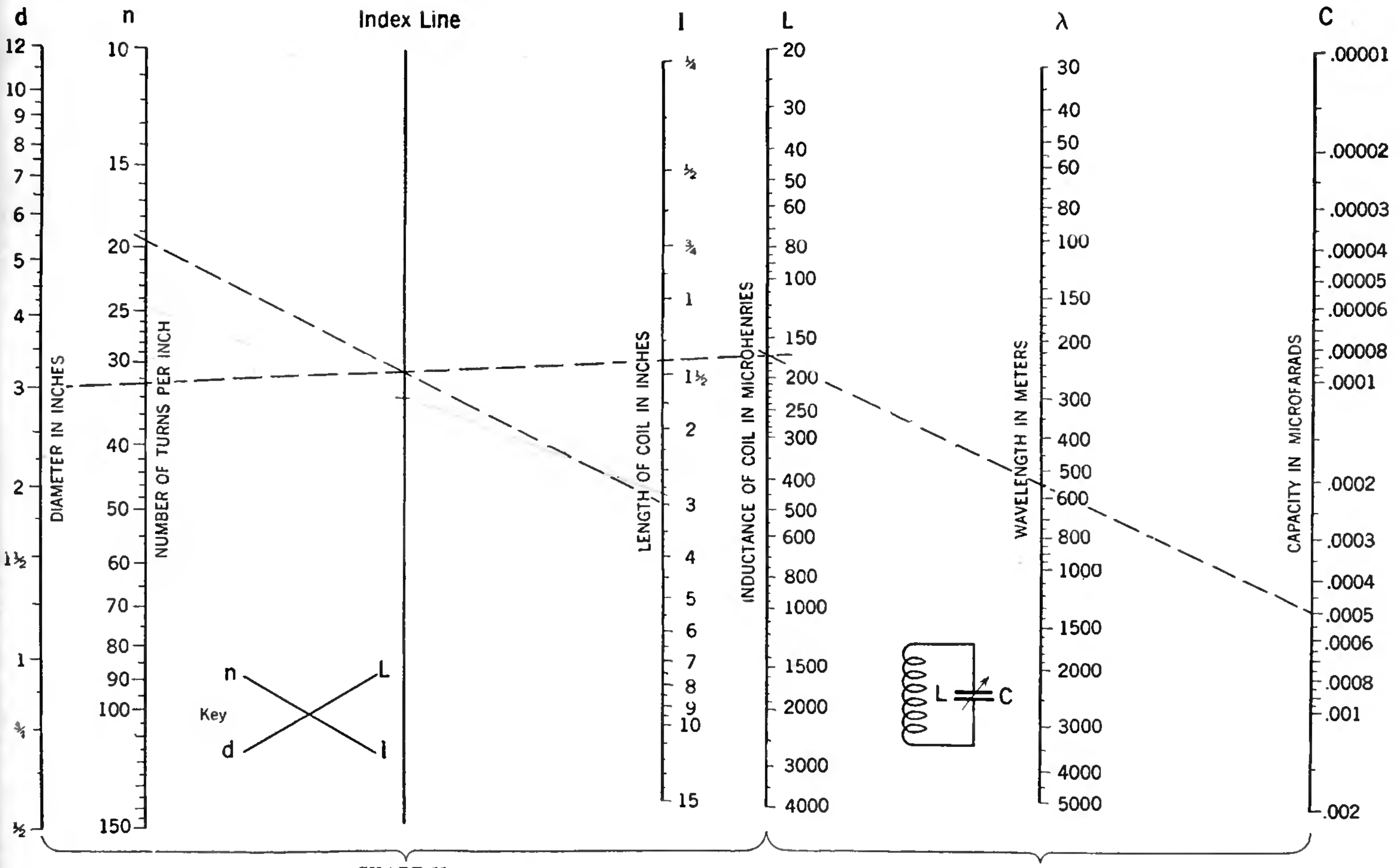


CHART II

Connect three known values as per key, and read fourth at point of intersection.
Example: If L=170 mh., d=3," and n=19.6, then l=3"

CHART I

Connect two known values and read third at point of intersection.
Example: If λ = 550 m. and C=.0005 mfd then L 170 mh

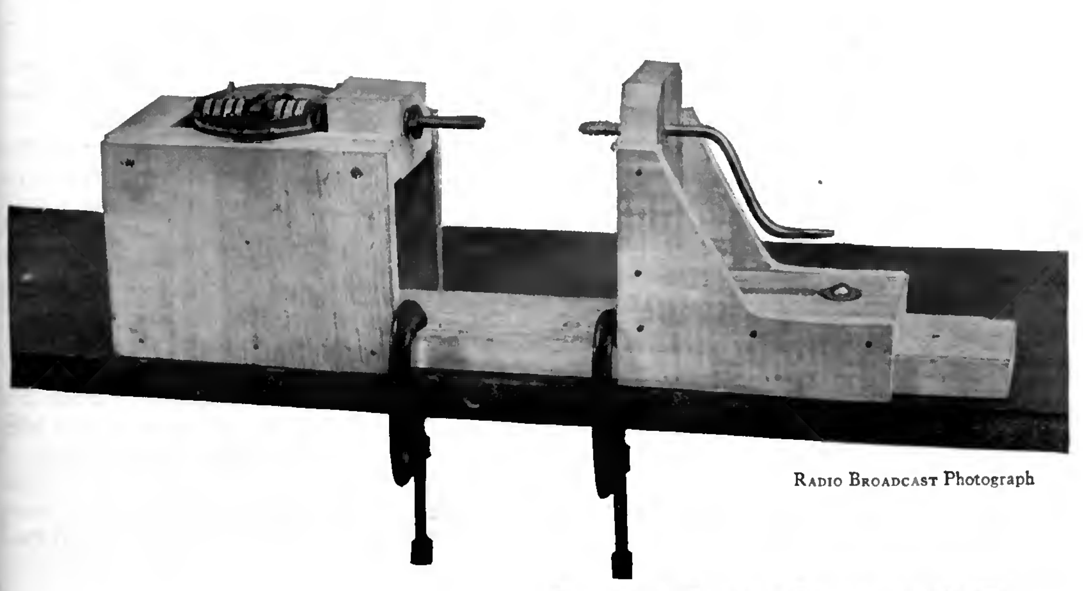
COIL DATA CHART

With the aid of this chart, a ruler, and pencil, the experimenter can very simply determine the approximate specifications for a solenoid coil to cover a definite frequency spectrum (wavelength range) with any condenser on hand. Full information for its use was contained in an article by Mr. Homer Davis, on page 46 of the May, 1925, issue of Radio Broadcast.

Briefly, the chart is used in the following manner:

Suppose the constructor has a .0005-mfd. variable condenser and he wishes to cover a tuning range whose extremes are 545 kc. and 1500 kc. (550 to 200 meters). Therefore, he must wind a coil so that, with the condenser plates entirely meshed, the tuned circuit, comprising coil and condenser, will respond to 545 kc. (550 meters). The problem is to first determine the inductance value in microhenries. By connecting together with a ruler and pencil the values of capacity (.0005 mfd.) on column C and the wavelength extreme (550 meters) on column λ (wavelength), and continuing this line so that it intersects column L, a value of L (inductance) is denoted.

Now, knowing the size of wire he is to use, the constructor looks for the number of turns to the inch for that particular size of wire as indicated on the wire table, Fig. 13, and then spots this position on column "n" above. If No. 18 d.c.c. is to be used, the number of turns per inch will be 19.6. Then he, knowing the diameter of the coil he is to wind, draws a line from the diameter figure point on column "d" to the inductance value in microhenries on column L, determined previously. This latter line between d and L intersects the index line. Now from the spotting on column n (19.6 if 18 d.c.c. be employed), a line is drawn to pass through the point of intersection on the index line continuing on to the column L, thereby indicating the approximate length in inches of the coil to be wound. Knowing this value, then L times n equals the number of turns for the complete coil.



Radio Broadcast Photograph

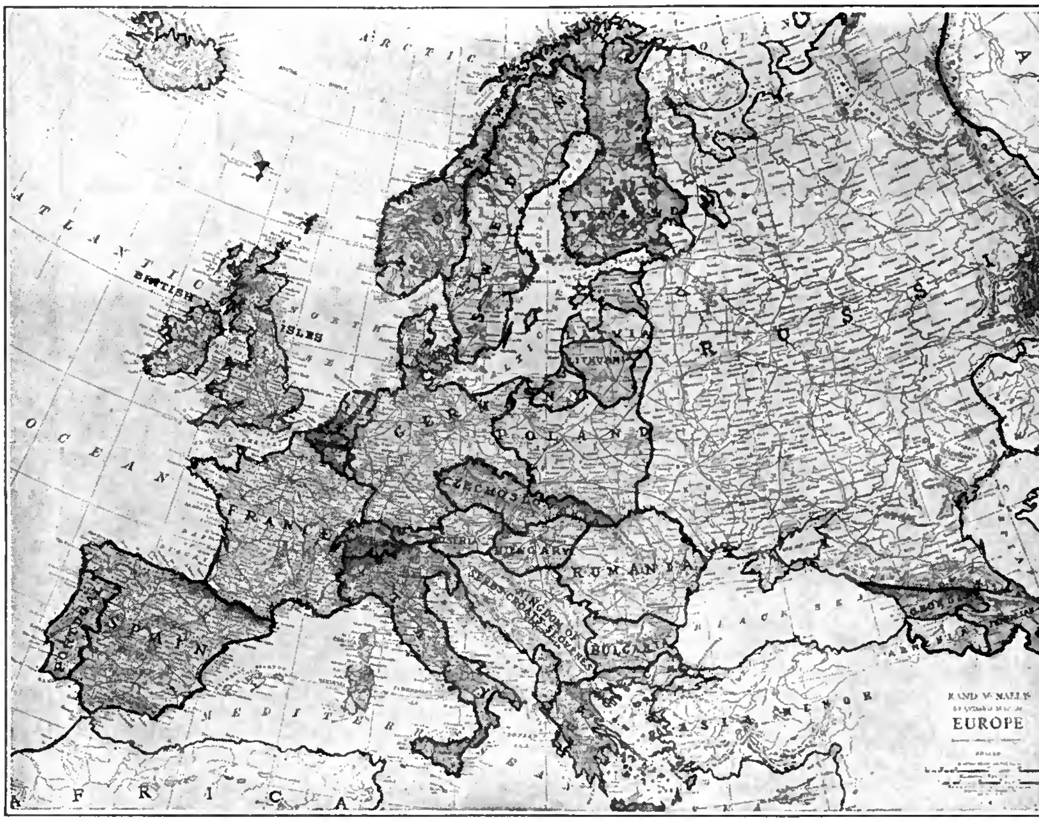
THE ASSEMBLED WINDER

Clamped to the bench and ready for work. By comparing this picture with the illustration Fig. 1, which shows the winder in operation, it will be plainly understood how the solenoid form—and other forms too for that matter—are fixed to the winder

The First Report on the International Tests

By WILLIS K. WING

SEVERAL days before the Third International Radio Broadcast Tests are completed, it is a difficult matter to prepare anything more than what the newspapers refer to as a "bulletin" on the general success or failure of the most elaborate of the inter-nation broadcasting efforts which have yet taken place. A story on the results of the Tests will appear in RADIO BROADCAST for April, after sufficient time has elapsed for the thousands and thousands of reports to be sifted and verified. Now, with a desk loaded with telegrams and detailed reports of reception of foreign stations contained in letters, covering reception for the first few nights of the Tests, it is not possible to present all the facts. Most of the news of immediate interest to radio listeners has been furnished them already through their newspapers and in that field a monthly magazine cannot hope to compete.



© Rand, McNally

But at International Test headquarters here in Garden City we have the reports of eager listeners who carefully tuned to the foreign wavelengths, and praises be to their radio souls, lots of them heard the coveted distant stations!

In brief, the first three nights of the Tests were very poor for receiving, at least on the East coast of the United States and in the Middle West. On the first two nights, reception was moderately good north and south and indifferently good east and west—the most important directions to the great body of American listeners. There were few indeed who reported reception of the English stations on Sunday, January 24th and of the Continentals on Monday, the day following. And, to top it off, and not to make excuses, but rather to state a sad fact, the oscillating receiver reared its electrical head and made reception well-nigh impossible for many listeners whose receiving equipment was efficient and sensitive enough to have a good chance of hearing the foreign broadcasts. If ever the genuine menace of the radiating receiver was demonstrated, it was demonstrated during these Tests.

On Tuesday night, the 26th, American listeners were more successful, and Cardiff and Aberdeen were reported in a considerable number of localities. Mail from the Middle and far West has not yet reached Garden City, so it is not possible to say at this time how successful listeners in those parts of the United States were in hearing English and Continental broadcasts on that night.

But on Wednesday night, the 27th, in the Eastern part of the United States, weather conditions had greatly improved and reception from the Middle European stations seemed to be much better, many verified reports being received on Hamburg and Prague, as well as on Madrid. The South American stations, too, seemed to come in better than before and the three Buenos Aires stations and the faithful OAX at Lima, Peru succeeded in reaching a considerable number of listeners.

During the first three nights of the international experiment, there were storms at sea, as a number of SOS calls gave evidence that ships on the Atlantic were having their own troubles—far more serious than the uncertain reception American listeners had to face. The confirmation programs from many of the Continental broadcasters which were forwarded to Garden City by Dwight K. Tripp, the representative of RADIO BROADCAST in Paris, by courier on the S. S. *Leviathan* were held up two days by a delay of that length in the arrival of the ship, due to the heavy weather on the Atlantic.

Of dramatic happenings, there were many, and it is hoped they can be chronicled in the April number of this magazine. There is the story of the experiences of those of the staff who took a broadcast receiver out to a thinly populated corner of Long Island, far from telephone or telegraph and connected with headquarters only by a battery-operated short wave transmitter and receiver, but that will have to wait.

In England, early cablegrams from Percy W. Harris, editorial manager of Radio Press, the English organization appointed by RADIO BROADCAST in charge of the Tests there, indicate that our fellow British enthusiasts were not highly successful in receiving American broadcasts during the first two days of the transmissions. There has not so far been time for reports more complete than that. Receiving conditions in England seemed to be exceptionally poor during the early part of the Test week.

Reports of reception of the foreign broadcasts, which are coming in to the offices of RADIO BROADCAST by mail and telegraph are being answered as promptly and completely as possible and an official card of verification is being sent to those fortunate enough to have heard any or all of the foreign stations. Those who have not yet sent in their report are urged to mail it in and to make it as complete, but as brief, as possible.

Super-Heterodyne Construction

In Which the Various Sections of a Super-Heterodyne Are Described in Turn—Timely Hints and Constructional Data are Given for the Benefit of Those Contemplating the Construction of Such a Receiver

By HAROLD C. WEBER

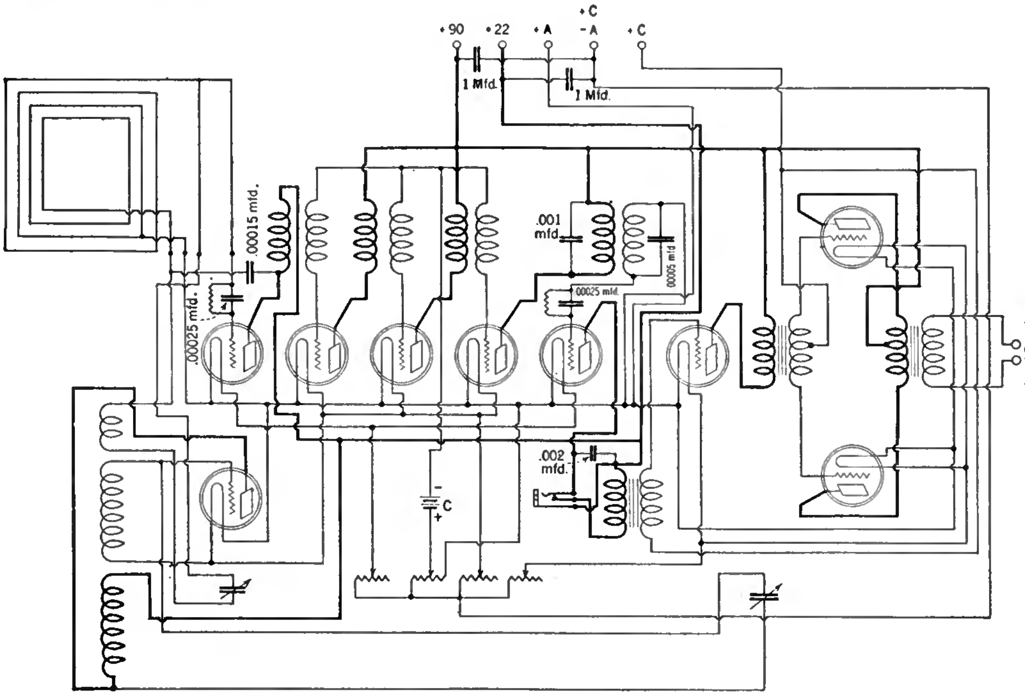
A GREAT DEAL of misunderstanding seems to exist at present in regard to just what advantage the super-heterodyne type of receiver has over other circuits. In the opinion of the writer a Roberts receiver properly constructed gives all the selectivity, and by the addition of two stages of audio frequency amplification, all the volume one could desire. It is remarkably free from distortion, and if one lives in a locality where a good outdoor antenna can be erected, there is some doubt in the author's mind as to whether the super-heterodyne will produce results any more satisfactory than those obtainable by the more simple Roberts circuit. The big advantage obtained by the use of the super-heterodyne circuit is its ability to work on a small loop and, in so doing, produce just as good results as can be obtained by other sets with the aid of an outdoor antenna. From this it can be seen that the super-heterodyne finds its greatest use in thickly populated sections where it is difficult to erect a satisfactory outdoor antenna. The builder of a super-heterodyne may expect to obtain the same results on an eighteen-or twenty-inch loop with his super-heterodyne that he has been obtaining in the same location with an outdoor antenna on either a good neutrodyne, for example, or a Roberts set. If he lives on the Atlantic Coast, and has been unable to receive Pacific Coast stations with his Roberts or neutrodyne set, it is doubtful whether he will be able to do any better with a super-heterodyne working on a loop. Attempts to make the super work on a large outdoor antenna are for the most part unsatisfactory, due to its great sensitivity. The weakest winter static noises resembled in volume a heavy thunderstorm, after passing through the set. Of course, working the super-heterodyne on an outdoor antenna has the further disadvantage that considerable annoyance will be caused to one's neighbors unless a buffer or blocking tube is used in front of the first detector.

The discussion will now be turned to the various component parts of the super-heterodyne, and as each section is discussed, various experimental results which have been obtained will be pointed out.

THE FIRST DETECTOR

THE first detector circuit of the beat type receiver is really little different from any other detector circuit, and it is imperative that if one wishes to obtain satisfactory results the same care be exercised in building this part of the set as would be exercised in the construction of any good low loss one-tube receiver. This means that the condenser used for tuning the loop must be a good one. Its capacity should not be more than .0005-mfd., and it should be equipped with a smooth-acting vernier dial. Considerable discussion has been raised as to whether this first detector circuit should be operated with a grid leak and a grid condenser or with a C battery. The author has tried both schemes and believes that there is nothing to be gained by the use of the bias battery. In all of the sets he has constructed results obtained with the grid leak and the grid condenser fully equal those obtained with a C battery. The use of regeneration on the first detector tube will be found helpful. This is most easily accomplished by the use of a split loop, as pointed out in Mr. Silver's article in the July, 1925, RADIO BROADCAST. It is not necessary to use the midget variable condenser as he suggested. One may wind the loop with bare copper wire, and then place the center tap on that point of the loop where the first detector just refuses to oscillate. In place of the midget condenser a .00025-mfd. fixed condenser may then be used. If the loop contains about fourteen turns of wire, it will be found that the best point for the mid tap is approximately four turns away from that end of the loop which is connected to the grid return, or ten turns away from that side of the loop connected to the grid.

One point seems to have been overlooked in this first detector circuit by a great many constructors; that is, the necessity for providing a low resistance path for the high-frequency oscillations in the plate circuit of the first detector. No one would think of constructing a single-tube regenerative set without the use of a proper phone bypass condenser, and yet a great many super-heterodyne constructors neglect to use a bypass condenser at the same point in their super. This bypass condenser need not be larger than about .00015 to .00025 mfd. and, in fact, if the split-loop method is used, the condenser which must be included in the circuit will serve the double purpose of providing regenerative feed-



CIRCUIT DIAGRAM OF THE AUTHOR'S RECEIVER

A nine-tube super-heterodyne. The only controls appearing on the panel are the two condenser dials, three rheostat knobs, a potentiometer control, and a single jack for headphone use. The loud speaker is put in operation by merely pulling out the phone plug and turning on the audio rheostat back and a low-resistance path for the high-frequency currents. The detector circuit must be coupled to the oscillator in some manner, and this can be done by coupling on to the plate circuit of the detector or to the grid circuit. Personally, the author feels that slightly better results are obtained by grid-circuit coupling than by plate-circuit coupling. The pickup coil may be placed either on the grid side of the loop or on the grid return side. The most satisfactory place for this coil seems to be between the grid return and that point where the tuning condenser connects to the loop. The coupling coil is shown connected in this position in Fig. 1.

Here again authors seem to differ as to the proper number of turns to be used for coupling. Anything from one turn to six turns seems to work satisfactorily on the broadcast wavelengths. Results obtained using from about six to thirty-five turns seem to be somewhat less satisfactory. Satisfactory operation is again obtained by the use of anywhere from thirty-five to fifty turns on the coupling coil. This may mean that the detector circuit can be coupled to the oscillator circuit either capacitively or inductively. Evidently, the transfer of energy is mostly by induction with the low number of turns in the coupling coil, and perhaps mostly by capacity when a large number of turns is used. It does seem, however, that there is a range from approximately six to twenty-five or thirty turns where results are inferior to those obtained either above or below this figure. Incidentally, there appears to be little actual advantage gained in making the coupling coil movable.

THE OSCILLATOR

THE oscillator is an extremely important part of any super-heterodyne. The author has found the Hartley oscillator circuit to be the most satisfactory. If a 30-kc. (10,000-meter) wave is used on the intermediate amplifier, a suitable construction for the coils in this circuit is two twenty-seven turn coils wound with No. 22 or 24 double silk-covered wire on a thin bakelite or cardboard tube, approximately $2\frac{3}{4}$ inches in diameter. Both coils are wound in the same direction. The proper method of connecting these coils in the oscillator circuit is shown in Fig. 2, and the coupling coil in the first detector circuit should be placed at the grid coil end of the oscillator coil unit rather than at the plate coil end.

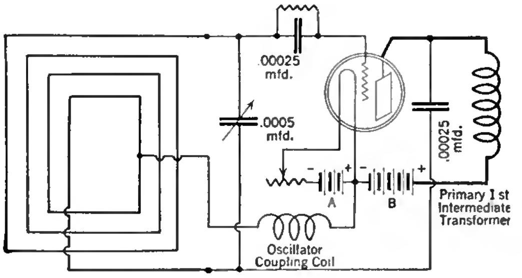


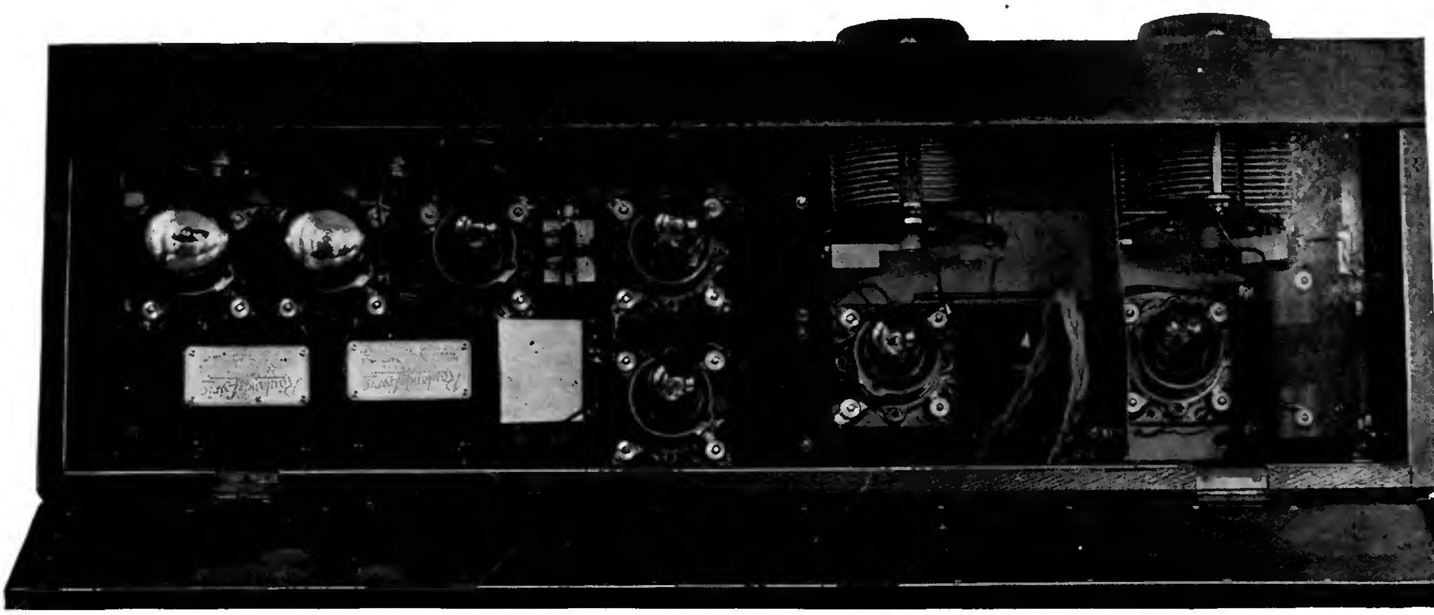
FIG. 1

Serious difficulty will no doubt be experienced with harmonics if one attempts to use more than twenty-five or thirty volts on the oscillator tube. Perfectly satisfactory results can be obtained with ten or twelve volts on the oscillator tube using 201-A type tubes. If the coupling coil of the first detector is coupled too closely to the oscillator circuit, some difficulty may occur, due to the fact that the oscillator will stop functioning whenever the first detector circuit is tuned to approximately the same wavelength as the oscillator. This difficulty is easily overcome by loosening the coupling between the detector and oscillator circuits.

Too much care cannot be exercised in the selection of a suitable tube for use in the oscillator. This is one of the most critical tubes in the whole set, and several should be tried in this position until one is found that functions satisfactorily. No station should be heard at more than two points on the oscillator dial in a properly constructed super-heterodyne. Most stations, even powerful locals four or five miles away, can be completely tuned out by a movement of less than one degree on the oscillator dial if the set is working properly. The same sharpness of tuning holds for the first detector circuit, if proper care is used in its construction, and low-loss parts are used throughout.

INTERMEDIATE FREQUENCY AMPLIFIER

SO MUCH has been said about intermediate-frequency amplifiers in various articles that the author really hesitates to add anything. A long discussion has been waged as to the relative merits of the air-core transformer versus the iron-core. It is usually admitted that it is much easier to amplify at a frequency of thirty kilocycles than at the higher frequencies to which most air-core transformers are tuned. Most iron-core transformers have their peak at about thirty kilocycles (10,000 meters), whereas the air-core transformers work at a very much higher frequency (shorter wavelength). This means among other things that, in general, more grid bias can be applied to an intermediate-frequency amplifier, using iron-core transformers, than to one using air-core transformers. Of course, increasing the grid bias decreases the B battery consumption, and when one is using anywhere from six to nine tubes, B battery current becomes an item of major importance. Offsetting this gain obtained by the use of iron-core transformers rather than air-core ones is the fact that unless the iron-core instrument is carefully designed, there is a great tendency for it to amplify at audio frequency, and therefore to be very noisy. If one uses the higher grade types of iron-core transformers now available, no difficulty will be experienced with noises from the intermediate-frequency amplifier.



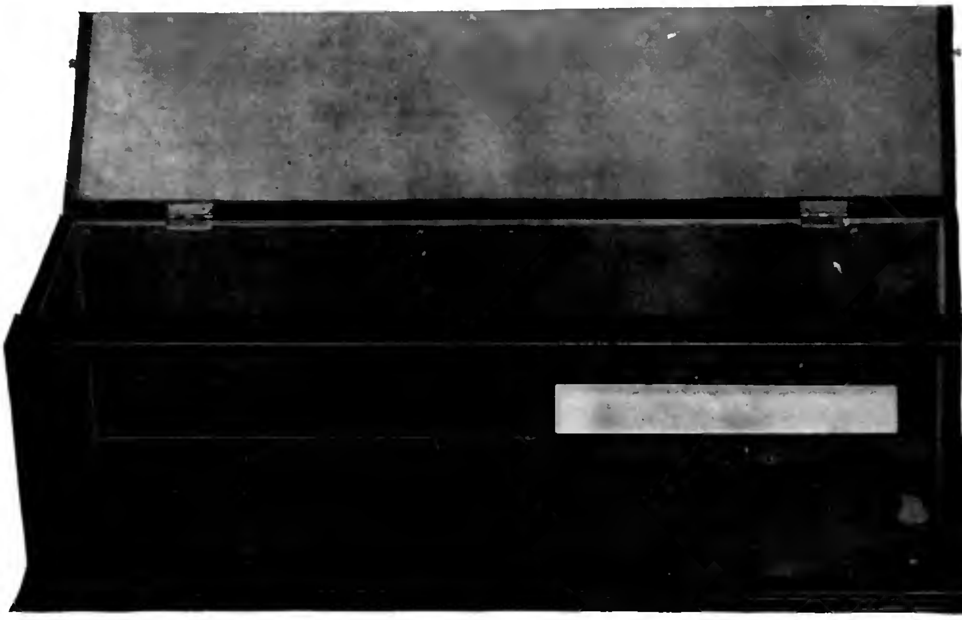
Radio Broadcast Photograph

A SEVEN-TUBE SUPER-HETERODYNE

Note the copper shield between the first and second tube units (at the right)

If the set is properly constructed, the intermediate-frequency amplifier often can be run with the potentiometer arm completely over to the negative side, and it will be found that often a few volts of C battery can be added to this circuit.

It is claimed that, unless the set is very thoroughly shielded, ten thousand meter transformers will be likely to pick up long-wave code signals. It is felt that most of the trouble experienced by the users of ten-thousand meter transformers in this respect is due to the fact that their leads have been made too long. The best plan at the present time seems to be to mount the long wave transformers, if they are of the iron core type, directly under the tubes to which they are to be connected, and then, if trouble is still experienced, to try grounding the metal casings with which most long-wave transformers are now protected. In fact, grounding the casings of these transformers is usually found advantageous in any case.



Radio Broadcast Photograph

A COPPER LINED CABINET

Shielding will prevent body capacity effects and also prevent the coils, transformers, etc., picking up the transmitted waves thus impairing the efficiency

The question of tuned input versus tuned output for the intermediate-frequency amplifier has long been a debated point. It has been argued that tuned output does offer some advantage in that a sharply tuned transformer will not pass any audio frequency which may be picked up by the first transformer in the train. This tends to cut out noise in the set. The author has tried both tuned input and output on the same set, and has come to the conclusion that, with the better makes of long-wave, iron-cored radio-frequency transformers now on the market, little trouble will be experienced from transformer noises in any case. There is one advantage that the tuned input circuit does have over the output circuit. It will be remembered that reference was made to the bypass condenser which is quite necessary across the primary circuit terminals of the first long-wave transformer in the first detector circuit. Placing a bypass condenser at this point is not very helpful to the amplifying action of the transformer, providing it is an iron-core instrument; but if a tuned air-core transformer is used at this point, the fixed condenser necessary across its primary terminals serves the purpose of a bypass for the high-frequency oscillations as well as serving as a means of tuning for the transformer. From this point of view it might be argued that tuned input does have some advantage over tuned output. Of course, if one is using a split-loop method for obtaining regeneration this advantage does not appear, and under these considerations it is doubtful whether either a tuned input or a tuned output offers any advantages. Surely any good iron-core transformer, when used in a properly constructed super-heterodyne, will give all the selectivity in tuning that could be desired, especially if the first detector is made regenerative. For those who are interested in experimenting with tuned input and output circuits, the following specifications will be found useful in constructing an air-core transformer having a peak at about 31 kc. (9600 meters); primary, 750 turns No. 30 d. s. c. wire, random wound on a form having a central opening $\frac{3}{4}$ of an inch in diameter and $\frac{5}{16}$ of an inch wide. Secondary, two 800-turn coils connected in series and wound with d. s. c. wire on the same

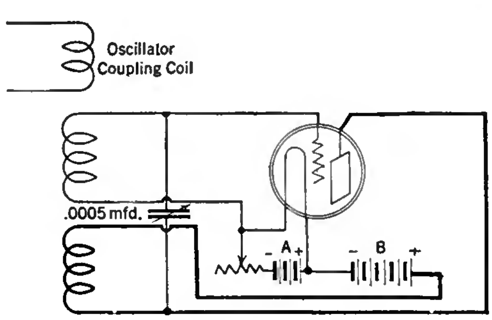


FIG. 2

form as the primary was wound on. The two secondary coils are to be placed one on either side of the primary coil. If these coils are wound on a suitable collapsible form, they can be lightly doped with collodion and made self-supporting, thus doing away with any supporting form. In this way some slight increase in efficiency can be had over coils wound on solid forms. It will be necessary to shunt a .001 mfd. fixed condenser across the primary of this instrument, and approximately a .00025 mfd. fixed condenser across the secondary. Inasmuch as many small fixed condensers vary somewhat, it may be necessary to try several before satisfactory results are obtained. If access can be had to a wavemeter tuning as high as 30 kc. (10,000 meters) of course one can design his transformer so that it will exactly match the peak on the iron-core transformers which are to work with it. A good intermediate-frequency amplifier will usually give all the amplification necessary with two stages, and it is very doubtful whether one should ever use more than three stages.

THE SECOND DETECTOR AND AUDIO AMPLIFIER

THE second detector usually gives very little trouble in any set. Rather a low value grid leak seems to work best in this circuit, usually about two to four megohms and, of course, the phone bypass condenser should not be omitted. Here again experiment will show the best value for this condenser. Usually a condenser with a capacity of from .001 mfd. to .006 mfd. will be found most suitable, preference being given to the low values.

A good super-heterodyne will give all the volume that one could desire for headphone use without any audio amplifier, even when receiving distant stations on the loop. For loud-speaker operation one, and possibly two stages of audio frequency amplification may be added. Here again the use of good transformers cannot be over emphasized. If the constructor is willing to pay a high price for one of the new type high ratio audio-frequency transformers now on the market, all well and good; otherwise he will probably obtain the most satisfactory results by not attempting to use a transformer having a ratio of more than 3 or $3\frac{1}{2}$ to 1. Some of the newer transformers mentioned above will amplify in a very satisfactory manner even though they do have ratios of 5 or 6 to 1. Such a transformer cannot, however, be constructed cheaply due to the fact that it requires a heavy core and an exceedingly large number of turns on its secondary. Unless the set is to be used in a large room or hall, one good stage of audio-frequency amplification will usually give enough volume for satisfactory loud-speaker operation. If a second stage is desired, it had best be either of the power type using some such tube as the UV-202 or the Western Electric 216-A, or perhaps, the push-pull construction which has been quite popular during the last year or two.

The second stage of audio-frequency amplification handles exceedingly heavy currents, especially on local signals, and any ordinary receiving tube will become so overloaded that bad distortion will occur. Some discussion has been raised as to the necessity for a filter before the audio-frequency amplifier to keep the intermediate-frequency currents from entering it. It is doubtful whether such a filter will be found necessary if careful construction work is done. The use of large bypass condensers (.5 to 1.0 mfd.) across both the amplifier and detector sections of the B battery, will aid in keeping these currents out of the audio circuits.

GENERAL CONSIDERATIONS

IF ONE is going to the expense of building a super-heterodyne, the author would by all means advise the use of storage battery tubes, except in those cases where a portable set is desired, or where the charging of storage batteries is a great inconvenience. The B battery current drawn by a super-heterodyne, although it is large, need not be excessive. The author's own set, using nine DV-2 tubes, draws but eight to ten milliamperes of B battery current and from $1\frac{1}{2}$ to $1\frac{3}{4}$ amperes on the A battery side, by actual measurement. If more than twenty milliamperes are drawn in the B battery circuit by a super-heterodyne using iron-core transformers, it is probable that there is something wrong somewhere in the set.

Any voltage from 45 to 90 is suitable for use on the intermediate-frequency tubes. For best results, one should not use more than 20 to 30 volts on the detectors.

In order to use as few rheostats as possible, the two detectors may be operated from one rheostat, the three intermediate amplifiers from a second, the oscillator perhaps from a third, while the audio amplifiers may well be run through fixed resistance units rather than from a rheostat.

Considerable care must be exercised in the selection of tubes for the intermediate-frequency amplifier, and it may be necessary to try several different arrangements of tubes in the set before a really satisfactory arrangement is found. The operation of the whole set may be ruined by one faulty tube anywhere before the second detector.

A great many times it will be found that the loop does not have much directional effect and that it can very often be built inside a cabinet housing the set with practically no loss in signal strength. This is true with the author's own set, and such a construction does much toward improving the appearance of the set and protecting the loop and its connections from dirt and injury.

A comparison of the results obtained by the author using his set, with those results obtained using other sets in exactly the same location, may be of interest. The set is located in one of the suburbs of Boston. Several years ago a three-tube set, employing the three-circuit tuner, was used in the same place with a three-wire indoor antenna about thirty-five feet long and twenty-five feet high. New York stations could be heard on the loud speaker regularly, and Chicago stations occasionally. About two years ago a five-tube neutrodyne set was installed. This employed three stages of neutralized radio-frequency amplification and two stages of audio-frequency amplification, one of the latter being reflexed through one of the radio tubes. Loud speaker operation on the Chicago stations was possible, using the same antenna as outlined above; fairly consistent loud-speaker signals on stations as far south as Cuba and Texas were obtained. The present set, a nine-tube super-heterodyne, using three stages of intermediate-frequency 30-kc. amplification and two stages of audio-frequency amplification, the second stage being push-pull, gives consistent loud speaker operation on Chicago stations and fairly consistent loud speaker operation on Cuba and the Texas stations. London's 2 LO was heard on the loop twice during last year's transatlantic tests, once on the loud speaker.

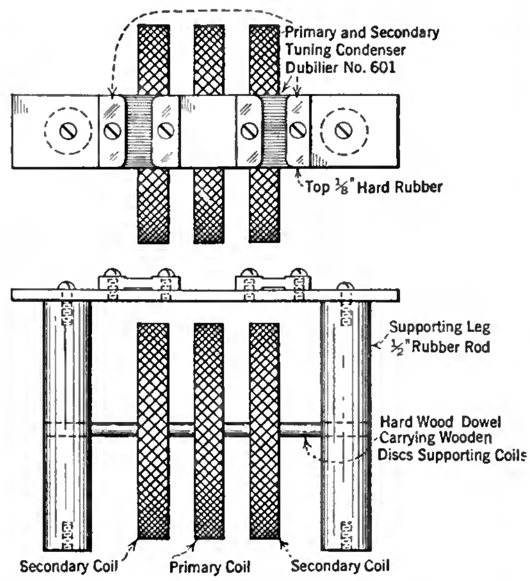


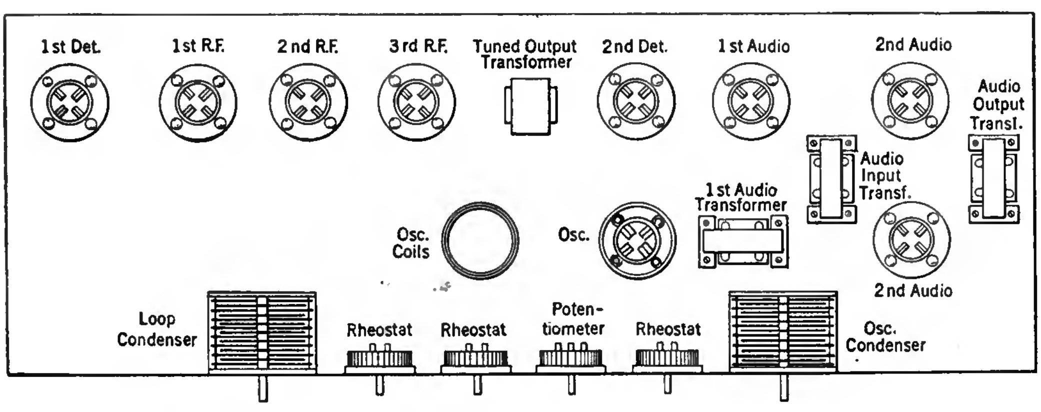
FIG. 3

A sketch of the author's 9600-meter tuned output transformer drawn approximately to scale

The author does not feel, however, that the present super-heterodyne, working on its built-in loop, is any more effective as a distance getter than was the previous neutrodyne set working on the thirty-five foot indoor antenna. Of course there is the advantage that the present set has but two tuning controls.

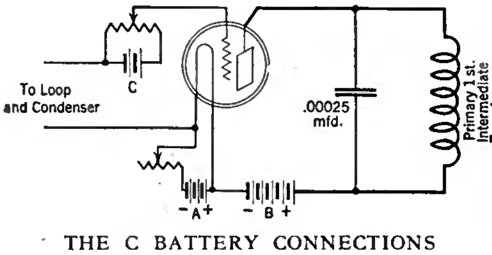
Whether or not the super-heterodyne is enough better than the other good circuits known to-day to justify the extra expense demanded in its construction and operation, is still a debatable question.

In conclusion let it be repeated that it is impossible to overestimate the undesirability of operating the super-heterodyne on an outside antenna. Even when a loop is employed it is possible to interefere with other receivers in the same building. For successful operation the type of receiver depends on the fact that it is a miniature transmitter, and as such, will cause considerable interference if coupled to an outside antenna.



LAYOUT DIAGRAM

Of the essential parts of a nine-tube superheterodyne using two stages of audio, the second stage being push-pull. Note the position of the oscillator tube, coils, and condenser, as far away from the first detector as possible. The long wave transformers are mounted under the three radio frequency tubes feeding into them, and are not shown in this sketch



THE C BATTERY CONNECTIONS

On the first detector tube to obtain grid bias. The potentiometer used here must be a high resistance one of about 1800 ohms. The high frequency bypass condenser may be seen directly across the first transformer primary. This is the method of connecting the condenser when regeneration is not used on the first detector

The Newest Achievements of

POWEL CROSLEY JR.

Industrialist—Pioneer Radio Builder—Master of Mass Production

Four Entirely New 4- and 5-tube Radio Sets—Also the Crescendon

Never before has Crosley engineering and manufacturing genius been so brilliantly demonstrated as in this group of new Crosley sets.

Here, at prices so low as to be literally revolutionary, are three 5-tube sets and one 4-tube set—entirely new in principle, design, circuit, and appearance—entirely unique in the results they give on distant and local stations—entirely unprecedented in the values they now introduce.

On two of these sets is offered the Crescendon, a new and exclusive Crosley feature—an extra volume control by which average incoming signals can be built up or modified in a manner nothing short of amazing. Introduced on the new 4-29 and 5-38, the Crescendon principle makes its first appearance in the low price field, its use having hitherto been restricted to one set costing several times as much.

Particular emphasis is directed to the new Crosley RFL receiving sets that utilize an entirely new and patented circuit which provides true cascade amplification and closely approaches the theoretical maximum of efficiency per tube. Non-oscillating at any frequency and absolutely non-radiating, the RFL Crosleys are specifically recommended for use in congested areas and for satisfactory performance in the hands of inexperienced operators.

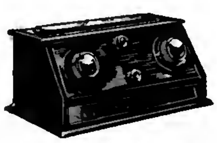
In addition to their truly marvelous selectivity, sensitivity, and purity of tone, these new Crosleys have been given a new order of beauty that cannot help but win the highest admiration.

We do more than urge you to go to the nearest Crosley dealer for a demonstration! We ask you to go prepared for the most startling revelation in radio ever announced in the entire history of the industry—and predict that your expectations will be more than satisfied!

Crosley manufactures radio receiving sets which are licensed under Armstrong U. S. Patent No. 1,113,149, or under patent applications of Radio Frequency Laboratories, Inc. ★

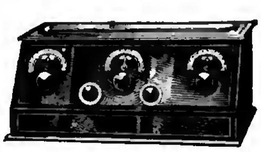
THE CROSLEY RADIO CORPORATION, CINCINNATI, OHIO

Owning and Operating WLW first remote control super-power broadcasting station in America



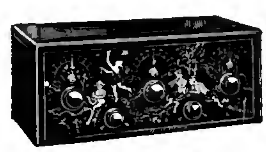
***The Crosley* 4-*tube*—4-29**

in which the Crescendon is equivalent to one or more additional tubes of tuned radio frequency amplification . . $29



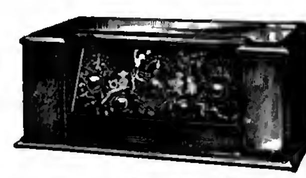
***The Crosley* 5-*tube*—5-38**

All the volume, selectivity, sensitivity and purity of tone available in the best 5-tube set—*plus the Crescendon* . . $38



***The Crosley* 5-*tube*—*RFL*-60**

A set so marvelous in performance that its appearance on the market is bound to create a new standard of comparison . . $60



***The Crosley* 5-*tube*—*RFL*-75**

For simplicity and speed in tuning, fidelity of tone, and decorative beauty—it stands unchallenged at twice the price . $75

West of the Rocky Mountains all prices as published are 10% higher

CROSLEY · RADIO

BETTER · COSTS LESS

★ Tested and approved by RADIO BROADCAST ★

THE GRID

A Department Devoted to Solving the Problems of our Readers

QUERIES ANSWERED

1. HOW MAY I OBTAIN A VARIABLE VOLTAGE SUPPLY FROM MY B BATTERY ELIMINATOR FOR THE PLATES OF MY RADIO FREQUENCY AMPLIFIER TUBES?
R. A. W.—New York City.

2. WILL YOU PUBLISH A SIMPLE CIRCUIT DIAGRAM FOR A LOOP R. F. RECEIVER?
F. M.—Cape May, New Jersey.

3. WHAT IS THE BEST WAY OF MAKING MY OWN GRID LEAKS FOR EXPERIMENTAL PURPOSES?
M. L. H.—Bay Shore, Long Island.

4. WHAT ARE THE OPERATING CHARACTERISTICS OF THE NEW TUBES?
C. A. B.—Little Rock, Arkansas.

5. I HAVE D. C. IN MY HOME. HOW MAY I CHARGE MY STORAGE BATTERY?
L. P.—New York City.

SEPARATE R. F. TUBE VOLTAGE FROM B BATTERY ELIMINATORS

MOST B battery eliminators are so constructed that only two distinct voltage values are obtainable, a variable one for the detector tube and a fixed figure for the audio amplifier. When a receiver employing radio frequency amplification is used, it is therefore necessary to apply the same potential to the r.f. tubes as is applied to either the detector or audio plates. It is often advisable to use an intermediate value for the r.f. tubes, however, and this may be accomplished by the addition of a suitable resistance in series with a second lead from the positive high voltage tap of the instrument.

It is a very simple matter to make this addition to the circuit, and it is possible to obtain the variable resistance on the market. In most instances one having an approximately correct obtain the desired voltage regulation. As an instance; if it is desired to regulate the voltage on the r.f. tubes from 65 to 100 volts, then the maximum resistance value is obtained by applying the formula:

$$R = \frac{E - E_1}{I}$$

Here E_1 = 65, E = 100, and I = current in amperes per r.f. tube. If no C battery is used in the radio-frequency amplifier then the plate current per tube will be about 5 milliamperes, so where the receiver consists of two r.f. stages the total is 10 milliamperes or .01 amperes. Substituting values for the formula we get—:

$$R = \frac{100 - 65}{.01}$$

or

$$R = \frac{35}{.01} = 3500 \text{ ohms}$$

Where a C battery is employed, the current is

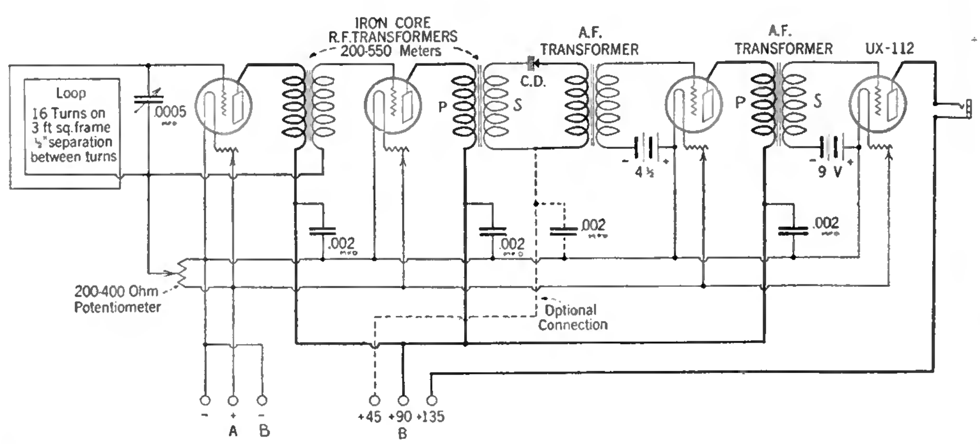


FIG. 2

range will have to be selected. For instance, if it is found that one having a maximum of 4000 ohms is necessary, one rated at 5000 ohms will be just as satisfactory.

The user can very simply determine for himself the value of the resistance necessary to reduced by a third or a half, and if the experimenter has a milliammeter he can determine in an instant the actual drain per tube by inserting the meter in each tube's plate circuit.

The connections of this additional resistance in the B supply circuit are shown in Fig. 1.

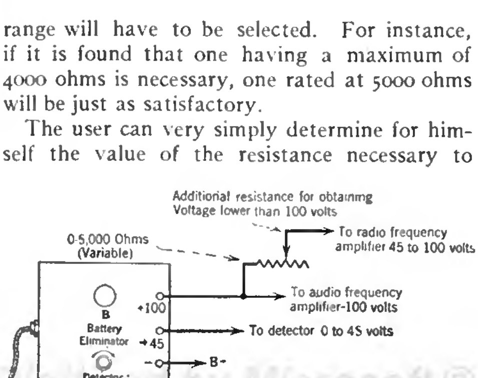


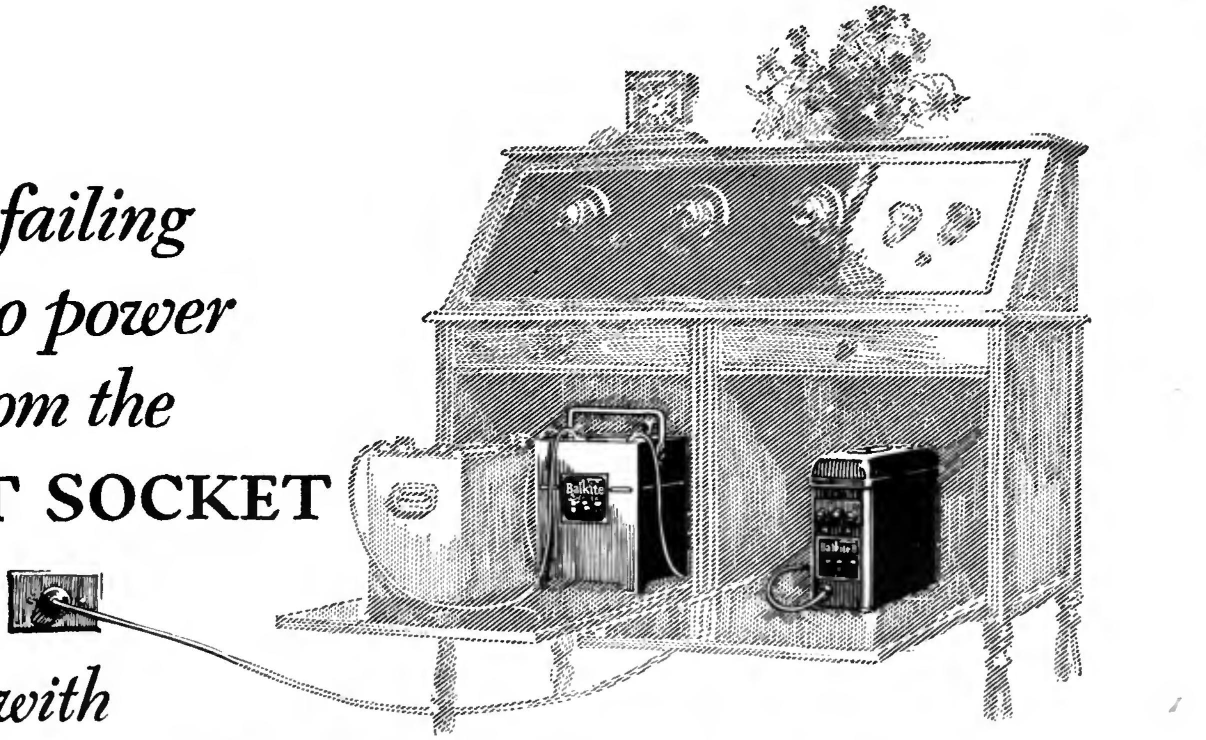
FIG. 1

ONE DIAL LOOP RECEIVER

A VERY simply constructed one dial receiver, employing two stages of untuned radio frequency amplification, a crystal detector, and two stages of audio frequency amplification, is shown in Fig. 2.

To prevent the radio frequency stages from oscillating continuously, a potentiometer of 200 to 400 ohms is shunted across the A battery

Unfailing radio power from the LIGHT SOCKET



with

Balkite Radio Power Units

Balkite Radio Power Units give unfailing, uniform current for both circuits from the light socket. One very popular Balkite installation, especially for heavy duty sets where reserve "A" power is required is with the Balkite Battery Charger and Balkite "B." Here the noiseless, high-rate Balkite Battery Charger is ideal. If your battery should be low, you merely turn on the charger and operate the set. Balkite "B" eliminates "B" batteries entirely and supplies plate current from the light socket.

Balkite light socket equipment

Another very popular Balkite installation is with the Balkite Trickle Charger and Balkite "B." The Balkite Trickle Charger converts your "A" battery into an automatic "A" power unit that provides "A" current from the light socket, so that both circuits operate from the lighting circuit. This installation enables you to convert your present receiver into a light socket set.

Noiseless — No bulbs — Permanent

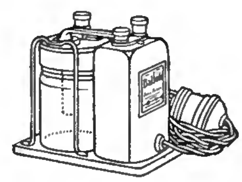
All Balkite Radio Power Units are permanent pieces of equipment, entirely noiseless, have no bulbs, nothing to break, replace or get out of order. Their current consumption is very low. All operate from 110-120 volt AC current, with models for 50, 60 and other cycles. *All are tested and listed as standard by the Underwriters' Laboratories.*

The Balkite Railway Signal Rectifier is now standard equipment on over 50 leading American and Canadian Railroads

FANSTEEL

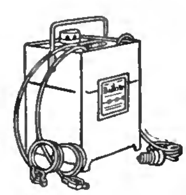
Balkite ★

Radio Power Units



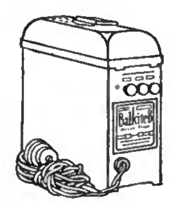
Balkite *Trickle Charger*

Converts any 6-volt "A" battery of 30 ampere hours capacity or more into an automatic "A" power unit that furnishes "A" current from the light socket. With 4-volt and smaller 6-volt batteries may be used either as an intermittent charger or a trickle charger. $10. West of Rockies, $10.50. In Canada, $15.



Balkite *Battery Charger*

The popular rapid charger for 6-volt "A" batteries. Noiseless. Can be used during operation. Special model for 25-40 cycles. $19.50. West of Rockies, $20. In Canada, $27.50.



Balkite "B"

Eliminates "B" batteries and supplies plate current from the light socket. For sets of 6 tubes and less. $35. In Canada, $49.50.

Balkite "B" II

Supplies plate current from the light socket. Will serve any standard set. Especially adapted to sets of 6 tubes or more. $55. In Canada, $75.

MANUFACTURED BY FANSTEEL PRODUCTS COMPANY, INC., NORTH CHICAGO, ILLINOIS

SOLE LICENSEES IN THE UNITED KINGDOM: MESSRS. RADIO ACCESSORIES LTD. 9-13 HYTHE RD., WELLESDEN, LONDON, N. W. 10

leads. The return side of the secondary of the first r.f. amplifying transformer and the lower side of the loop are connected to the central arm of this potentiometer. It is recommended that a power tube, such as the UX-112, be employed in the last audio stage. This will insure quality reproduction providing a C battery of the proper value is employed, to bias its grid. The use of a C battery in the first audio stage will be found helpful also, and should be included, although its value will not be as high as for the second stage.

Any type of loop capable of being tuned to the broadcast band of frequencies is suitable

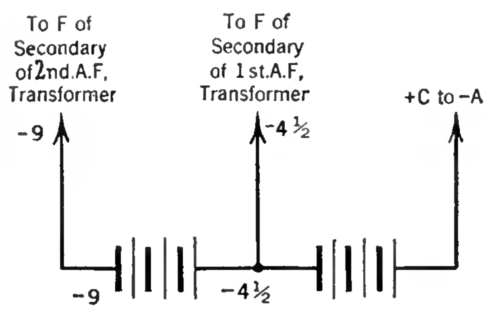


FIG. 3

but for those who wish to make their own, it is suggested that a box frame, three feet square and ten inches wide, and having 16 turns of No. 18 bell wire wound thereon, separated ½ inch apart, be employed.

Values for the various parts are indicated in Fig. 2 while Fig. 3 shows how two 4½-volt C batteries, connected in series, may be used to furnish grid bias for both audio amplifier stages.

MAKING YOUR OWN GRID LEAKS

THE true experimenter always desires to make as much of his own apparatus as is possible. Grid leaks are important in maintaining the proper standard of reception and not always is it possible for the experimenter to secure a grid leak of the value which will produce these results.

With the aid of drawing ink and a business

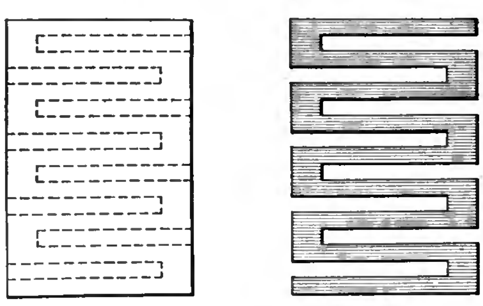


FIG. 4

calling card, it is possible to make grid leaks of various values.

One side of the card is completely covered with the ink and then by cutting into the sides with a pair of scissors as shown in Fig 4, it is possible to vary the value of leak by removing the sections cut into.

Grid leaks of this type should be thoroughly dried before using, as the value of the leak will vary with different degrees of temperature and moisture.

Paper clips make satisfactory connections to the ends of the inked paper.

NEW TUBES AND THEIR CHARACTERISTICS

ONLY recently the new line of radio tubes has been added to the fast-growing accumulation of apparatus from which the constructor may make his choice in building high quality receivers. More and more attention is being centered upon the production of units designed to be employed in receiver installations where quality is the goal.

A BATTERY SUPPLY	FILAMENT TERMINAL VOLTS	B BATTERY (AMPLIFIER)	GRID BIAS	NORMAL PLATE CURRENT
FOR THE UX-112 THE REQUIREMENTS ARE:				
6	5	157.0	10.5	7.9
6	5	135.0	9.0	5.8
6	5	112.5	7.5	2.5
6	5	90.0	6.0	2.4
FOR THE UX-120 THE REQUIREMENTS ARE:				
4.5	3	135	22.5	6.5

The new tubes offer to the constructor the means for operating his receiver at the efficiency at which it should be operated. However, there are certain requirements that must be observed in the use of these tubes.

Those that interest the constructor most are the power tubes, UX-112 for 6-volt source, and the UX-120 for 4½-volt source. Each must be supplied with its correct grid and plate voltage or else there is no advantage in their use. The requirements are shown in the accompanying table which appears at the top of this column.

HOW TO CHARGE STORAGE BATTERIES FROM D. C.

THE charging of storage batteries which serve to supply the energy for the filaments of radio tubes is a problem which has engaged the attention of many engineers who are seeking to make this work easy for the man at home.

In many places only alternating current is obtainable for charging purposes and, where this is the case, some rectifying devices must be employed to change the current in the lighting mains from alternating to direct current. Where a simple rectifier is used the resultant rectified current is not purely a constant direct current but is more correctly termed a pulsating direct current.

A glance at A in Fig. 5 shows how this occurs. The alternation or cycle of current in an alternating current line assumes a definite form starting at a zero or neutral line. It then rises to a positive value afterward decreasing to the neutral again. This constitutes a half cycle. Now it continues below the neutral line toward the negative in the same fashion as it went positive. Therefore, it is observed that the cycle consists of two wave forms, one positive, the other negative in potential.

The rectifier is so designed and operated as to exclude the negative half of the alternation, permitting only the positive half to pass. This results in a series of pulsations of a positive nature which, if visible, would look like those shown in B. It is these periodic raps or pulsations which enter the battery on charge, causing a chemical change in the nature of the plates of which the battery is composed, so that it resumes its original charged state.

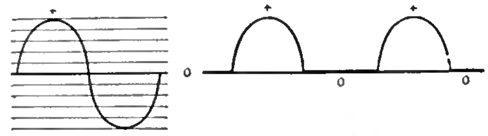
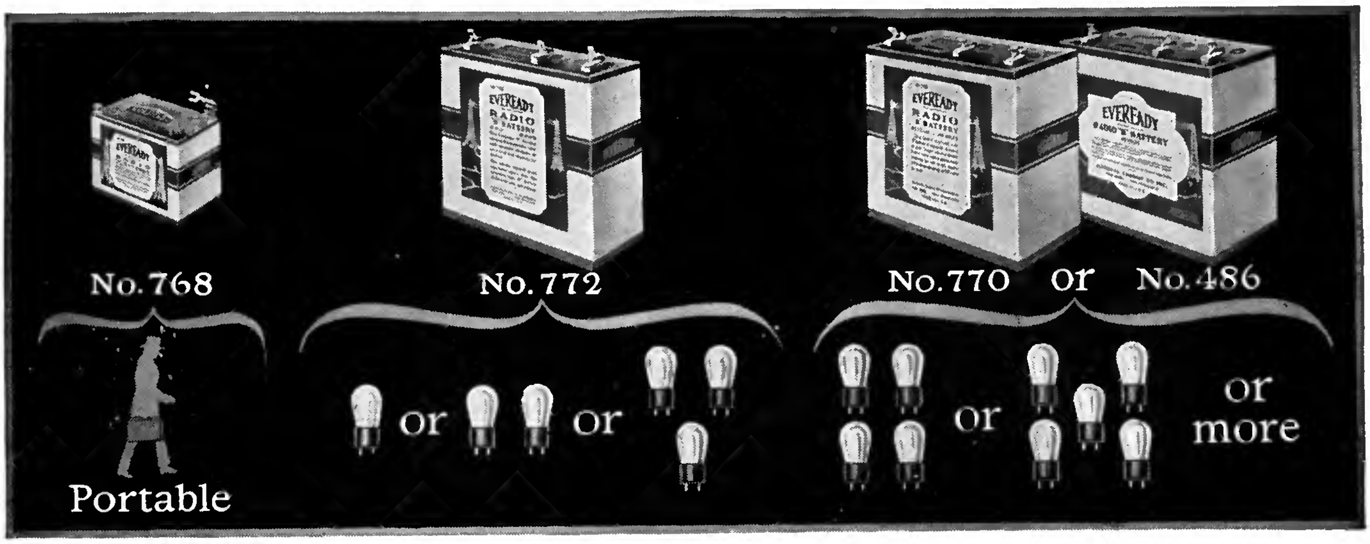


FIG. 5

This chemical change within the battery must be accomplished slowly, that is, at a low amperehour rate, otherwise the compound pressed into the plates of the battery will disintegrate and fall to the bottom of the cell, thus causing short-circuits from plate to plate.

Where the charging current is direct current a different procedure must be employed. Here

Perhaps you, too, can cut your "B" battery costs in half. Just follow the chart. It gives you the secret of "B" battery economy.



THOUSANDS of people have made the discovery that Eveready "B" Batteries, when used in the proper size and with a "C" battery*, are the most economical, reliable and satisfactory source of radio current.

On sets of one to three tubes, Eveready "B" Battery No. 772, used with a "C" battery, will last a year or longer, usually longer. On sets of four and five tubes either of the larger Heavy Duty Eveready Batteries No. 770 or No. 486, used with a "C" battery*, will last eight months or more.

These figures are based on the average use of receivers, which a country-wide survey has shown to be two hours daily throughout the year. If you listen longer, of course, your batteries will have a somewhat shorter life, and if you listen less, they will last just that much longer.

Here is the secret of "B" battery satisfaction and economy:

With sets of from 1 to 3 tubes, use Eveready No. 772.

With sets of 4 or more tubes, use either of the Heavy Duty Batteries, No. 770, or the even longer-lived Eveready Layerbilt No. 486.

Use a "C" battery on all but single tube sets.

Evereadys give you their remarkable service to the full when they are correctly matched in capacity to the demands made upon them by your receiver. It is wasteful to buy batteries that are too small. Follow the chart.

In addition to the batteries illustrated, which fit practically all of the receivers in use, we also make a number of other types for special purposes. There is an Eveready Radio Battery for every radio use. To learn more about the entire Eveready line, write for the booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you on request. This booklet also tells about the proper battery equipment for use with the new power tubes. There is an Eveready dealer nearby.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

---

*NOTE: In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it.

EVEREADY
Radio Batteries
—they last longer

Tuesday night means Eveready Hour —9 P. M., Eastern Standard Time, through the following stations:

WEAF–*New York*
WJAR–*Providence*
WEEI–*Boston*
WTAG–*Worcester*
WFI–*Philadelphia*
WGR–*Buffalo*
WCAE–*Pittsburgh*
WSAI–*Cincinnati*
WEAR–*Cleveland*
WWJ–*Detroit*
WGN–*Chicago*
WOC–*Davenport*
WCCO { *Minneapolis* / *St. Paul*
KSD–*St. Louis*
KGO–*San Francisco, 8 P. M. Pacific Coast Time*

the current is already direct so there is no need to rectify. However, it usually is higher in voltage than is desirable, and if a battery were connected to it directly, the low resistance of the battery would cause high current to be passed through it. This is equivalent to a rapid high charge which, as explained previously, causes disintegration of the plates of which the battery is composed. Therefore, when employing d.c., it behooves us to regulate the current flowing through the battery on charge so that this breaking up does not occur. If the resistance of the battery could be increased, then less current would flow in the circuit. Of course, it's not possible to increase the battery resistance, but an external resistance can be added to the circuit which will accomplish the desired result.

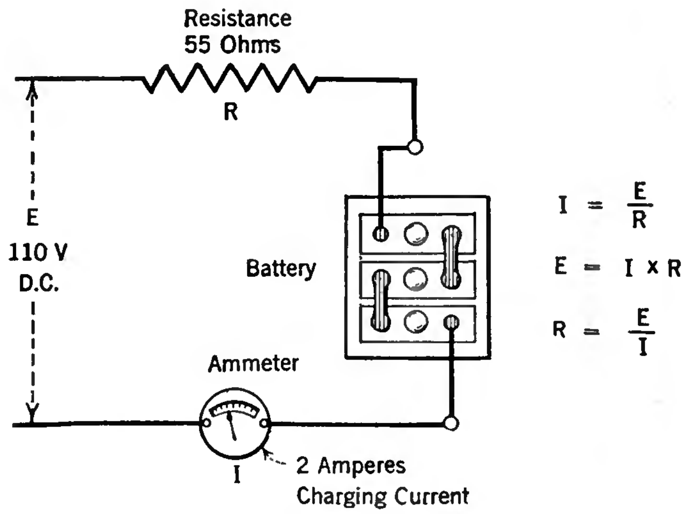


FIG. 6

By the use of a simple formula, it is possible to calculate the resistance necessary to charge the battery at a predetermined rate. In this formula, W = I x E, the E represents the d.c. line voltage, usually 110 volts, and I represents the

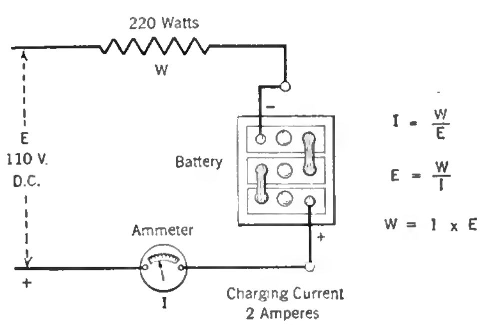


FIG. 7

rate of charge in amperes at which we wish to charge the battery. Let us suppose that we wish this rate to be 2 amperes. Then I = 2, and W represents watts, the unknown. If we could determine this value of W, then we could make use of the many home electric appliances, such as electric light bulbs, toasters, irons, heaters, etc., to charge the battery. Usually the manufacturers of such devices have a nameplate fastened to the apparatus which, among other things, tells its line voltage and watts value.

By applying the formula we find that W = 2 x 110 = 220 watts. From this we see that, if in the charging circuit we employ a device rated at 220 watts, the battery will be charged at the rate of 2 amperes. Batteries are rated in capacity, that is, their ampere-hour capacity. Theoretically, if a 100 ampere-hour battery be discharged at the rate of 2 amperes, it will last for 50 hours of use. In recharging this battery to its former state of usefulness, it is necessary to charge it for 50 hours at 2 amperes or 25 hours at 4 amperes or 100 hours at 1 ampere, etc.

Coming back to the use of formulas, if we wished to determine the actual resistance of the device necessary to charge the battery at 2 amperes, the formula $R=\frac{E}{I}$ would be employed. By substituting values we see that $R=\frac{110}{2}=55$ ohms. To check back our first formula, W = I x E, there is another one, $W=I^2xR$, which will prove that the resistance of a 220 watt device is 55 ohms when used on a 110 volt d.c. line. Substituting values, $W=2^2x55$, or W = 4 x 55 = 220 watts.

Often the experimenter will know his line voltage and the wattage of a piece of electric apparatus. By using the formulas above and transposing symbols, it is possible to determine the rate of charge of a battery circuit when that apparatus is included in the circuit as part of the charging medium. The variations or transpositions of the first formula W = I x E are, $E=\frac{W}{I}$ and $I=\frac{W}{E}$. It is the last one that we can apply in the last case described, $I=\frac{W}{E}$ or $I=\frac{220}{110}=2$ amperes. If W = 600, then $I=\frac{600}{110}=5.45$ amperes. These explanations will become more apparent from an observation of the circuits in Figs. 6. and 7.

In a great many homes there is employed a local lighting system, such as the farm lighting affairs. They consist mainly of a bank of storage batteries totalling 32 volts, with a direct current generator, the latter being used to charge them. Often it is not practicable to move the radio storage battery to the location of the generator and batteries, and it is more convenient to charge the battery from a light outlet. By inserting a resistance in series with the 32-volt line, the 6-volt battery may easily be charged. Applying the above formula to determine the resistance necessary to charge at the rate of 2 amperes $R=\frac{E}{I}$ or, $R=\frac{32}{2}=16$ ohms. Where the value of a resistance is known, say 8 ohms, and it is desired to determine the rate of charge when using that resistance, then $I=\frac{E}{R}$, or $I=\frac{32}{8}=4$ amperes.

GRID INQUIRY BLANK

Editor, The Grid
RADIO BROADCAST
Garden City, New York

DEAR SIR:

Please give me the fullest information on the attached questions. I enclose a stamped envelope.

☐ I am a subscriber to RADIO BROADCAST and therefore will receive answers to my queries free of charge.

☐ I am not a subscriber and enclose $1 to cover cost of answers.

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ADDRESS ....

G. M. ....

Model R Receiver: ***Rauland-Lyric-equipped.*** **Price $90 (East of the Rocky Mountains)**

Beauty and Permanence

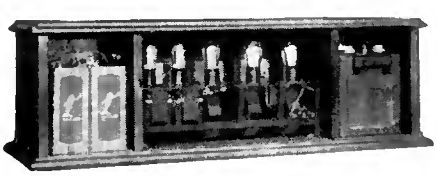
Listeners Marvel—
at the wealth of enjoyment awaiting but a touch of the fingers.

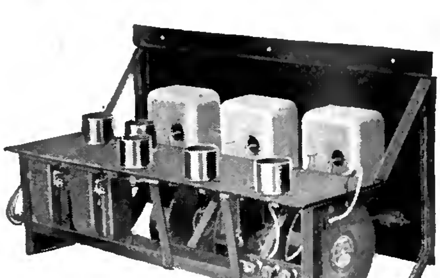
Women Are Delighted—
with the tasteful stateliness of the Model R cabinet, as much as with the neatness of its battery accommodations.

Engineers Voice Approval—
of the rigid spot-welded steel chassis, protecting from damage every part of a set that stands as a notable example of the *completely manufactured* rather than the merely *assembled* radio receiver.

Service Men Commend—
the thoroughness with which every part has been made proof against the interruption of its service, so far as human ingenuity can devise.

Dealers Are Enthusiastic—
over the excitement created everywhere by this unique receiver and the uniform satisfaction felt by its users.





All that you want in a radio—natural tone, sharp selectivity, straight-line-frequency tuning (360°) unaffected by position of the fingers, extreme sensitiveness, permanence.

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The leading wholesaler of radio apparatus in your community has probably been, for years, an ALL-AMERICAN Authorized Distributor. ALL-AMERICAN Guaranteed Radio Products are being shown everywhere by responsible and reliable dealers.

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A Department for the Exchange of Ideas and Suggestions of Value to the Radio Constructor and Operator

CONTRIBUTIONS to this department are welcome and those used will be paid for at the usual rates, that is, from two to ten dollars each. A prize of twenty-five dollars is given for the best idea used during each three-month period. The prizewinner for the last period was announced in the February Radio Broadcast. *Manuscripts intended for this department should not exceed about three hundred words in length, and should be typewritten. Little consideration can be given to manuscripts not typewritten. Envelopes should be addressed to this department,* Radio Broadcast, *Garden City, New York.*

HOW TO MAKE BALLOON COILS

BALLOON coils are often seen in many of the latest circuits, but no instructions are given for making them, thus depriving the experimenter of most of the real pleasure of building his own set.

They can be easily made, however. First of all secure a round stick about an inch in diameter and ten inches long, for a winding form. When using one coil within a larger coil (primary and secondary), one form will need to be larger by about a quarter inch, or more, in diameter. Saw a slot about seven inches long in the form and make a wedge as shown in A, Fig. 1, to hold it open while winding the coil. Wrap this form with paper to prevent the insulation of the wire sticking to it when the cement is applied. A tack is employed to hold the paper and is left protruding from the wood so that the beginning of the wire may be fastened to it when the next procedure, that of winding the coil, is started. A second tack is used to hold the other end of the coil when the latter has been completely wound. The size of wire and number of turns can be taken from a manufactured coil, or found by trial. To hold the wires together while bending the coil around the core, the use of collodion, or better still, a solution of acetone and celluloid, is recommended. When thoroughly dry, the coil can be taken off by removing the wedge and closing the slot. A round piece of wood will do for a core for a small coil, or a piece of bakelite tubing for a larger one. Make the core any convenient length. The diameter of the core may be found by cutting a strip of paper the length of the winding and making the core of such size that the paper will not quite meet. Remove the paper from outside of coil and place on the core as shown in B, Fig. 1. A waxed thread should be run through to secure the coil to the core; then carefully bend the coil around the core and secure with the thread. Space the free coils as evenly as the job requires. A thread around the core on the outside of the coil as shown in C, will help to hold the individual turns steady. When these coils are to be used one inside the other, secure the larger coil to the core but do not space the wires at the joint. The small coil can be slipped in the larger one. A narrow strip of paper is used to space the coils as shown in section in C. Now secure the smaller coil with thread and space the coils as desired.

John L. Lee,
Washington, D. C.

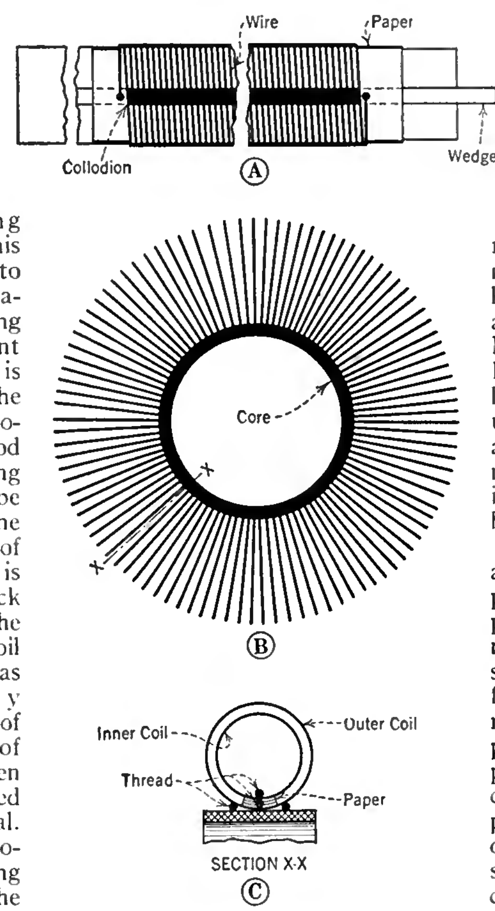

FIG. 1

A GOOD AUDIO BYPASS METHOD

FROM a constructor's point of view may I register a point in connection with Mr. Millen's power amplifier as published in the November, 1925, Radio Broadcast. I have reference to the use of a resistance as a means of securing the negative grid bias, as is best illustrated in his Fig. 9.

Let us suppose that a milliammeter in the plate circuit of the power tube registers 10 milliamperes, and let us suppose that the audio frequency fluctuations range from 5 milliamperes to 15 milliamperes. The voltage drop across R_3 is proportional to the value of the plate current, since the entire plate current must pass through R_3 in order to reach the filament. The voltage drop, therefore, not only varies in the ratio of 1:3 during the audio frequency cycle but unfortunately this variation is—as one might say—"180 degrees out of phase" with the grid current fluctuations. When the grid has reached its most positive potential, the negative grid bias is then at a maximum, because the plate current is at a maximum, and when the grid has reached its most negative potential, the negative grid bias is then at a minimum because the plate current is at a minimum. The effect, therefore, is to reduce the amplitude of the grid circuit fluctuations, and con-

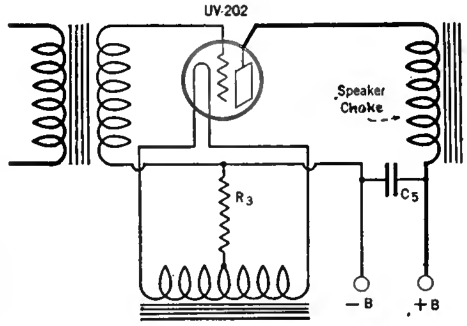

FIG. 2

sequently the amplification. It amounts in fact to a reversed feedback.

The audio frequency bypass condenser, C5, of his Fig. 4, if transferred to Fig. 9 for simplicity of illustration, would appear as in accompanying Fig. 2. In this position C5 does not overcome the objections noted as the entire plate current (both d.c. and a.c. components) must still pass through R3.

I wish to suggest that C5 be placed as in Fig. 3 shown herewith. It is evident that in this position only the average plate current (i.e. the d.c. component) will pass through R3, and a fairly constant grid bias will be obtained throughout the entire audio frequency cycle which will neither add to, nor substract from, the grid current fluctuations. The a.c. component of the

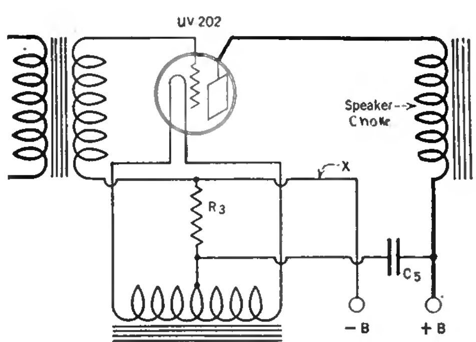

FIG. 3

plate current is now supplied by C5, or "bypassed" if one wishes to think of it in that way.

With the change in position of C5, if now a 20-henry 25-milliampere choke is introduced at X, the combination becomes as good as a dry cell C battery.

JEROME KIDDER, M.D.
Salina, Kansas.

HOW TO OBTAIN IMPROVED LOUD SPEAKER REPRODUCTION

THE ideal radio set of to-day is, no doubt, the one constructed with a view of securing the highest possible acoustic perfection of reproduction. Sources of distortion in a multi-tube set are galore, and it takes expert knowledge to build one that can be depended upon to bring in the favorite broadcast programs day after day with an unfailing quality of reproduction.

Every component that goes to make up your receiver installation may in a way, be considered as a distortion device. Let us consider the present day loud speakers, ignoring entirely for the moment all distortion that may be due to resonance and similar phenomena. Those built along electro-magnetic lines employ the ordinary telephone type diaphragm and an electromagnet. On these speakers the magnetic stress placed upon the diaphragm by the non-modulated component of the plate current is the cause of a certain drag or excessive inertia that is productive of distortion.

On electro-dynamic loud speakers, distortion is partially due to the great load that the low impedance moving coils place upon the tube with the output of which they are connected in series.

Any overloaded loud speaker will produce distorted reproduction.

To improve the quality of reproduction by improving the operation of the loud speaker used in conjunction with a set,

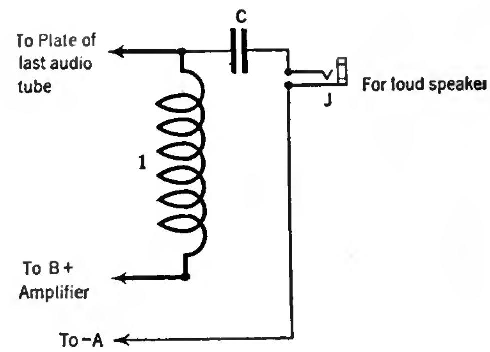

FIG. 4

it is generally recommended to employ some sort of a shunt plate feed for the loud speaker in such a manner that only the modulated component of the plate current be permitted to flow through the loud speaker coil windings.

Fig. 4 shows the conventional arrangement of such a plate shunt feed, where I is usually the secondary of an audio transformer or an impedance of similar characteristics, C a 1-to 4- mfd. blocking condenser, and J an open circuit output jack.

The writer has found that practically identical acoustical improvement can be had by an arrangement as shown in Fig. 5, where R is a grid leak of approximately 50,000 ohms, C a 1- to 2-mfd. condenser, and J the output jack.

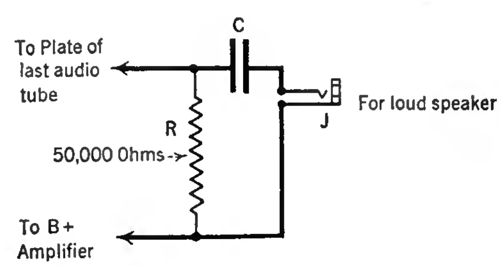

FIG. 5

This arrangement was found quite as effective in reducing loud speaker distortion as is the one shown in Fig. 4. It has a tendency to stabilize the audio amplifying system which is especially apparent when high plate voltages are employed.

It can be built into any set as it takes up very little space, and it does not cost nearly as much as the impedance shunt-plate feed that is the more commonly used.

BORIS S. NAIMARK,
New York City.

A LOW LOSS COIL

THE following method describes the making of a low loss solenoid coil which is quite rigid and can be removed with ease from the coil form.

COILS

by SICKLES

developed exclusively for the Aristocrat

THE F. W. Sickles Co. felt strongly that a receiver so advanced in design as the "Aristocrat" deserved coils just as advanced in order to give to the home constructor the inherent benefits of this receiver.

As a consequence Mr. Sickles, who is the developer of the proved "Diamond Weave" principle in coils and who is chief engineer of the F. W. Sickles Co., set to work. The result of his engineering ability backed by thorough-going and practical research, is being enthusiastically welcomed by laboratories everywhere in America. The "Aristocrat" Coil by Sickles is based upon scientific facts, not wishes nor fancies. And these facts were determined by an exhaustive and conclusive series of tests upon highly sensitive and calibrated electrical instruments.

The "Aristocrat" Coil is unquestionably the best coil ever produced by Sickles.

Write for Radio Broadcast's Five Foot Diagrams.

★

THE F. W. SICKLES CO.

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To make the coil form, a wooden block is turned down to a hollow cylinder 2½ inches in diameter and 4½ inches long. See Fig. 6. Then two plugs and two rings are made, one ring and plug for each end of the tube. The diagram shows the constructional data for these. Now two grooves are cut lengthwise on opposite sides of the tube, and a saw cut is made halfway between the grooves on one side. This completes the coil form.

The four bakelite strips, shown in the illustration, are heated until they can be slightly curved, as shown in Fig. 7, and are then allowed to cool. By curving the strips the middle turns of the coil are held fast. The strips are, of course, equal in width to the grooves mentioned above.

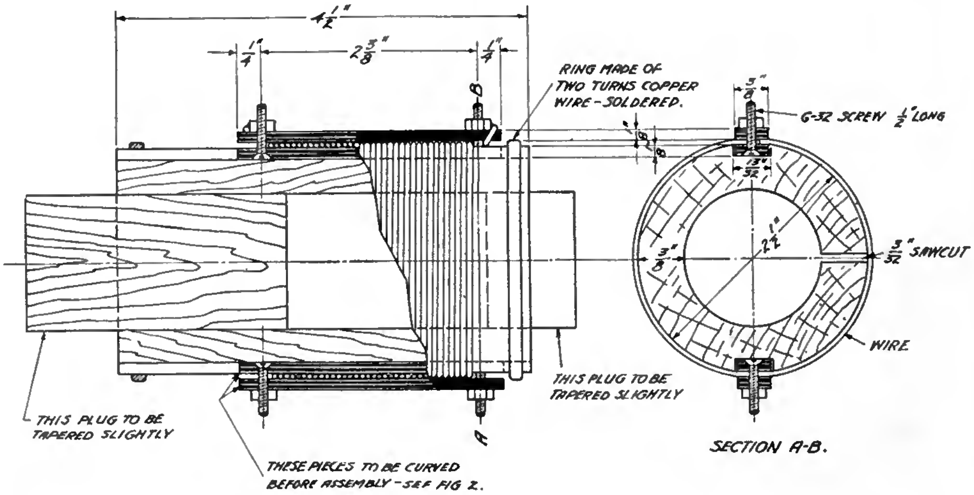


FIG. 6

Before starting to wind the coil, the two copper-wire rings are put on the form ends and the plugs inserted. Then two of the bakelite strips, with their screws, are placed in the grooves and the curve taken out by binding with string at the middle. The beginning of the wire is bent around one of the screws, which are used for terminal posts, and the winding proceeded with in the usual manner, care being taken to keep the bakelite pieces straight. When finished, bend the wire around the other screw and then fasten down the other two bakelite strips on top of the wire. A little binder can be used to cement the wire to the strips.

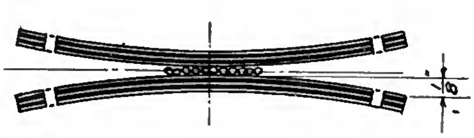


FIG. 7

To slip the coil off, remove plugs and rings and compress the tube.

The experimenter can, by lengthening the bakelite strips and using the same size wire, wind a primary coil at one end of the tube. If smaller wire is used, the outside strips will have to be in two pieces. Also a fixed or movable tickler could be mounted at the other end of the coil.

Everett Freeland,
Dowagiac, Michigan.

ONE USE FOR A BYPASS CONDENSER

It is noticeable that in a large number of radio receivers, commercial or home made, the quality of tone is not as good as it should be. In some receivers there is a distinct hiss or a high shrill whistle which comes in continuously with the music or speech. This whistle or hiss is caused by some slight feedback between the tubes, and seems to indicate that there is some oscillation in the audio frequency end which should not be there. To the critical listener this is very objectionable. It may often be effectively stopped, without affecting the volume of the receiver, by placing a small mica type bypass condenser in the proper place. The condenser should be placed across the plate and plus filament of the last, or in other words, the output tube. Its value should not be less than .005 mfd. but it may be found on trial that this should be increased to .01 mfd. A convenient way of mounting the condenser is given in the sketch Fig. 8, which shows the underneath part of the socket and contact springs. A small brass strip about one inch long, with a hole near each end, can be bolted direct to the condenser and to the bolt holding the socket spring. This idea was tried out on a manufactured set of the lower priced kind, and the results were so much improved that such a condenser is being placed on every set of this type that is sold. Placing a condenser across the speaker posts of the receiver was not found to produce the same results as the volume was reduced to some extent, and the tone changed.

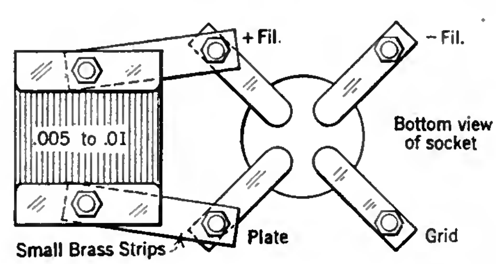


FIG. 8

K. B. Humphrey,
Brooklyn, New York.

A New Way to Make Money in Radio

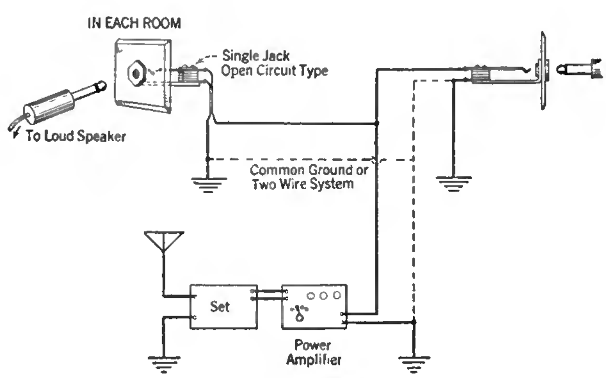
As Long as New Apartment Houses Are Being Erected, There Will Be Plenty of Opportunity for the Go-Ahead Man

By D. C. WILKERSON

AS WITH the swing of the pendulum, the first impressions which labeled radio with the yellow-golden streak as a bonanza for quick wealth, seem to have changed of late.

Hundreds of fly-by-night radio enterprises are going permanently out of business, and perhaps their disgusted proprietors have spread the story that "radio is a lemon." At any rate, although many attractions are offered to young men to take up radio and kindred subjects by the large corporations, most of whom spend real money to train these neophytes, the 1925 crop of college graduates has not leaped into the arms of these welcoming agencies.

Regardless of false impressions blabbed about hither, thither, and yon, by those who may be soured on radio, the radio art is yet a sound and promising field for men, young or middle-aged, or even old. Its possibilities are so tremendous that one can scarcely grasp them. A field for radio not generally realized will be discussed here.



CENTRAL DISTRIBUTION PLAN

A series of jacks, one in each hotel room or apartment living room, may be connected in parallel to the output of a central receiver kept in tune by the telephone operator. A separate ground for each jack is often advisable, it being as near to the jack as possible

Have you ever stopped to consider how radio in real estate is a genuine asset? Only last month one realty firm of note advertised that their new subdivision of houses was in an excellent location for radio, in other words, out of the dead spot zones.

Now then, how many new houses are being built by companies of large operating facilities in your neighborhood? Perhaps ten, fifty, a hundred, or maybe a thousand, depending upon where you live.

Would these houses sell more readily if they were equipped with antenna and ground, and convenient connections inside? You can bet your new loud speaker they would.

Now then, who has enough initiative to organize and broach the proposition of making such installations for the building operations company? It would not require much investment in the way of tools and equipment, while copper wire, insulators, screws, spreaders, masts, and the like, can be obtained anywhere. You could make a deal with your local hardware store to supply you at a discount.

Armed with a ladder, some roof "stickers," and some gumption, a couple of bright active fellows could "clean up" in the home town on a job like this. Old clothes, a flock of screw drivers, and a smile or two, would make valuable adjuncts.

Why not try it some of you fans who want to capitalize your hard-earned knowledge of radio?

Again, another market for your knowledge presents itself. It is becoming quite the thing for multiple installations to be rigged up for hotels and apartment houses. Here *is* a field.

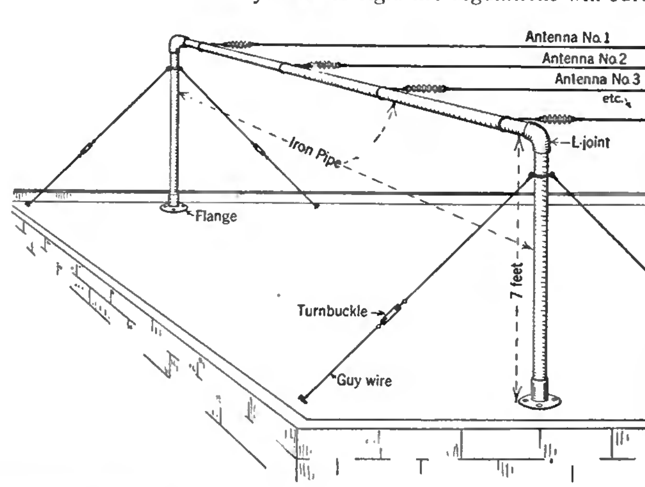
Some jack plates for wall plugs, wiring connecting to a central distribution point where the elevator operator, or telephone girl, keeps tuned-in to some program or other, is not a difficult job.

Inexpensive loud speakers, with plug in each suite, complete the panorama. Some of the finest hotels and apartment houses in the country are being built with these radio conveniences installed.

The work must be done by somebody, and it might as well be you.

STURDY ERECTION A PRIME FACTOR

AND here is another stunt. How about these tanglefoot rooftops which entrap the wary burglar or zealous fireman with equal facility? More rigid fire regulations will surely

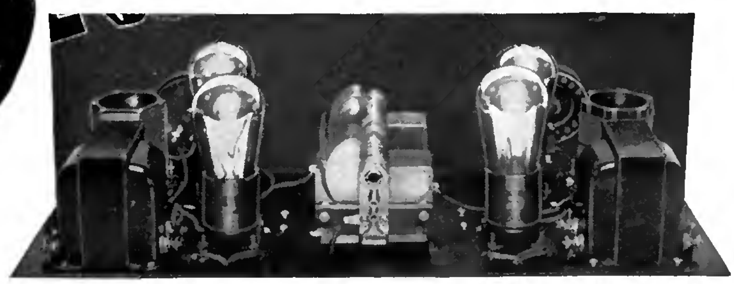


A NEAT MULTIPLE ANTENNA ARRANGEMENT

By the use of iron piping supports, several antennas may be supported without fear of disaster during heavy storms

Send for this New Hookup

S-C



Four Tube Receiver

Here is the outstanding radio receiver development of the season, in which is combined the genius of two of the most successful and distinguished radio engineers, assisted by the engineering and laboratory staffs of seven prominent radio manufacturers. Here is a receiver for the home builder that will represent for several seasons to come a far greater value than any other design available. Send for the book. Read how to obtain the following

Startling New Features

SINGLE CONTROL—But one tuning or station selector control.

SELECTIVITY—In a residential district of New York City, within a few hundred yards of powerful stations, thirty-five stations were heard between 9 and 10 p. m. on the loud-speaker. KFI, in Los Angeles, was heard with ample volume to fill two rooms. Tests in Chicago brought in either coast with ample speaker volume, and indicated that a consistent range of 1,000 to 2,500 miles might be expected.

QUALITY—Two new-type Thordarson power amplifying transformers possessing a substantially flat frequency characteristic over the range of 40 to 6,000 cycles, give a quality of reproduction so perfect that comparison by the best trained human ear with other types of amplifiers will not reveal any superior type.

VOLUME—In all cases the volume will exceed that obtainable from other four-tube receivers, and in practically all cases equal or exceed that obtainable from standard five and six-tube receivers.

UNLIMITED WAVE LENGTH RANGE—Through the use of interchangeable coils, the wave-length range is practically unlimited.

WIRING AND ASSEMBLY—All wiring is carried in a special harness. Since each wire is exactly the right length, and has a special color, it is impossible to go wrong in wiring. No soldering is needed unless preferred by the builder. Only a screwdriver and a pair of pliers necessary to assemble this set in less than two hours.

Over-all design, rugged and solid. Adapted to practically any standard cabinet, any standard tube, any battery or eliminator source of supply, outdoor antenna or loop. While the parts are the best that the leading laboratories of the country afford, the set can be built at an extremely low cost. Full description of the receiver will be published in the March issue of Popular Radio.

Get the hand book at your nearest Radio Dealer or clip the coupon and send with 25 cents TO-DAY. Address

The S-C Merchandising Committee
106 S. Wabash Ave.
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No choicer group of radio products has ever been embodied in a single radio receiver. Not only are these manufacturers nationally known and accepted as the leaders in radio design and construction, but they have developed for the S-C receiver many new features which will create a new standard in reception throughout the radio world.

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Gentlemen: Please find enclosed 25c, for which send me hand book of the new S-C Receiver.

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A KEY TO RECENT RADIO ARTICLES

By E. G. SHALKHAUSER

THIS is the fifth installment of references to articles which have appeared recently in various radio periodicals. Each separate reference should be cut out and pasted on cards for filing, or pasted in a scrap book either alphabetically or numerically. An outline of the Dewey Decimal System (employed here) appeared in the November and January RADIO BROADCAST, *and will be reprinted in an early number.*

R382. INDUCTORS — COILS. *Toroids.*
QST. Dec. 1925, pp. 9–12.
"Toroids," F. J. Marco.

Through the increased use of radio frequency amplification, coils have been designed which are said to give greater selectivity than is the case with common solenoid coils The toroid coil is an outgrowth of some of these newer developments. It has practically no external field. Considerable theoretical and practical data accumulated by the author, is presented. The advantage of this new coil lies in the lessening of interstage magnetic coupling. It does not nullify interstage oscillations in r. f. amplification.

R582. TRANSMISSION OF PHOTOGRAPHS. — PHOTOGRAPH TRANSMISSION.
QST. Dec. 1925, pp. 12–17.
"Practical Picture Transmission," T. P. Dewhirst.

The Jenkins Laboratories have two picture transmission machines available for amateur use, the "Midget" and the "Junior." Both of these instruments are pictured and described in detail. Certain facts regarding the use of the apparatus and method of operating it are considered. Circuit diagrams are shown and explained.

R386. FILTERS. — FILTERS.
QST. Dec. 1925, pp. 24–26.
"Amateur Filter Problems," F. S. Dellenbaugh.

A summary of problems pertaining to low-pass filters from 25 cycles a. c. to commutator ripples in generators, is given. A full page of design data covering construction of induction coils with carrying capacity of .05–.5 amperes, is included. The "brute force" and "intelligence" method of filtering are discussed, and diagrams shown. Tests of filter action using telephone induction coil and headphones are diagrammatically included.

R357. FREQUENCY CHANGERS. — FREQUENCY Doubling
QST. Dec. 1925, pp. 29–30.
"Frequency Doubling in Vacuum Tubes," T. T. Greenwood.

A method whereby the ordinary three-electrode tube may be used to double the output frequency in a circuit, is described. Use is made of the decrease of grid current for either increase or decrease of plate potential. Diagrams illustrate the points under consideration.

R374. DETECTORS, CRYSTAL. — CRYSTAL, *Carborundum.*
QST. Dec. 1925. pp. 31–32.
"The New Carborundum Detector," M. L. Hartmann and J. R. Meagher.

A fixed crystal detector for broadcast receivers is described. Carborundum is used since this crystal is superior to any others, considering electrical stability and permanence. It has been developed to a point, according to the author, where its use may he an asset to modern receiving sets. The commercial product is shown and circuit diagram given.

R402. SHORT WAVES. — SHORT-WAVE TRANSMISSION.
Proc. I. R. E. Dec. 1925, pp. 677–683.
"An Investigation of Transmission on the Higher Radio Frequencies," A. Hoyt Taylor.

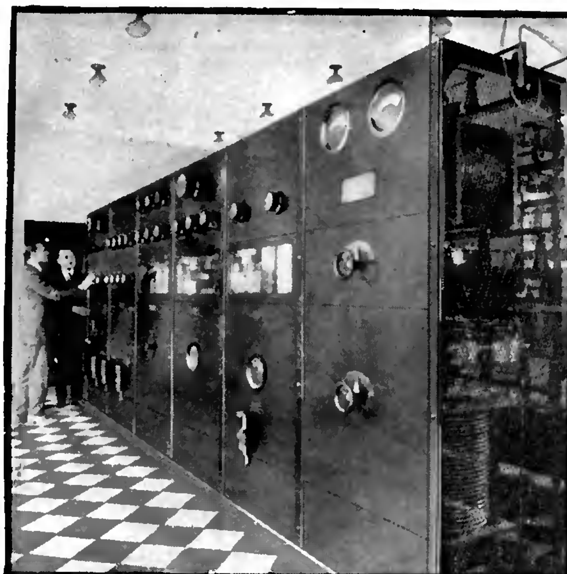
A preliminary range chart has been constructed for telegraphic communication, 5 kw. in the antenna, at various frequencies. The conclusions upon which the range chart is based are derived from experiments made by the Naval Research Laboratory, from experiments made by amateurs, and from such data as the Laboratory has had access to from commerical and Government sources at home and abroad.

An attempt has been made to indicate in a general way the advantages and disadvantages of high frequency telegraphic transmission. Various critical regions are pointed out where new phenomena make their appearance; (1) region between 2000 and 3000 kcs. (2) region around 6000 kcs. (3) developments at higher frequencies of uncertain ranges.

The development of a missing region to extensive areas is shown to take place with a frequency rise to 20,000 kcs. The chart also attempts to indicate, in a general way, the region of uncertain communication and the regions where further exploration is urgently needed. It is quite evident that the range data is far from complete and that many individual cases will be found in contradiction to the chart, but it does represent a general average of the situation as it presents itself to the engineers in the Naval Service.

R115. DIRECTIONAL PROPERTIES. — DIRECTIONAL RECEIVERS
Proc. I. R. E. Dec. 1925, pp. 685–707.
"A New Directional Receiving System," H. T. Friis.

The paper discusses methods of comhining the signal currents from the different antennas in a directional receiving system, and a detailed description is given of a system by which all phase and amplitude adjustments are performed upon the beating current inputs of a double detection receiver. The theoretically derived shape of the directional characteristic of a two-loop system has been verified by experiments, and data on reduction of static for such a system are given. Photographs and diagrams are shown of all the apparatus used.



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R140. CIRCUITS. CIRCUITS, *Transmitting.*
Radio. Dec. 1925, pp. 26 ff.
"How to Indentify the Transmitting Circuits," Lieut. J. B. Dow, U. S. N.
An oscillating tube circuit is used for transmitting purposes. Six basic circuits, the Meissner, Coupled plate, Coupled grid, Hartley, Modified Hartley, and Colpitts, are listed by the author, together with diagrams and a general discussion. Other circuits, such as the grid condenser and leak system, are considered modifications of the fundamental ones. Some of the modifications are taken up and diagrams shown.

R343. ELECTRON TUBE RECEIVING SET. RECEIVER, *LC-26.*
Popular Radio. Dec. 1925, pp. 495–511.
"LC-26 Receiver," L. M. Cockaday.
A receiver considered by the author as the best one yet constructed, and available in parts for the radio experimenter, is described. It is a five-tube resistance-coupled set. Front, rear, and side views, including wiring diagram and list of parts, are shown. All details pertaining to the set are carefully presented.

R381. CONDENSERS CONDENSER LOSSES
Popular Radio. Dec. 1925, pp. 521–525.
"Condensers," S. Harris.
The question of losses in condensers is a difficult problem in radio engineering, but one should have some idea about high frequency resistances in condensers. The radio experimenter will have no difficulty in understanding some of the effects due to eddy currents, dielectric losses, etc., the author believes. A simple method of measuring such losses in condensers is presented by the writer.

R550. BROADCASTING. INSTRUMENTS, *Placing of*
Popular Radio. Dec. 1925, pp. 526–532.
"The Oboe in 4-D," T. L. Bayard.
"The location of each instrument in group radio transmission, orchestra or band, before the studio microphone, is a problem which has been studied at some length and solved to some extent by engineers of station KDKA at Pittsburgh. Charts and explanations furnish the reader with considerable detailed information.

R582. TRANSMISSION OF PHOTOGRAPHS PHOTOGRAPHIC TRANSMISSION.
Popular Radio. Dec. 1925, pp. 540–544.
"Pictures by Telephone or Radio," E. H. Hansen.
A new method of transmitting pictures by radio, called the "Phono-Photo" method, is described. Fundamental data on present types of systems developed, are reviewed and compared with the system presented by the author. A photo-electric cell is required, actual pictures being transmitted over the ordinary telephone lines in a remarkable short time.

R261. ELECTRON TUBE VOLTMETERS. VOLTMETERS, *Vacuum Tube.*
Popular Radio. Dec. 1925, pp. 552–555.
"A Vacuum Tube as a Voltmeter," L. M. Cockaday.
A three-electrode vacuum tube is used as a voltmeter to cover a considerably greater range than the voltmeter in common use, since it can be applied to either d. c. or a. c., from a fraction of a volt to several hundred volts. An explanation of its uses, and the method of applying it, is given in detail. Circuit diagram and apparatus assembled, is shown.

R382. INDUCTORS. INDUCTANCE VALUES.
Popular Radio. Dec. 1925, pp. 559–561.
"The Relative Merit of Some Types of Inductance," B. B. Minnium.
The author presents a careful analysis of several types of inductance coils, mainly pertaining to the method of winding them, and makes a comparison of their relative L-R values. Some conspicuous results are obtained, which should be considered carefully before deciding which coils are the best. A graph shows the L-R ratio and the wavelength plotted for six types of windings. The torus coil appears to be far the poorest coil investigated.

R364. CRYSTAL DETECTORS. CRYSTALS.
Popular Radio. Dec. 1925, pp. 575–576.
"Do Impurities Improve Crystal Detectors?,"
Doctor Wherry, of the Bureau of Chemistry, presents one of the most complete lists of crystal detector minerals and their composition, which has ever been published. It appears that crystals with some impurities are better for high frequency detecting purposes than the pure minerals, although there are some exceptions.

R342.7. AUDIO-FREQUENCY AMPLIFIERS. AMPLICATION *Audio-Frequency*
RADIO BROADCAST. Jan. 1926, pp. 313–316.
"Additional Notes on the Model 1926 Receiver," E. R. Pfaff.
The author describes an improved audio amplifying unit to be used with the McMurdo Silver receiver (described in Nov., 1925, RADIO BROADCAST) using transformer, resistance, or choke-coil coupled amplifiers. In using increased plate voltages for power tubes, it is frequently necessary to use a shunt method of horn connection for good results. Resistance coupling, with its advantages and precautions to be observed, is reviewed at length.

R402. SHORT WAVES. SHORT-WAVE TRANSMITTER.
RADIO BROADCAST. Jan. 1926, pp. 321–325.
"A Universal Short-Wave Transmitter," N. Hagemann.
The construction of a high frequency telegraph transmitter, using receiving parts, is described. The circuit shown is capable of steady oscillations even when plate or filament current should vary somewhat. Complete instructions, wiring diagrams, and photographs are given.

R343. ELECTRON TUBE RECEIVING SETS. RECEIVER, *Universal.*
RADIO BROADCAST. Jan. 1926, pp. 331–336.
"Radio Broadcast's Universal Receiver.", A. H. Lynch.
The article starts with a general review of the radio parts situation at the present time and proceeds to give a detailed account of several good receivers which may be built by the home constructor. The "Universal," an exceptionally efficient four-tube receiver, using one r. f. stage, tuned and neutralized, a regenerative detector, and good audio stages, is described, photographs serving to illustrate the general layout of instruments.

R550. Broadcasting. Station.
Radio News. Dec. 1925, pp. 798 ff. *Broadcasting.*
"What Happens In the Broadcast Station," A. P. Peck.
A fundamental descriptinn of the operation of a modern broadcasting station, including the principles of sound vibrations, the purpose of the microphone, the operation of the transmitting tubes, the method of modulating high frequency currents, and the equipment of the rooms housing the broadcasting station.

R142.3. Inductive Coupling. Coupling.
Radio News. Dec. 1925, pp. 800 ff.
"Coupling—Tight or Loose?", S. Harris.
In this article, the first of a series, is presented a mathematical treatise on the question of coupling between coils. Actual measurements, made with different coils, are shown graphically, with constants of the coils given. Only concentric coils are considered, variations being made in diameter of coils, number of turns, and position of primary with respect to secondary (whether in center or to one end). The effect of the antenna constants, when considered with coil coupling, is another important factor.

R402. Short Waves. Transmitter,
Radio News. Dec. 1925, pp. 803 ff. *Short-Wave.*
"The Baby Transmitter," W. B. Schulte.
A complete description of a low power transmitter using UV-199 tube, and operating at high frequencies (7500 kc.), is given. The modified Colpitts oscillator used, was developed at the Burgess Laboratories. Ordinary dry batteries furnish the plate and filament supply. The circuit diagrams show clearly how this set can he constructed.

R334. Four-Electrode Tubes. Electron Tubes,
Radio News. Dec. 1925, pp. 804 ff. *Four-electrode.*
"Multiple Grid Vacuum Tubes and Their Advantages," T. H. Nakken.
The author presents an analysis and working principle of a two-grid tube, giving its advantages and theory of operation. One grid is connected directly to part of the B battery voltage in order to neutralize the space charge within the tube. The other grid performs its regular functions as in three-electrode tubes. It is said that capacity effects between grid and plate may be prevented by this unique arrangement of grids. As a power tube, this device has many possibilities.

R402. Short Waves. Transmitter,
Radio News. Dec. 1925, pp. 807 ff. *Five-Meter.*
"Five-Meter Transmission," R. E. Kolo.
The construction of a transmitter and receiver operating on 50,000 kc. (5 meters) and the arrangement of Lecher wires to measure these high frequency currents, is given. The University of Illinois experimental station worked out the apparatus design. Data on construction and operation is given in detail.

R381. Condensers. Condensers,
Radio News. Dec. 1925, pp. 808f. *Electrolytic.*
"Electrolytic Condensers," T. A. Smith and J. Millen.
"A description of the much talked of electrolytic condensers, is presented. Tables give relation of capacity to voltage formation values and the critical voltages for aluminum anodes with various electrolytes. Construction of such condensers for transmitting and receiving purposes, and proper sized choke coils to be used for good results, is part of the information given to enable the constructor to build his own.

R375. Detectors; Rectifiers; Miscellaneous. Eliminators,
Radio. Dec. 1925, pp. 15 ff. *A, B, and C Battery.*
"The A B C Battery Eliminator," G. M. Best.
The construction of an eliminator to replace the A, B, and C batteries, thus operating the radio receiver from the regular 110 volt a. c. power circuit, is described. Any set using up to and including eight tubes, may connect to this eliminator. Some changes in wiring are necessary in the set. A list of complete parts are given and diagrams shown. The construction of the eliminator is not difficult, and is considered quiet in operation. Rewiring diagrams for the Browning-Drake and also an eight-tube super-heterodyne, are given.

R073. Training of Operators. Examinations,
Radio. Dec. 1925, pp. 22 ff. *Government.*
"Passing Your Next Radio Examination," C. W. Rados.
Complete information is presented concerning the license examinations for amateur and commercial operators. These examinations are conducted by the Department of Commerce and may he taken at any one of the district offices. A code test comes first, followed by an examination in theory and laws of radio communication. A sample code test is also included in this very complete article.

R343. Electron Tube Receiving Set. Receiver,
Radio. Dec. 1925, pp. 25 ff. *Browning-Drake Single Control*
"The Single Control Browning-Drake Receiver," H. A. Nickerson.
A method of converting the Browning-Drake circuit to single control is described, using two condensers mounted on one shaft. This circuit is well adapted to such an arrangement, writes the author. The principle of operation, with the change suggested, is considered at some length. Other changes to be made are also given consideration.

R143. Damping; Decrement. Damping.
Radio. Dec. 1925, pp. 29 ff.
"Damping," L. R. Felder.
A fundamental and simple explanation of the question of "damping," also called "decrement," is given. "Damping" is found in all radio circuits, since they all have more or less resistance. It will increase broadness of resonance as explained and indicated graphically. This problem must therefore be considered in the design and efficiency of all radio apparatus.

R242. Reactance-Variation Method. Coil Measurements
Radio. Dec. 1925, pp. 31.
"A Standard of Coil Comparison," G. F. Lampkin.
The author makes a plea for expressing in some standard way the meaning of coil efficiency. He suggests that the ratio of L-R he used, and gives his reasons, explaining this ratio of reactance to resistance at some length.

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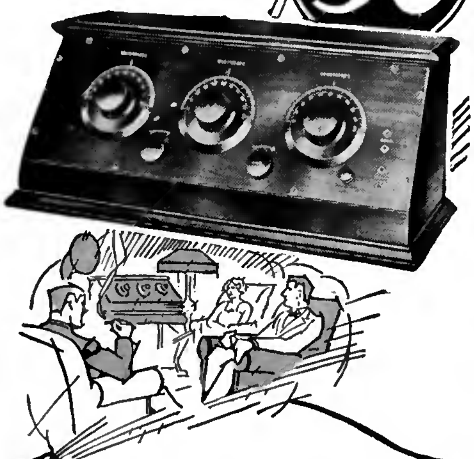

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R134.4. Regenerative Action. Regenerative Amplification
Proc. I. R. E. Dec. 1925, pp. 709–753.
"An Analysis of Regenerative Amplification," V. D. Landon and K. W. Jarvis.

This paper shows some of the defects of present theories regarding regeneration, and presents a new method of analysis based on the idea of a power balance. It is shown that a signal voltage does not supply power to a regenerated circuit, but merely prevents certain losses from occurring. This upsets the balance between power input from the tickler and power lost in the circuit, so that oscillation occurs. The amplification obtainable in this way has a definite limit, the limit being caused by variations in the plate and grid impedances of the vacuum tube, as the amplitude of the grid voltage increases. The rate of variation of these impedances as the grid voltage increases, depends on the tube and on the direct voltage used.

The use of a grid leak and condenser decreases the voltage amplification, by increasing the rate of change of the plate-filament impedance. In general, however, increased detecting efficiency more than makes up for the difference when audio frequency output is considered. The effect of resistance in the grid circuit is to decrease the amplification by increasing the effect of the impedance variations.

The best turn ratio to use in a regenerated transformer is the same ratio that should be used in a non-regenerated transformer. The amplification obtainable increases rapidly as the strength of an applied signal is decreased. Although the inductance-capacity ratio does not affect the amplification obtained on an a. c. wave train, this ratio does affect the amplitude of the audio output when a modulated signal is being amplified. If a low L-C ratio is used, high notes will be lost when a weak signal is being received with full regeneration.

Regenerative amplification also occurs when a tube is in a condition of self-oscillation, providing the strength of the local oscillation is weak. A regenerated circuit amplifies non-resonant frequencies to a certain extent, the amount depending on the value of the reactance that would be needed to tune the circuit to the non-resonant frequency.

R382.5. Oscillation Transformers. Inductances, *Air-Core.*
Proc. I. R. E. Dec. 1925, pp. 755–766.
"Designs and Efficiencies of Large Air-Core Inductances," W. W. Brown and J. E. Love.

Representative designs of large air-core antenna tuning inductances suitable for outdoor and indoor service, are described. The latest improved designs are described in greater detail and compared with earlier designs on a basis of efficiency and kilovolt-ampere capacity. Formulas are given for calculating the ohmic and eddy current conductor power factor of coils using finely stranded, separately insulated, strands. In graphical form are shown the variations of ohmic and eddy current power factor with frequency, with four different conductors wound in a given arrangement to given dimensions. Also the variation of the sum of ohmic and eddy current power factors, with frequencies for a representative conductor on various diameters, are given. These values were calculated by the formulas given, and indicate very high efficiencies for the latest types of coils.

R342.6. Radio-Frequency Amplifiers. Transformers, *Radio-Frequency*
Proc. I. R. E. Dec. 1925, pp. 767–779.
"An Efficient Tuned Radio-Frequency Transformer," F. H. Drake and G. H. Browning.

A mathematical discussion of a new type of r. f. amplifying transformer is given, which, it is claimed, is capable of giving greater amplification per stage than other transformers now used. Circuit diagrams and charts are shown verifying the theoretical work done.

R610. Equipment; Station Description. Station, *Broadcasting.*
Radio News. Dec. 1925, pp. 770 ff.
"Britain's New Superpower Broadcasting Station," A. Dinsdale.

Great Britain's largest broadcasting station, located at Daventry, is described. Several photographs show interior and exterior arrangements. The present rated power output is 25 kw., although up to 60 kw. can be used in the future. The circuit design, oscillator, amplifier, modulator, and submodulator, are discussed separately. The tubes are water-cooled, the system employed being taken up in detail. The station frequency is 187 kc. (1600 meters), call letters 5 xx.

R113.1 Fading. Fading.
Radio News. Dec. 1925, pp. 772 ff.
"The Nature, Cause, and Reduction of Fading," G. W. Pickard.

Mr. Pickard discusses the inconstancy of the space circuit, giving a very exhaustive and complete study of the probable causes of fading. His explanations are supplemented by charts and data taken over long periods of time. From his observations it appears that the Kennedy-Heaviside layer theory does not explain day and night and seasonal variations, but the cause must be found elsewhere. A system of multipoint antennas for receiver, transmitter, or both, is proposed to improve conditions.

R130. Electron Tubes. Tubes, *Cold-Cathode.*
Radio News. Dec. 1925, pp. 786 ff.
"Cold-Cathode Gas-Filled Discharge Tubes," C. B. Bazzoni.

Some fundamental principles pertaining to electron discharges through vacua, are presented. The Crookes dark space and the Faraday dark space in partially exhausted tubes, are two of the interesting phenomena explained at some length.

R350. Generating Apparatus; Transmitting Sets. Transmitters, *Radio Telephone.*
Radio News. Dec. 1925, pp. 790 ff.
"Transatlantic Radio Telephony," G. C. B. Rowe.

According to information in this article, the Western Electric Company will announce transatlantic radio telephone service on a commercial basis shortly. A new system of transmission, known as the single side-band eliminated carrier, is used. This system is described and illustrated. A special system of reception is necessary, a local oscillator being employed in order to properly detect the signals. The advantages of this new system are discussed at some length.

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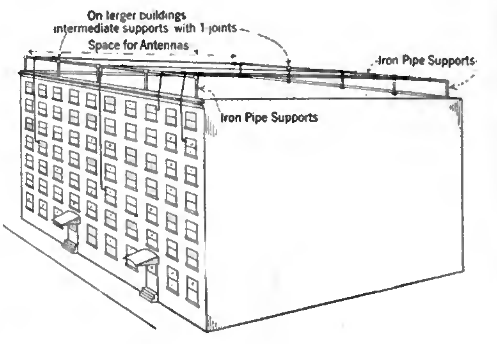
demand a changing of this bad condition. Who is going to be the bright fellow to straighten it out at a profit to himself?

A survey of most apartment-house roofs in the country will show what has to be done. Far beyond the unsightliness of these trap-maze, antenna-ridden roofs, it is not pleasant to have to duck and dodge such affairs when bent on getting a breath of fresh air.

There are two ways to get this thing ironed out. Dr. A. Hoyt Taylor has invented a multiple-tap antenna from which as many as a hundred sets can be connected. Why not apply this principle to rigging up apartment house roofs in a more workmanlike manner?



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In which the possibility of a tangled mass of collapsed antennas is greatly mitigated. Nowadays the average apartment house rooftop is "enhanced" by a multiplicity of awkwardly arranged antennas in all stages of confusion

Or again, the use of a solid spreader at either end of a roof made of iron pipe and joints, properly braced, and carrying a whole gang of antennas at a safe height above the roof, is easy to set up.

Who is going to get this business? It is there, waiting for somebody. Big or little; a crowd of young men interested in radio should have no trouble in making their knowledge pay them big dividends.

Here are some sketches to show you just how to solve such problems. It is essential that radio encourage young men, all men, in fact, to get into the game and use their knowledge for the advancement of the craft. There is always a scarcity of men who know their business, especially in radio.

There are more men versed in the bread-and-butter knowledge of radio, of a type fitted to perform the work outlined here, than in almost every other industry. You men who read this publication must know quite a bit about radio.

Put your knowledge to work. It means money to you; it means experience, and new minds, and more willing hands to do the work that radio needs to have done.

DEMAND FOR RADIOS INCREASES IN CZECHOSLOVAKIA

FOLLOWING a severe depression in the radio business during the summer months in Czechoslovakia, things are now beginning to look up again, and the last few winter months have seen quite a strong demand for radio equipment. It is extremely difficult to obtain accurate figures of the total number of receiving sets now in use, but two reliable sources estimate this figure to approximate 20,000, of which 8000 are located in the city of Prague, where is a 5000 watt broadcasting station. At present there are forty-nine manufacturers of radio equipment in Czechoslovakia, but they do little business, most of the apparatus there being of foreign manufacture.

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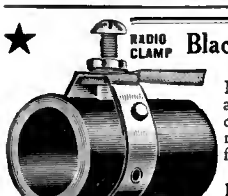

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The TOBE DEUTSCHMANN High-Voltage By-Pass Condenser in its silvered, shielded metal case is designed for all usual by-pass work in radio receiving-sets, and for construction of "B" eliminators of the Raytheon and other types.

0.10 Mfd.. .$0.60c. 0.5 Mfd.. .$0.75
0.25 Mfd.. .$0.70c. 1.0 Mfd.. .$0.90
2.0 Mfd.. .$1.75

We announce a new TOBE High-Voltage Filter Condenser for strictly filter uses, for power amplifiers and other high-tension work up to 750 volts. Each of these is individually tested and stamped with date of test. Accuracy is guaranteed to within 5% of rating. Put up in heavy metal cases and recommended for precision work. Prices are the same as our former list on filter condensers.

The new TOBE "B" BLOCK is out, for "B" eliminator construction, with one 8 Mfd., two 2 Mfd., and two 1 Mfd. condensers in one case. Saves $2.50 over cost of separate units,—saves space,—saves wiring.

Send for free eliminator diagrams ★

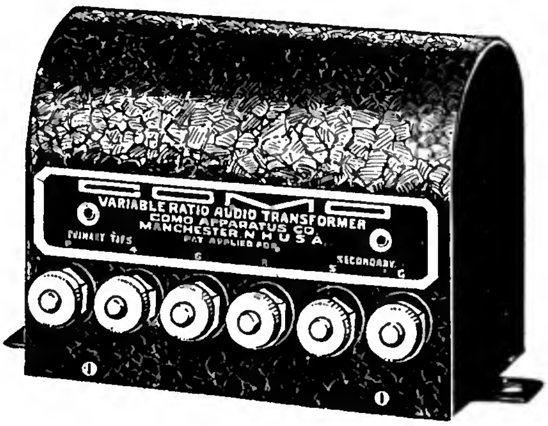
TOBE DEUTSCHMANN CO.
Cornhill, Boston, Mass.

COMO

VARIABLE-RATIO AUDIO-TRANSFORMER

4 to 1 - 6 to 1 - 8 to 1

all in one transformer



With this new Como Variable Ratio Transformer the set builder may secure for each stage of audio amplification the exact ratio best suited to the purpose. He may match more closely the primary impedance of the transformer with the plate impedance of his tubes, with a choice of 6 different values.

Built by a pioneer in radio manufacturing, this new Como product will reproduce music and speech with lifelike faithfulness.

In the familiar Como round-top, shielded metal case, at your dealers.

★ PRICE, $6.00

Send for descriptive pamphlet R

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Kelley Street Manchester, N. H.

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Send $1.00 for wiring diagrams showing parts used and how to make any set or circuit (1 to 8 tubes) operate satisfactorily without A, B or C batteries, from A. C. or D. C. This is the newest and greatest proposition in radio. *Write for literature, terms and prices at once*

THE POWEROLA RADIO CORP., 1845 BROADWAY, NEW YORK CITY

WHAT OUR READERS WRITE

Naval Radio

PROFESSOR MORECROFT'S comments on the Naval Radio Service in the December RADIO BROADCAST created quite a considerable amount of interest. This especially interesting letter from a gentleman apparently in an excellent position to criticize, should be read in conjunction with Professor Morecroft's remarks elsewhere in this number.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

SIR:

After a long month of waiting for your December issue to reach the Coast, I was successful in obtaining a copy today.

After reading Prof. J. H. Morecroft's article about the Naval Radio Service I decided that an answer to a few of his statements and questions was in order.

Just a year ago on the 22nd of this month, I was discharged from the Naval Radio Service. At the time of the *Honda* disaster I was on the U. S. S. *Sumner*, No. 333, 12th Squadron of the Pacific Destroyer Force. My log was used at the hearing which was held at North Island and I *know* it was through no fault of radio that the disaster occurred. If Mr. Morecroft had looked this matter up more carefully before his writing, he would not have made such a statement.

As for the California-Hawaii flight Mr. Morecroft states: "According to the planes commander, a perfect landing on the ocean was made and nothing happened to interfere with the radio apparatus performing as it was intended to do. Why didn't it perform?" The generators for the radio are wind driven therefore a plane must do her working before landing. Also the transmitting antenna is reeled in before landing. It is a known fact that these planes could not carry the extra weight necessary to transmit while on the water. Of course we all have some ideas of 'How it should have been done' but put yourself in their position and you will see it different. All possible space was needed for fuel, etc., and fuel is heavy—so are batteries, or other equipment necessary for transmission while a plane is down.

Very truly yours,
H. A. HALCOMB.
San Diego, California.

Standardization of Radio Parts

THE need for universal standardization of radio parts is still very general, but much progress in this matter has been made since the inception of broadcasting. The subject was revived in a recent letter to this office, and we would like the comment of our readers on this matter.

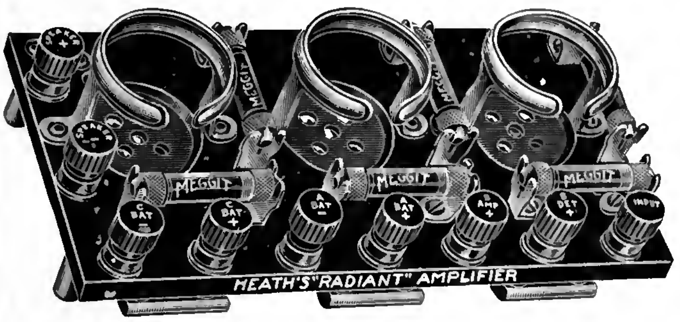
ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES, CHICAGO, ILLINOIS

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

SIR:

Every one in the radio industry realizes that standardization of radio parts and sets is necessary to bring about a more stabilized condition. The A. M. E. S., which has brought about the

THE ARISTOCRAT



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When building this receiver be sure you **use only the parts specified** and you will have the satisfaction of possessing the finest receiver yet developed.

3—S-M 311 .00035 S. L. F. Condensers
3—4 in. Kurz Krasch Moulded Dials
3—S-M 515 Coil Sockets
2—S-M 112A Inductances
1—S-M 110A Inductance
6—S-M 510 Sockets
2—Carter 6-ohm imp. Rheostats
1—Central Laboratory 500,000 ohm Modulator
3—Daven Resistance couplers complete
1—Carter 101 Jack
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1—Carter On-off Switch
1—.002 M. F. Condenser
2—Dubilier .5 M. F. By-pass Condensers
1—7 x 24 Drilled, Sanded and Engraved Bakelite Panel
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Engineers of the leading manufacturers who make these parts endorse the operation of the Hammarlund-Roberts Receiver only when it is constructed with these specified units which the designers have found to coordinate most efficiently with one another.

Order from this list and we guarantee you prompt delivery.

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Unit No. 5.	2 Na-ald "Super DeLuxe" 4 in. Bakelite at	.75	1.50
Unit No. 6.	5 Na-ald "DeLuxe" Sockets ....at	.75	3.75
Unit No. 7.	1 Na-ald K3844—1¾ in. Dial ......at	.20	.20
Unit No. 10.	1 Carter 25-ohm "Imp" Rheostat ....at	1.00	1.00
Unit No. 11.	1 Carter Single Circuit No. 101 "Hold-Tite" Jack ....at	.70	.70
Unit No. 12.	1 Carter "Imp" Battery Switch ......at	.65	.65
Unit No. 16.	1 Durham Metallized Resistor ....at	.40	.40
Unit No. 8.	4 Amperites No. 1-A ....at	1.10	4.40
Unit No. 13.	1 Dubilier Type 640-G .00025 mfd. Grid Condenser ....at	.50	.50
Unit No. 14.	1 Dubilier Type 640 .002 mfd. Fixed Condenser ....at	.45	.45
Unit No. 15.	1 Dubilier Type 640 .006 mfd. Fixed Condenser ....at	.80	.80
Unit No. 9.	5 Prs. Union Phone Tip Jacks, per pair at	.25	1.25
Unit No. 17.	1 Hammarlund-Roberts Foundation Unit (contains engraved bakelite-Westinghouse Micarta panel, drilled bakelite sub-panel metal brackets and wire ..at	7.90	7.90

Complete Parts as specified $57.50

Hammarlund De Luxe Cabinet $12.

Wired and Ready to Use $10. Extra

General Radio UNIVERSAL RECEIVER

This is the simplified 4-tube circuit described in detail in the January issue of this magazine. Diagrams and complete instructions furnished with each complete set of parts.

Complete Parts $38.50

Mail orders shipped same day received

HEINS & BOLET
46 PARK PLACE, NEW YORK

standards in the electric light and power field, have created a Radio Section to standardize radio sets and parts.

The Radio Section so far has made wonderful progress in radio standards, but before going further, it is considered advisable to get as much information as possible as to what should be standardized. Some of the things we have in mind that should be standardized at once are as follows:

1. Should Rheostats, Condensers, etc., be of the one-hole mounting type, or mounted by means of screws?

2. Should Dials and Condensers be so designed that when the dial is turned to the right the numbers on the dial increase, or should the numbers increase when the dial is turned to the left?

It seems to us that inasmuch as rheostats turn from left to right, that the other controls should turn in the same direction. There are many sets and condensers on the market on which the dials turn from right to left. It would seem that if this could be standardized it would be a step in the right direction.

3. Should all Dials and Knobs have the same size Holes, and if so, what size do you recommend?

4. How far should Condenser Shafts project through the panel?

There seems to be no standard length of condenser shaft, which results in much annoyance, due to the fact that dials do not fit properly.

The Radio Section has already standardized such items as Cords, Cord-tips, Plugs, Jacks, Rheostat Shafts, Standard Color Code for wiring sets, etc.

What other specifications, in your opinion, should be standardized?

Your recommendations will be beneficial and we will greatly appreciate any assistance or suggestions you care to give.

Very truly yours,
A. J. CARTER.
Chairman, Parts Committee Radio Section.

A Letter from Chicago's "Miss Radio"

BEFORE the commencement of the recently concluded International Tests, RADIO BROADCAST appointed listening posts all over the country so that the fullest possible data could be collected on this subject after the Tests were completed. One of our letters was sent to Chicago's "Miss Radio," and here is her reply.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

Sir:

I would like very much to be appointed as an official listening post for the International Radio Broadcast Tests. I have a certificate of reception awarded to me last year for the successful reception of programs as broadcast from 2 LO and FPTT, Paris.

I am using an Atwater Kent-10, an Atwater Kent-20, and an Apex Super-Five. I have three different antennas; (1) 140 feet long, south to north; (2) 100 feet long, east to west; (3) 50 feet long, north to south. I have logged 264 different broadcasting stations, and am still going strong. The Atwater Kent-10 was my first set, and was bought in March, 1924.

I was awarded second prize in the "Radio Diana" contest conducted by the Radio World's Fair in New York City, and was awarded first prize in the "Miss Radio" contest at the Chicago Radio Show. I hope to have a five-watt short-wave transmitter going soon.

Very truly yours,
FLOSSIE E. ERICKSON,
Bloomington, Illinois.