Custombilt RADIO

A Magazine of Technical Accuracy for the *Professional* Set Builder

Facts *vs.* Fallacies *of* Radio Frequency Amplification

Demonstrations That *Sell*

Trouble Shooting *Simplified*

Such Popularity *Must be Deserved*

BOOK TWO 1926

25

A VALUABLE FRANCHISE FREE

RECOGNITION — PROTECTION COOPERATION

The first step in becoming one of our representatives is the successful assembly and operation of at least one *Quadraformer* receiver.

As soon as we receive your report—and I know it will be an enthusiastic one—you will receive the CERTIFICATE OF MERIT illustrated above and the special sales helps reserved for our authorized representatives.

All retail inquiries from your locality will be referred to you.

We never forget that your success is our success.

Everything possible that we can do to assist our authorized representatives we will do.

Whether it be assembling, installing or selling—no matter what problem you may have, we stand ready to help.

Your name will be registered and your record personally followed by Mr. Gearhart.

You'll find a Partnership with us Worthwhile!

GEARHART-SCHLUETER RADIO CORP'N

Fresno, California

Custombilt RADIO

A Magazine of Technical Accuracy for the *Professional* Set Builder

BOOK TWO 1926

Facts vs. Fallacies of Radio Frequency Amplification

By E. J. GEARHART

Associate, Institute Radio Engineers

FACTS: Anything that is done; reality; truth.
FALLACIES: Mistake; an unsound method of reasoning.
—Webster's Dictionary.

MUCH has been written about radio frequency amplification. Theoretically it is the best method of redio reception, but in practical use this system has never equalled theory (on broadcast wave lengths) because of the general unstability and tendency toward tube oscillation in such circuits.

This characteristic has almost universally been blamed on the minute capacity that exists between the plate and grid of the vacuum tube.

Prof. R. R. Ramsey, of Indiana University, in "Experimental Radio," says:

"Radio frequency is not a success on short wave lengths owing to the capacity of the tubes. The capacity effect in the tube tends to make the tubes oscillate and works in opposition to the inductive effects of the coils of the radio frequency amplifier."

Walter Van B. Roberts, inventor of the Roberts Circuit, says in "Radio Broadcast" in an article on oscillations:

"We have seen that the only way energy is fed back (assuming the grid circuit well separated and shielded from the plate circuit) is by the effect of the variations of plate potential acting on the grid through the small capacity that exists inside the tube itself."

Another authority, C. M. Jansky, Jr., in the January, 1925, issue of "Radio," goes further still, and says:

"This production of oscillation is not dependent on any couping between circuits A and B (first and second stages) other than the capacitance between the elements of the tube and it cannot be prevented by placing the coils and condensers in any particular position or by winding the coils in any particular direction."

For the moment let us accept the theory (or rather hypothesis) advanced by these gentlemen, principally because

it is essentially the same theory that most investigators in radio frequency amplification accept.

Without going deeply into the theory of their action, let us now consider present practice for the prevention of oscillation in a tuned circuit radio frequency amplifier.

It is accomplished, commercially, in four ways, the first two of which are essentially the same: The deliberate introduction of loss into one or both radio frequency circuits.

(1) POTENTIOMETER CONTROL: This method is too well known to justify extended description here. Suffice to say that the voltage-divider is so connected in the circuit so as to place a positive potential on the grid limiting amplification to the point where oscillations do not occur.

(2) FIXED (OR VARIABLE) RESISTANCES placed in series or parallel with one or both of the radio frequency circuits. This system is preferable in some respects to (1) as it is not so apt to produce distortion. It is not as selective, however.

(3) THE INTRODUCTION OF UNKNOWN LOSSES and resistances. There are a number of radio sets and kits now on the market whose manufacturers claim that their circuits are "self-neutralized." As a matter of fact most of these circuits are stabilized by the conscious or unconscious use of high resistance windings or condensers; rheostat control (reducing the filament reduces amplification under the oscillation point); few turn primaries, etc.

(4) THE NEUTRODYNE SYSTEM.

So we find that, except for the Neutrodyne system, which I will discuss further on, the standard practice of controlling oscillations is by the introduction of resistance.

Let us consider what Morris S. Strock, of the Bureau of Standards, says (in part) about lost energy in coils in an official article published in "Popular Radio:"

"Coils of low power loss will permit of good amplification without excessive filament currents or high plate voltage," and, "First, it should be stated that power losses in a coil increase as the resistance of the coil is increased."

We find then, that the use of resistances or losses in a tuned circuit radio frequency amplifier will stop oscillation, *but amplification is very materially reduced and the power losses of the circuit greatly increased.*

The most interesting, and a year ago the most popular, method in use for controlling the tube oscillations is the neutrodyne system. While this system has been often described it is necessary for us to go into it briefly once more to understand what follows:

To be accurate, let me quote J. F. Dreyer, Jr., of the Hazeltine Research Corporation, from the August, 1924, issue of "Radio Broadcast:"

"Fig. 1 illustrates a vacuum-tube amplifier whose grid and plate circuits are both tuned to the desired frequency. A passing radio wave causes a minute current to flow through the grid circuit C1L1. This circuit being tuned to the wave frequency, and thus having a high impedance, builds up an appreciable

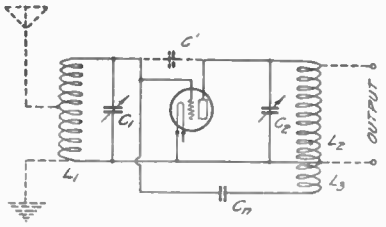


Figure 1

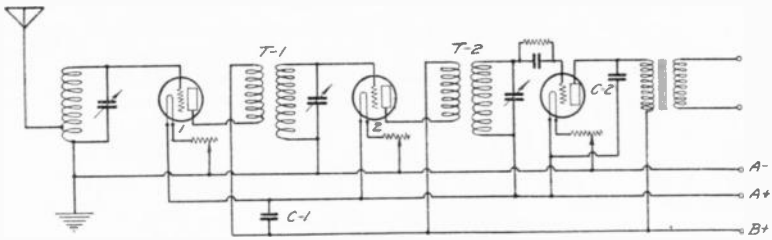


Figure 2

voltage which is impressed on the grid of the vacuum tube. By the relay action of the tube a similar current flows in the plate circuit. As this circuit is also tuned to the wave frequency, it builds up a still higher voltage which is passed on to the next tube. Without neutralization, regeneration takes place due to the capacity coupling of the grid and plate circuits.

That is, the voltage built up in the plate circuit of the tube causes a current to flow through this capacity C1 which reinforces that already present in the grid circuit due to the passing wave. This may be sufficient ot cause self-sustained oscillations which, unless very carefully controlled, completely destroy the value of this form of amplification.

"The Hazeltine circuit as embodied in the Neutrodyne receiver eliminates this effect in the following way: A third coil, L3 is coupled closely to L2 as shown, so that one end (the other end being grounded) varies in potential in exactly opposite phase to that of the plate end of L2. A small condenser Cn is then connected between this end of L3 and the grid of the tube. If C1, Cn, L2, and L3 are properly related, the following action occurs: a current still flows through the plate-grid capacity, due to the voltage built up in L2, but this current no longer enters the circuit C1L1 for the reason that the combination CnL3 demands exactly the same current. This current therefore, instead of flowing down through C-L1 passes back harmlessly through CnL3 to its source at the plate of the tube."

Facts vs. Fallacies

All authorities to the contrary, we have proven, ot our own satisfaction at least, that the neutrodons (Cn) *do not stop oscillations by neutralizing tube capacity.*

It is true that there is a slight feed-back through the tube, but we have found that its effect towards oscillation does not compare with:

(1) the electro-magnetic coupling between neutroformers,

(2) coupling between stages due to the impedance of the leads of the "B" battery,

(3) coupling introduced by improper connection of grid returns,

(4) coupling introduced by inductive loops in the wiring.

(5) Electro-static coupling between instruments or wiring.

The above statements are true of not only the Neutrodyne, but of *any* tuned circuit radio frequency amplifier.

Disregarding our claim (1) for the moment, as not yet proven, let us consider the second statement (2).

There are several "tricks" in circuit design of radio frequency amplifiers, the true purpose of which are often unrecognized by the public (and some radio engineers). Very probably, in

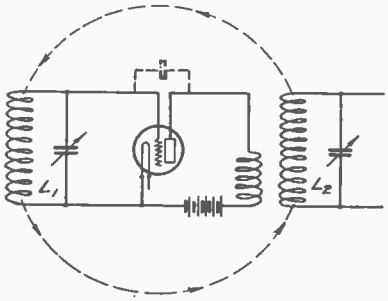


Figure 3

most cases, they have been made use of simply because 'cut and try" methods showed that their use improved results.

Consider Figure 2.

This is easily recognized as an ordinary standard two-stage radio frequency amplification circuit.

Now let us trace the direction of flow of the radio frequency current produced by tube No. 1 *if the by-pass condenser C1 were omitted.* Remember it must flow in a closed path. Starting at the plate the current passes through the primary of T1 and then to the B battery, through the B battery and back to the filament, where the electron stream completes the circuit to the plate. The current from tube No. 2 flows from the plate through the primary of T2 and then *through the same B battery leads and battery* as the current from tube No. 1. This common impedance causes coupling between the two circuits. Condenser C1, which should be .5 mfd. or larger, *placed where shown,* which is not across the battery binding posts as I have seen some constructors use it, by-passes the current from tube No. 1 directly back to its filament, preventing its passage through the battery leads with the current from tube No. 2.

The plate of the detector tube also carries radio frequency current and a by-pass of about .002 mfd., as shown by C2, should be connected directly from the plate *to the filament.* It should *not* be placed, as is common practice, across the phones or primary of the first audio transformer, as this would force the current to travel through the common B battery, causing coupling with tube No. 2.

Now even with these precautions carefully observed, if T1 and T2 are standard neutroformers or other ordinary air core transformers, and no neutralizing condensers, potentiometer, resistances, or other losses are introduced in the circuit it will oscilate violently when tuned to resonance, at least on the lower wave lengths.

Setting the coils at the well known angle of 54° 57″ does reduce the electro-magnetic coupling to a low minimum, but it does not eliminate it sufficiently to stop oscillation by any means.

What then, is the major cause of this undesirable unstability?

Authorities seem to agree that the cause is tube capacity.

But neither Mr. Schlueter or I agreed with that belief, for our experiments had proven to us that the electromagnetic coupling between the air core transformers and the other instruments in the circuit was the real culprit.

Let us examine the neutrodyne circuit again with the new theory in mind:

Fig. 3 shows only that portion of the circuits surrounding the second stage of amplification that has influence upon the coupling.

What is known as positive feedback is shown by the arrows. The fields of the air-core coils used are quite extensive due to the low circuit resistance and do couple as shown. The energy passing through the vacuum tube emerges 180 degrees out of phase. On each half-cycle or alternation of the current, the voltage rises to maximum strength one-half cycle behind the current. When the current is rising to a peak on a positive alternation, the voltage is rising to a negative peak,

which peak belongs with the preceding alternation of the current, which was a negative one. At any given instant therefor, when signals are passing through the amplifier, the energy in L2 will be 180 degrees out of phase with that in L1.

The connection of the neutrodon from the tap on L2 to the grid of the tube takes advantage of this fact *and balances the magnetic feed-back between the transformers by making the voltages oppose one another.* The current then rises to similar peaks in the two adjoining grid circuits at the same instant while in one the voltage is rising to a positive peak in phase and in the other it is rising to a negative peak out of phase.

The only reason for connecting the neutrodon to the tap on the lower end of L2 is that a larger "neutralizing" condenser can then be used and still have the opposing voltages equal.

Unfortunately the neutrodyne system will not work satisfactorily on all wave-lengths. It is like many theories that work out beautifully on paper and then fall down in practice. It can not be balanced out to eliminate oscillations on the low wave-lengths without destroying the amplification on the high wave-lengths.

Mr. Schlueter and I realized that if an air-core transformer could be made *with no external magnetic field,* there could be no magnetic feed-back between stages if the other ordinary precautions were observed. And if such transformers were inserted in the circuit in Figure 2 in place of T1 and T2 without changing another wire and the circuit did not oscillate when tuned to resonance, then verily, the new theory was established.

The problem was to design an *efficient* fieldless coil.

After many weeks of laboratory work, we succeeded in designing a new and radically different radio frequency transformer which is called the *Qudraformer,* which has no end losses, no external magnetic field (they can be mounted one-half inch apart) and extremely low power losses.

Immediately following our application for patent several manufacturers began advocating various designs of torodial transformers (*which the Quadraformer is not*), with claims of results closely paralleling those you will get with the *Quadraformer.*

It might be of interest to tell you why we discarded the torodial idea nearly a year ago.

Perhaps you have wondered what a torodial coil is. If you will imagine taking an automobile tire in one hand and a spool of wire in the other and winding the wire around the automobile tire until you come to the place of beginning, you will, in imagination, have constructed a torodial coil. It is a coil wound around a ring. (See Figure 4.)

In our early experiments we naturally turned first to the torodial idea, for it is the oldest known method of constructing a coil with a closed magnetic field.

I have before me as I write a text book of the International Library of Technology No. 383, published by the

Figure 4

International Text-book Company of Scranton, copyright *in* 1915, in which on page 13 of the chapter on "Direct Current Generators" is shown a "ring winding" described as:

"The winding is a continuous spiral * * * all the flux, except a few stray lines, follows the ring between adjacent poles."

And again, in "Radio," a magazine published in San Francisco, for November, 1923, Page 25, is shown two illustrations of torodial coils, with the statement:

"To confine the magnetic effects of a coil it is necessary to reduce its stray field. Even though two coils may be at right angles there may be some magnetic induction due to stray fields. To avoid this it is necessary to use certain types of coils called 'torodial' coils. There is practically no magnetic field from such a coil, the entire field being confined within its core."

The article that probably drew manufacturers' attention to the torodial idea is of much later date, for no torodial coils were placed on the market until after its publication.

John Scott-Taggart, writing on "Multi-Stage Radio Frequency Amplification," in "Radio News" for December, 1924, (Page 928), describes the torodial coil at length, as experimented with by himself and Mr. G. P. Kendal. His description closes with the significant statement:

"The arrangement must therefore not be taken as a solution to the problem of multi-stage radio frequency amplification; it is, however, a very interesting suggestion for overcoming one of the coupling effects likely to cause instability."

Mr. Scott-Taggart does not tell you why the torodial idea is a partial failure nor have we the space here to give you the great amount of data that we secured during our experiments. Let us dismiss the torodial coil in just a few words:

It is nothing new, in fact it is probably the oldest known type of closed magnetic field coil.

We reduced the idea to practice and designed a torodial radio transformer, with primary and secondary windings, over a year ago—and then discarded it, because, among other reasons:

Being wound in ring or spiral shape the length of one side of the coil is longer than the other, reducing the inductance so much that many more turns of wire are necessary to cover a given wave-length than in the ordinary single layer coil. This adds considerable resistance to the coil.

A high number of turns in the primary can not be used as it causes broad tuning, and in many cases self-oscillation, which if balanced out by the neutrodyne method or suppressed by the use of resistance, introduces the very losses we wish to avoid.

And finally, the capacity coupling between the primary and secondary causes great losses. The metal in the primary forms one side of a small fixed condenser and the metal in the secondary the other side. This forms a by-pass effect which is disastrous to efficiency at broadcast wave-lengths.

In the peculiar method of arranging the two sets of four series coils in the *Quadraformer* we overcome the disadvantages of the torodial coil and do secure an efficient radio frequency transformer with a closed magnetic field.

The use of the *Quadraformer* in such circuits as Figure 2 absolutely eliminates undesirable oscillations in tuned circuit radio frequency amplification with more efficiency per tube than has ever before been realized. Absolutely quiet reception, unbelievable volume, and pure natural tone result.

Such Popularity Must Be Deserved

THERE'S something going on in the radio world.

Nothing spectacular; nothing remarkable. But when every small brook starts to rise, there's a big flood in the river.

And the *fact is* undeniable; in every section of the country, radio men are turning to the *Quadraformer*—hundreds of them every month.

It is in no spirit of "brag" that we report this large and sustained growth in *Quadraformer* sales. Naturally we are gratified—but it is not the size or the rate of the increase, but the *cause,* that is the interesting thing.

Some time ago we published the following statement:

I might tell you as certain other set manufacturers seem fond of claiming, that with the Quadraformer you'll get from coast to coast. I have many letters from Quadraformer builders who have done this and more, but I am not going to tell you that you can do it, for frankly I don't know.

A number of revolutionary advantages have been attained. The total absence of all stabilizers, resistances, and other neutralizing devices allows all the radio energy to be utilized in developing the true signal. Speech and music come in with rich, sweet tones. There is little or no background of noise. There is no distortion. Distance seems to make little difference.

Reception in some localities is far superior to others—and even in the same location reception of distant stations is erratic on any radio set.

One night you may secure reception that is nothing short of marvelous and yet the very next night stations 500 miles away may not come in as they should.

That's the real truth about DX on any radio set—no matter what any one else may tell you.

I would rather under-estimate the performance of our set than to make extravagant claims and then have you disappointed.

If our simple assembly instructions are faithfully and exactly followed, the Quadraformer will do more than any other five tube set under the same conditions. And that's saying a lot.

And the *Quadraformer's* present record is proof that the radio dealers have checked up this statement.

The sales of *Quadraformer* have steadily grown—reflecting the deliberate and measured judgment of hundreds of dealers.

The public was finally ready for *quality* radio reproduction—and the *Quadraformer* fills the bill.

Any advertising man will tell you that there is no other advertising in the world as effective as "word-of-mouth" advertising—that is, one man telling another the merits of a product.

Next to trying out something for yourself, endorsement by one who has already tried it is the most convincing argument on earth.

We are willing to have you compare the *Quadraformer* with any other radio receiver made—*bar none.*

Read what these men who have actualy assembled and operated the *Quad*raformer have to say. Note that these are not letters of six months or a year ago—note that we publish the full names and addresses so that you can ask them about the set yourself if you wish.

(Please, if you write any of these men, be kind enough to enclose a stamped and addressed envelope for their reply.)

PLAYS STATIONS ON THE LOUD SPEAKER THAT OTHER SETS CAN'T PLAY ON THE HEADPHONES!

Newman, Calif.,
April 5, 1926.

"The *Quadraformer* works fine. It has a wonderful tone with a great deal of volume.

"It is the best set I have ever heard, or want to hear.. I get KFRC in the afternoon with too much volume, if turned full on, while other sets can't get them on the headphones."

—Alan R. Whitehurst.

EIGHTY-EIGHT STATIONS IN THREE NIGHTS

Somersworth, N. H.,
March 29, 1926.

"You may be interested to know that I have built five of your *Quadraformer* sets and they are all in use here, giving great results.

"In three nights I logged 88 stations, from which I got *verified* reception reports. Two of the stations were in California. KGO and CNRV I logged two nights. These 88 stations are in 27 different states and five different provinces in Canada. I didn't count stations like WGV or KDKA."

—Ernest D. Royce.

AFTER BUILDING SEVEN SETS

Philadelphia, Pa.,
March 26, 1926.

"To date I have built seven *Quadraformer* sets and every one works great.

"Between the seven sets California has been received three times, Oregon once, and such stations as Cuba, Texas, New Orleans and Florida are received often.

"I have built quite a few sets and will not hesitate to say that the *Quadraformer* will absolutely outclass any Browning-Drake or Neutrodyne.

"I have an eight-tube Victoreen super laying down in the cellar that I have discarded in favor of the *Quadraformer* set. The super will bring in more distance but the reception is very noisy and harsh."

—R. Cottngham.
2732 Eyrie Street.

FROM COAST TO COAST WITH FOUR EUROPEAN STATIONS ON HIS LOG FOR GOOD MEASURE

Burkburnett, Texas,
Feb. 22, 1926.

"Let me say that the writer went from coast to coast and the first night of the 'trans-atlantic' test had music and speech from four European stations.

"The *Quadraformer* is as hard as heck to beat—that's all."

—G. W. Counter.

BEST HE EVER HEARD

Columbus, Ohio,
March 20, 1926.

"The *Quadraformer* is the best five-tube set I have ever heard and will bring in any station that you can get on a super.

"At Columbus I get stations from every state in the Union, also Cuba, Mexico, and San Juan, Porto Rico.

"Now that you have a proposition that I can build sets and sell them at a good profit you can put me down as one service man in Columbus.

—Louis C. Riehle,
82 S. 4th Street.

NOW A *QUADRAFORMER* BOOSTER

Omaha, Neb. ,
March 18, 1926.

"After building two *Quadraformer* sets I can only say that they have any other set I have ever heard beaten by far.

"I have built and sold over fifty sets of all makes, sizes, and descriptions, but I am now a *Quadraformer* booster.

"I would like to tell you just some of the results I have been getting. I hear PWX, Havana, every time I try for them. WTAM, Cleveland, comes in like a Victrola, on four tubes. KFI, Los Angeles, KPSN, WJAX, CFAC, all come in with all the volume I can use on my speaker."

—Chas. A. Marsh,
4234 Lorimore Ave.

Custombilt
RADIO

Published by the Gearhart-Schlueter Radio Corp'n, Fresno, Calif.

It is our wish that every radio dealer interested in the sale of parts or custom-built sets receive this magazine regularly. If you are not on our mailing list and would like to be, just send in your name and we will do the rest.

BOOK TWO 1926

Editorial

I WANT to express my appreciation to the many dealers who joined the ranks of *Quadraformer* boosters during March.

We welcome you into our rapidly growing family, and assure you that we stand ready to help you in any way that we can, to a bigger, better success.

It is interesting to note, that though we are now entering what some call the "off-season," *Quadraformer* sales in March were almost as large as they were last December. Even we were caught unawares, and orders received after March 15th had to be back ordered. I am glad to say that we are now in position to make our usual "same day" shipments, as we have increased our production to the point where I am sure no further annoying delays will occur.

Speaking of the "off-season," reminds me of a very pertinent article on this subject in the April number of THE RADIO DEALER, by Thomas Andrews. He says, in part:

"Too many radio dealers are prone to look upon the coming of the warm weather with dread and a jaundiced eye. There is no use in attempting to deny that there is some reason for this, but to the live radio dealer, in this good year of our Lord, 1926, there will occur many good reasons why the coming season of warm weather, when radio sales should traditionally slump almost to the zero point, will not be devoid of its pleasant aspects.

"Radio today is not what it was when it first came to the notice of the general public. It is not even what it was last year. It is no longer a boom proposition, hag-ridden by get-rich-quick manufacturers, sharp selling policies, cut-throat competition, and divers other menaces. Radio retailing today is on a sane and level-headed basis, and is daily becoming more and more stabilized.

DISCARDING OLD IDEAS

"People are learning more and more about radio, and as they learn the facts a lot of the old ideas are going into the discard. The people who used their sets all last summer—and enjoyed them!—have spread the news around, and the general public is coming to realize that *with the exception of a very few exceptional nights, radio can be enjoyed, in most states of the Union, almost as much in summer as in winter.*

"There are several factors to be considered at this point. One of them is that the static-to-signal ratio of our present day sets is far more favorable to reception in static-y weather than were the sets that were first put in the market for broadcasting reception. Radio frequency amplification is largely responsible for that, together with the fact that the modern multi-tube sets, with their tremendous amplification possibilities, can be used with indoor or at least very small out door aerials, thus minimizing atmospherics to a marked extent. Then, too, the tremendous power of our modern stations makes it easy to work through any except the most heavy static, and the stations are growing more powerful all the time.

WORK WITH HEAD AND HANDS

"Far be it from us to maintain that business is destined to be good this summer for the radio dealer who lays back in the traces and waits for the money to pour into the old cash register.

But as far as that goes, business doesn't come of its own free will and accord, to any great extent at least, at any time of the year or in any business. The merchant who works, with both his head and his hands, is the one who retires soonest.

"Just how to go about getting the business that will be available this summer is a subject of vast scope, hardly to be covered here. There are, however, certain points that might be profitably brought to the attention of the ambitious reader.

"First of all, of course, there is the advertising to consider. Advertising is the right-hand man of the ambitious merchant in any line of endeavor. Don't let up on your advertising during the summer months. Keep plugging away, pointing out the facts as you see them, somewhat along the lines brought out in preceding parts of the present article. Make the people realize what they already know (read that over again, there's a mighty good thought in it!) that radio is something that fits into almost every moment of modern life, twelve months out of the year.

"Practice what you preach. Take your own radio set along with you out into the open. Encourage your friends and customers to do the same thing. Their example will be useful in making others, not owners of radios, desire a set of their own. Talk about your outdoor summer radio achievements; encourage others to do it. Get the other dealers to do the same thing. You'll all profit.

"Put in some real window displays. Get the summer spirit into them, and don't begrudge a few pennies spent in making your windows doubly attractive during the season when your business has a natural tendency to slump. Even if your displays are mere catalogs of your merchandise during the winter, put a selling punch into them during the summer. They'll repay you a hundredfold!

"Read your trade journals more carefully than ever. The best authorities in the contrary will help you, through the pages of the radio journals. The Editors of radio trade publications pay thousands of dollars every month to men who know how to help the radio retailer make more money, and with the assistance of these men and your own good judgment and merchandising ability, it would be odd indeed if you could not do what other radio dealers are doing.

"Above all, keep a stiff upper lip and don't moan. A smile and a cheery word go a long way to make business good. Talking good business helps make it good, remember that, too. The merchant who is always saying business isn't so good seldom has any to talk about. The merchandiser who always says business is good, and grins as though he meant it, has a happy faculty of bringing business to his shop. Call it psychology or what you will; it works. Try it!"

—E. J. GEARHART,
Editor.

FLAWLESS QUALITY

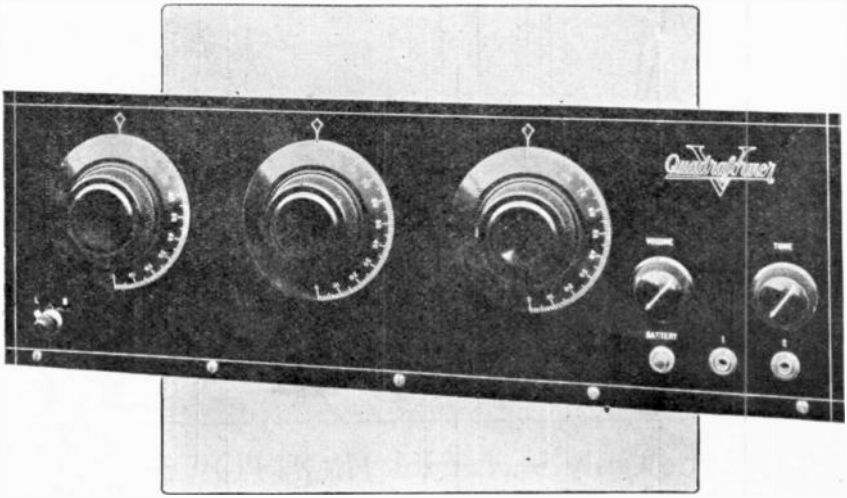
Santa Paula, Calif.,
March 22, 1926.

"I have built one of your *Quadraformer* sets and without doubt it is the best set on the market.

"In one evening I logged 39 stations *outside of California.*

"As a test for pure tone quality I have used the set on all makes of horns but the quality is flawless."

—AULAUF RADIO CO.,
219 W. Main Street.



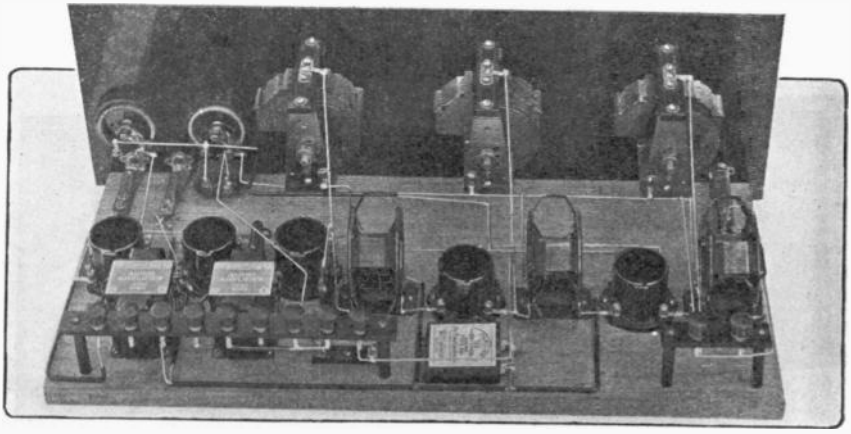
The *New* Quadraformer

that really does things
which no set in radio
history ever did before

It is easy to tune—no wiggling of rheostats or oscillation controls, no squeals or distortion.

The *Quadraformer* employs a new method of tuned radio frequency amplification in which all so-called "neutralizing" devices are done away with. They are not needed. Internal set noises are eliminated, instead of being imperfectly suppressed.

It's a trouble-proof set, far more sensitive and far more selective, of greater volume and more natural tone than any radio receiver you have ever heard.



It Is the Only Successful *HIGH-POWERED* Non-Regenerative Set Ever Developed

It is a truly amazing five-tube receiver.

It is one of the simplest of all sets to build, requiring neither a large assortment of tools nor a wide technical knowledge of radio. The only tools needed are pliers, screwdriver and soldering iron, all of which are usually found in the average home. There is not the least chance of going wrong or of not securing a neat workmanlike job, as the instruments practically mount themselves as you follow the complete step-by-step instructions.

"Old stuff!" you say?

It does sound like it when you read the words, but not when you hear the results.

SPECIALLY DESIGNED FOR THE PROFESSIONAL SET-BUILDER

A world of reserve volume, more selective on the lower wave-lengths, more sensitive, still better tone and much more easily built than any previous *Quadraformer.*

By buying in large quantities we are able to furnish you the complete kit containing every part necessary to complete the set for

$36.75

PREPAID TO YOU

(RETAIL PRICE $55)

ALL SHIPMENTS CASH WITH ORDER OR C. O. D.

Here's What the Complete Kit Contains:

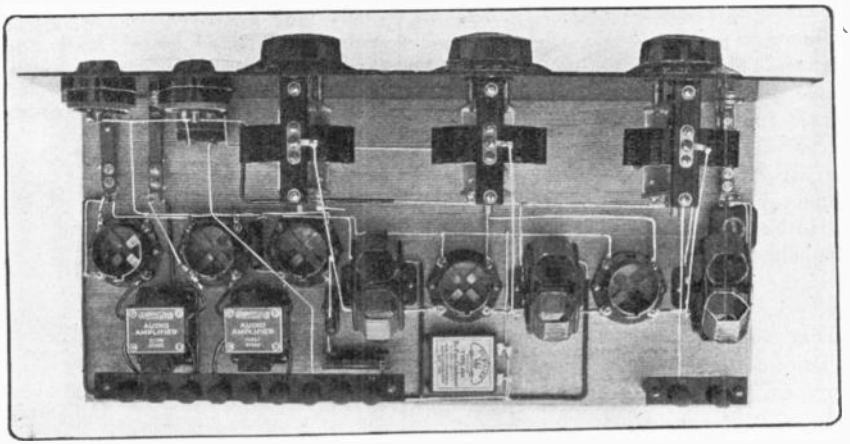
1 **Quadraformer Essential Kit, containing** one aerial coupler and two inter stage Quadraformers	$12.75
1 **Quadraformer Panel,** 7"x21"x⅛" bakelite. Completely drilled and engraved	6.00
1 **Hardwood baseboard,** 9"x20"x⅝ non-warpable	1.00
1 **Gearhart-Schlueter First-Stage Amplifier**	4.75
1 **Gearhart-Schlueter Second Stage Amplifier**	4.75
3 **Precise Syncrodensers, No. 790L**	12.00
5 UX type Naald tube sockets	1.75
3 **Four-inch bakelite dials,** clockwise graduations 100-0	2.25
2 **Six-ohm bakelite rheostats with knobs**	2.00
1 **Carter No. 3 jack switch**	1.15
1 Open circuit jack	.70
1 Filament control jack	.90
1 Filament switch	.60
1 **Gearhart-Schlueter Terminal Assembly** complete with two drilled and engraved bakelite strips, eleven mounted binding posts with soldering lugs and nuts, four mounting pillars and mounting screws	2.25
20 ft. Gosilco wire, sterling silver, 24-K gold plated	1.20
6 ft. Flameproof black spaghetti	.50
1 .5 mfd. Dubilier by-pass condenser	.75
1 .002 mfd. Micamold fixed condenser	.35
2 .00025 mfd. Micamold fixed condensers	.70
1 5 megohm Micamold grid leak	.30
1 Grid leak mounting	.30
40 Tinned soldering lugs	.20
27 No. 4 5/16" R H N P wood screws	.20
5 No. 6 ⅝ O H N P wood screws	.05
Total	$57.40

You may purchase any of the individual parts at 35% discount from the retail prices quoted. (Except the *Quadraformer* Essential kit which is $7.88 net, our audio amplifiers which are $5.70 a pair net, and Gosilco bus-wire which is 4c a foot net.) *All prices prepaid.* We can furnish Marco Vernier Dials for $3.42 extra.

We will assemble and wire the set for you complete for $10.00 additional.

Mr. Gearhart will personally answer all your questions and give you any further instruction necessary without charge of any kind.

GEARHART-SCHLUETER RADIO CORP'N, FRESNO, CALIF.



Price Cutting Is Peanut Salesmanship

The price-cutter is worse than a criminal. He is a fool. He not only pulls down the standing of his goods; he not only pulls down his competitors; he pulls down himself and his whole trade. He scuttles the ship in which he, himself, is afloat.

Nothing is so easy as to cut prices; and nothing is so hard as to get them back when once they have been pulled down.

Any child can throw a glass of water on the floor, but all the wisest scientists in the world can't pick that water up.

Who gets the benefit of price-cutting? Nobody.

The man who sells makes no net profit; and the man who buys soon finds himself getting an inferior article.

No manufacturer can permanently keep up the standard of his goods if the price is persistently cut. Pretty soon he is compelled to use cheaper materials, and to cut down the wages of his workers.

The man who cuts prices puts up the sign: "This way to the junk heap!"

He admits his own failure as a salesman. He admits he has been defeated according to the Marquis of Queensbury rules of business. He admits he cannot win by fighting fair.

He brands himself as a hitter-below-the-belt.

If the business world were dominated by price-cutters, there would be no business at all.

Price-cutting, in fact, is not business any more than smallpox is health.

—By Herbert N. Casson.

Trouble Shooting Simplified

There Are Many Things, No Fault of the Quadraformer Set Itself, That Will Result In Weak Signals or No Signals at All. Therefore, When Trouble Develops in Your Set or if the Newly Constructed Set Fails to Operate, Don't Start Tearing Up or Rewiring the Set Until You Are Sure That Everything Else Is as It Should Be

PART TWO

If you have folowed out all the suggestions in Part I, as given in last month's issue, without improving the operation of your set, your trouble is probably in the set itself and the tests given here should be made.

WHEN SET IS ABSOLUTELY "DEAD"

1. Aerial or ground may be disconnected. See that all connections are tight and properly soldered.

2. Lightning arrester improperly installed or defective. Remove and test set.

3. Open circuit in *Quadraformers* or audio transformers. Test with phones and battery across primary and also across secondary. Should be a click when circuit is made. To make this test connect one tip of your phones (or horn) cord to the positive terminal of an ordinary dry cell. Connect a piece of wire to the other battery terminal. Now touch the remaining phone tip to the end of this wire. There should be a loud click. You can now test all coils and wiring, by touching the phone tip to one terminal of a coil, for instance, and the wire to the other terminal. The coil winding should complete the circuit. If there is no click, the coil is open-circuited. If there is a click, the circuit is complete. All coils should show closed circuits across their primaries and also across their secondaries.

4. Short circuit in *Quadraformers*. This is usually caused by getting soldering fluid on the windings or burning with hot solder or a hot soldering iron.

5. Tube prongs not making contact with tube socket springs. Bend all springs up.

6. Grid condenser open or short circuited. Test with phones and battery. There should be no click. If there is a loud click condenser is shorted Replace.

There may be a faint click due to condenser discharging. This does not indicate a defect. If it makes a scratchy noise condenser is leaking. Replace.

7. Dead batteries.

8. Defective loud speaker. May be burned out or short-circuited. Test by replacing tips of cord across 1½-volt battery. If no click is heard either speaker or cord is defective. Do not attempt to repair but return to dealer.

9. Short circuited by-pass condensers. Test with battery and phones as in No. 6.

10. Phone plug may be defective or short-circuited. Insert plug in jack and see that it makes proper contact with springs of jack. Test for short circuit with battery and phones.

11. A or B batteries reversed in polarity or wrongly connected.

WEAK OR DISTORTED SIGNALS

See also Tests Nos. 1, 2, 5, 6, 7, 11.

12. Defective grid leak. Replace with another grid leak. You must use five megohms with the Quadraformer circuit.

13. Tube socket springs or tube prongs dirty. Clean all springs and tube prongs with sandpaper or fine file.

14. Loose connections in rheostats. Inspect and tighten.

15. Excessive B battery voltages. Decrease voltage and note effect.

16. Excessive filament current on detector or audio tubes. Retard rheostats and note effect. Detector and audio rheostat should be kept at lowest point that gives best reception.

17. Defective audio transformers. Test with phones and battery.

18. Dampness in coils causes partial short circuit. A lighted electric light globe placed in cabinet of set for a few hours will dry it out.

19. C battery reversed.

SCRAPING, SCRATCHING OR KNOCKING SOUND

See also Tests 12, 14.

20. Aerial may be swaying against limbs of nearby tree or against the building, grounding it intermittently.

21. Variable condensers dirty or plates rubbing. Clean with pipe cleaner. Adjust rotor plates. Bend bent plates back into shape.

22. Plate or grid leads touching or too close to other wiring causing oscillation by inter-stage coupling.

23. Microphonic tubes. See text of Bulletin 3, under "Tubes".

WHISTLES, SQUEALS OR HISSES

Properly constructed, the Quadraformer will not oscillate at any dial setting with aerial and ground connected.

See also Tests Nos. 6, 12, 23.

24. When a loud crackling or crashing noise is repeated at frequent intervals, and these noises cease when aerial and ground is disconnected from the set, you may be sure that the trouble is due to atmospheric "static".

25. A continuous low toned hum or growl may be due to power lines or lighting wires running parallel to the antenna. In such case, the antenna should be re-erected at right angles to the lines.

The same hum or growl may be caused by a leak in a power line or a transformer leak on some power or light line. If you are fairly sure that this is the trouble, make a complaint to the electric lighting or power company.

A continuous high pitched thin hum may be due to an open grid connection in your set or to the loss of the grid leak. Look for loose connections.

26. If the leads to the primary or secondary of either inter-stage *Quadraformer* are reversed the set will oscillate violently. Check your connections against wiring diagram.

HUMMING OR BUZZING

See also tests No. 26.

27. Open circuit in secondaries of coils or in grid wiring.

28. Grid prong of tube not making contact with grid spring of socket.

FADING OR WAVERING SIGNALS

29. A loose antenna wire swinging in the wind will cause fluctuating signals or alternate weakening and strengthening. Tightening the aerial is the only remedy.

Signals may fade out and then return to full strength because of atmospheric conditions, particularly in the summer time, and this trouble cannot be remedied. This is not due to any trouble in the receiver.

When two or more aerials are erected side by side on the same roof within a few feet of each other, fluctuations and fading may be caused by interferences between the aerials. The only sure remedy is to re-erect the antenna at right angles to one another and to place them farther apart.

30. Note that grid wiring is *always* connected to stationary plates of variable condensers. If connected to rotor plates there will be "hand capacity" evident, and signals will fade when hand is removed from dial.

Demonstrations That Sell

By J. F. THOMAS

IT is just as important to make the proper demonstration of a set to close a sale as its to have the set properly wired and performing right.

After making an appointment to demonstrate in a prospect's home, if possible deliver the set, batteries, speaker, etc., in the afternoon, and get everything hooked up and tried out. It is a good plan to take the tubes out when you leave, making it impossible for anyone to play with the set and put something out of order. When returning in the evening it is only a minute's work to insert the tubes and you are ready to go. This makes a very much better impression on the prospect than to have to bring in a lot of equipment and hook everything up, before getting started.

A very important thing in making a demonstration is to get one good program at a time and not to switch from one station to the other rapidly. You will find that nine people out of ten buy a set for entertainment and not for the novelty of seeing how many stations can be tuned in in a certain time.

If your prospect is really interested in buying a set it is not necessary to stay until midnight to close the sale. Sales are sometimes lost by not bringing a demonstration to an early close.

Let the prospect tune in some stations, there is nothing like getting the "at-the-wheel-yourself" feeling. When he has tuned in a few stations himself he is usually ready to say "yes."

Don't try to sell on DX claims. The Quadraformer will give a better tone, bring in the signal quieter and get as much distance as any five-tube set and oftentimes more, but the man who starts selling sets based on DX is starting wrong, as DX depends on many factors, none of which you can guarantee.

Know your set, keep abreast of the times in radio by proper reading. Make the proper demonstration and nine times out of ten the Quadraformer will sell itself, especially if the prospect has already heard some other sets.

Making the Quadraformer More Selective Without Regeneration

REGENERATION has disadvantages that makes its use with any radio receiver objectionable. Leaving the question of patent infringement out of the question, there still remains the fact that a regenerative set when improperly operated can certainly howl and squawk in an unworldly way.

Its only advantage is that, in badly congested locations, it does make a set very selective.

If you are near several high-powered broadcasting stations you can make your *Quadraformer* much more selective by following these suggestions:

Use a very short aerial, not over sixty feet long, including lead in. Change the .00025 mfd. series condenser C—1 to .0005 mfd.

Shield the back of your panel with light copper. Have a tinner make you a copper box to fit the entire inside of your cabinet except, of course, the front where the panel goes. Ground the shields to the ground post of the receiver.

You'll be surprised at the difference.

FOR THE CONVENIENCE OF EASTERN DEALERS

We Announce the Appointment of

E. M. CLARKE
1523 Chestnut St.
Philadelphia, Pa.

As our representative. Mr. Clarke carries a complete stock of Gearhart-Schlueter products and will give you prompt and efficient service.

WE HAVE ALSO A LOCAL BRANCH IN SAN FRANCISCO

In Charge of
J. F. THOMAS
47 Second Street

Mr. Thomas also carries a a complete local stock and will be glad to be of service to our Northern California Dealers.

Why Radio Frequency Transformers Burn Out

On several occasions, it has been brought to our attention that the primaries of the *Quadraformer* Inter-stage Transformers have mysteriously burned out.

This is no fault of the *Quadraformer*. The same thing can happen to any radio frequency transformer.

It can only be done by accidentally short circuiting the "B" battery across the filament. The resistance of the *Quadraformer* coil is *very low*, in fact much lower than a vacuum tube, and in case of a short circuit the coil will burn out *instead of your tubes*. A new *Quadraformer* costs $2.63 wholesale, *while five tubes cost $7.00*.

Many accidental short circuits are caused by carelessly inserting a UX tube in the old-style or universal socket. As you know the UX tube has very long prongs, so long in fact that they touch the socket springs when the bayonet pin is resting on top of the socket shell. If the tube is inserted "any old way" and twisted into place, as was the custom with the old UV tubes, you are almost sure to burn out your tubes or the primary of one or more of the coils. The remedy is to use UX sockets or to use great care in inserting your tubes. Be sure the bayonet pin on the tube base is exactly over the slot in the socket when inserting the tube.

Another cause for short circuits can be a defective tube in which the plate is shorted to the filament. You can test a tube for this defect with a 4½-volt "C" battery. Connect one terminal to one filament prong of the tube. With a short wire connected to the other terminal of the "C" battery touch the other end of the wire to the plate prong. *The tube should not light.* Test the grid prong also in the same manner.

When only one coil is burnt out your trouble is confined to the circuit that coil is in. If both coils burn out, the cause is more likely to be in defective wiring or a shorted by-pass condenser. Test the .5 mfd and the .002 mfd.

The *Essential* Kit

Consists of the three *Quadraformers*—Antenna Coupler and two Inter-stage Transformers—together with FULL SIZE Layout Chart and complete step-by-step instructions. Attractively packed in three-color display cartons

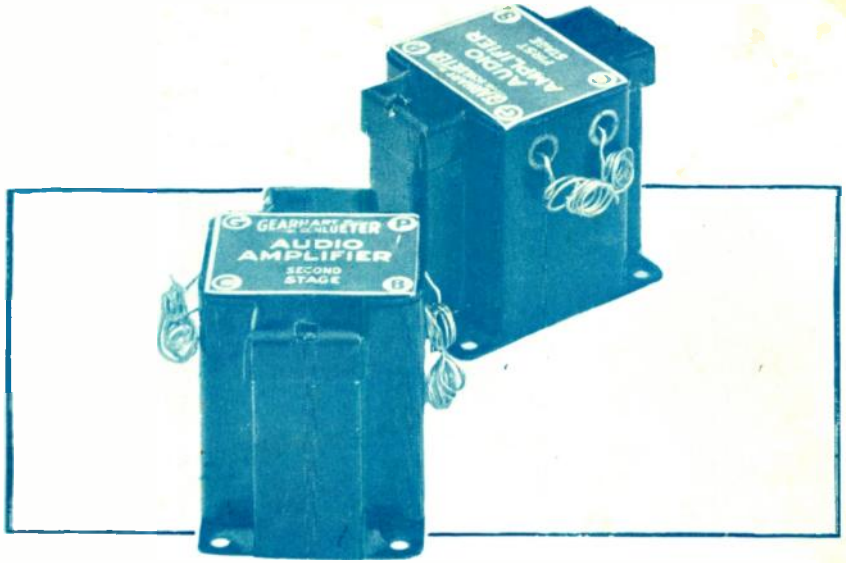
Sell these Essential Kits to the man who prefers to "build" his own.

LIST PRICE $12.75

DEALERS' NET PRICE $7.88 PREPAID

GEARHART-SCHLUETER RADIO CORPORATION

Fresno, California



Volume—with *Real Quality!*

If the transformers you have used distort voices and music when you want full volume, if they blur the low notes, if you have felt something lacking in quality, *use these new Gearhart-Schlueter Amplifiers in your next set.*

At last the rolling thunder of the pipe organ and the deep boom of the bass drum is reproduced with startling realism with no sacrifice of the highest notes audible to the human ear.

Gearhart-Schlueter Amplifiers are made in two types, one for the first stage and one for the second stage. The primary inductance of the first stage is higher than that of the second stage. They are designed to work [illegible] pairs.

While they are the equal of any audio transformer on the market we are not going to ask a list price of $8 or $10 each, but have priced them at $9.50 a pair. Standard equipment in complete Quadraformer kits.

NET PRICE: To Dealers and Set Builders, PER PAIR $5.70 PREPAI[illegible]

Your Money Refunded If Not More Than Pleased!

GEARHART-SCHLUETER RADIO CORP'N

Fresno, California

"Believe *me*, Mister, You have the goods!

Your bulletin of someone getting a foreign station during International Test Week sure makes me laugh."

Mr. W. M. Gay, proprietor of the Houston Radio Shop; Houston, Pa., wrote us the above on March 9, 1926. He adds:

"Why get excited over that man's reception? I can show two verifications from *real* foreign stations—and *not on Test Week either*—and have letters out now asking for *three more!*

"I have the *Quadraformer* set beside one of the best known makes of supers, of which I am the authorized dealer, and the *Quadraformer* outperforms it every time.

"I am going to handle the *Quadraformer* exclusively from now on."

Wonderful reception. Unusual for even the *Quadraformer;* but it does show what the *Quadraformer* will do when our simple assembly instructions are faithfully followed.

Proper installation and operation had a lot to do with it too.

And of course weather conditions were right.

I don't like to use DX reception as a sales argument—for that's one thing in radio no one can honestly guarantee.

One night you may secure marvelous reception and yet the very next night stations 500 miles away don't come in like they should.

But since so many of the set manufacturers are shouting "Coast to Coast" it does me good once in a while to give you a peek at some of the records *Quadraformer* builders have made.

Competitive demonstrations sell the *Quadraformer!*

Distance plus beautifully perfect quality—the ideal combination in radio —Is it any wonder that the *Quadraformer* actually sells itself?

GEARHART-SCHLUETER RADIO CORP'N
Fresno, California

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