

The I·R·S·M

NEWS AND DIGEST

DIGESTS IN THIS ISSUE

Loudspeaker Baffles and Cabinet Resonance

—Radio-Craft

A Direct-Coupled Beam-Power Amplifier

—Service

How Will Television Effect the Radio Industry?

—Radio Engineering

When Meters Blow

—Electronics

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—Service

Feedback Amplifier Design

—Electronics

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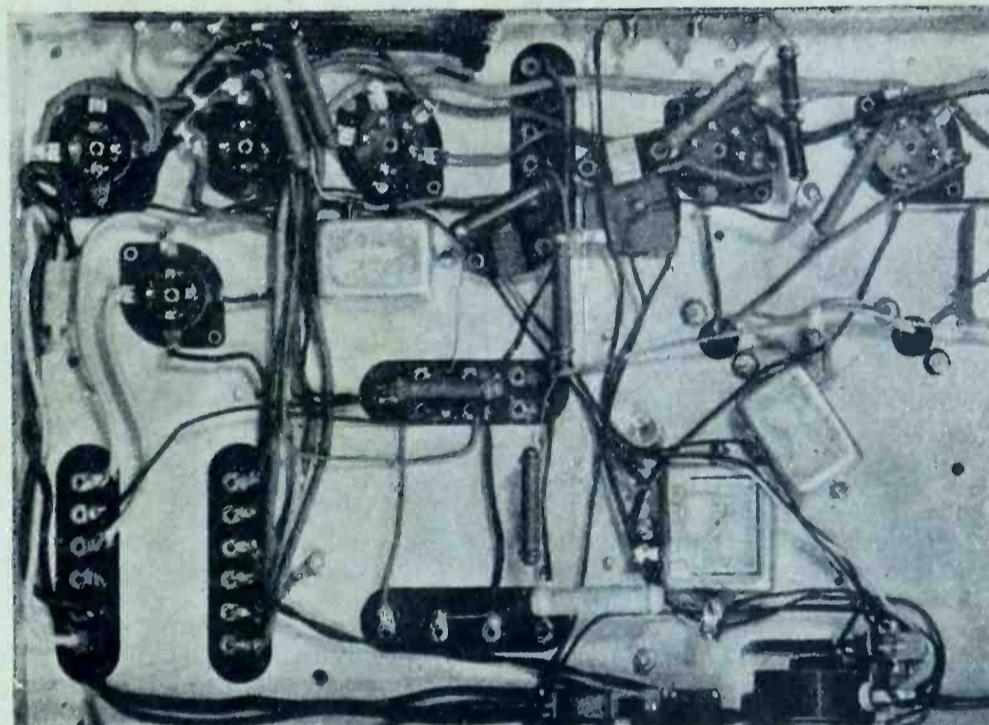
—Proceedings of the Institute of Radio Engineers

A Volume Expander That Works

—Electrod Contact

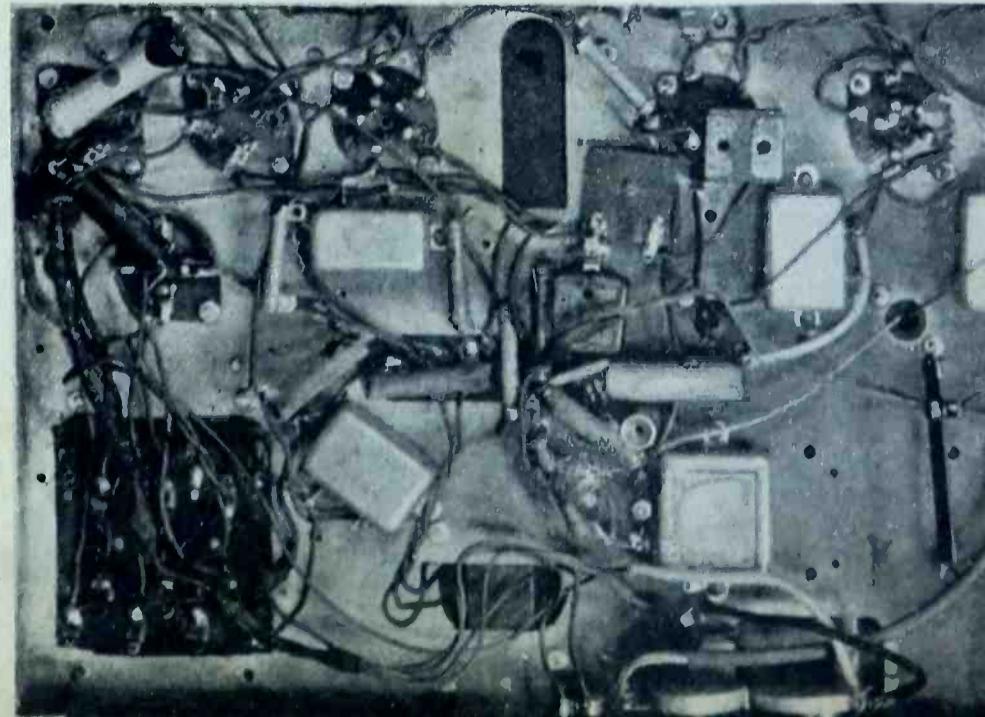


MARCH, 1937



ABOVE: The set as it came from the factory. Note the orderly arrangement of wires and parts.

BETWEEN: The set after passing through the hands of a "screwdriver artist." Note the "rat's nest" effect.



LICENSED RADIONEERS

Members Radio Service Registry

Are

MOLDING PUBLIC OPINION WITH THE FOLLOWING FACTS:

"Believe it or not, eighty per cent of all radio sets in use today have been found to be improperly installed. Licensed RADIONEERS can be relied upon to install your set correctly."

"Better be safe than sorry when you need service on your radio. You are safe when you call a Licensed RADIONEER.
"RADIONEERS are dependable."

"Tinker! Tinker! Tinker! That is what two out of every three men who service radios do when they try to fix your set. Tinkering consumes a great deal of time and Tinkerers want to charge you for it. RADIONEERS do not tinker! They scientifically determine what is wrong and then proceed to repair it. Therefore, RADIONEER service is quicker and less expensive."

"Licensed RADIONEERS have proven their superior ability to service radio sets by passing the examinations given by the National Board of Radio Service Standards.

"RADIONEERS are dependable."

"When a Radio Service Man becomes a licensed RADIONEER he has received the stamp of approval of the Radio Industry as a man of superior ability in the servicing of Radio Receivers."

"It is less expensive to call a Licensed RADIONEER when your radio set needs servicing because his proven knowledge allows him to do the work quicker and more accurately so he does not have to charge so much as an incompetent does who would work on your set for hours and maybe never find what is fundamentally wrong with it."

"'Tinkeritis' is a disease that is quite often fatal to radio receiving sets and its effect extend to the nerves of human beings. It is caused by exposing your radio set to an incompetent tinkerer. If caught in time it can be cured by placing your set under the care of a Licensed RADIONEER."

"Many people have learned how foolish it is to put their radio set into the hands of anyone who cannot prove that he is a RADIONEER."

You are engaged in radio servicing because you thoroughly enjoy the work. Maybe you are good at it. Why not be the best in this line of work in your community? You can be and can prove it by securing a license as a Radioneer.

Radioneers are members of Radio Service Registry. Every day Radioneers are being shown how to secure more than a proportionate share of the business in their community. Every day Radioneers are putting these methods into operation in communities from coast to coast and their business is booming. You should be able to do the same.

Those interested in becoming Licensed Radioneers may get complete details by writing the

NATIONAL RADIO SERVICE QUALIFICATION PROJECT

500 North Dearborn Street,

Chicago, Illinois

The I-R-S-M

NEWS AND DIGEST

VOL. 1.

MARCH, 1937.

NO. 2.

DON STOVER, Editor.

M. W. HINSON, Advertising Manager.

KEN HATHAWAY, Managing Editor.

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For complete details on any of the subjects covered by these Digests, refer to the publication in which the original article appeared as indicated.

The Institute will be glad to assist any service man who wishes to place his subscription for any of these publications, either by providing information concerning addresses or by forwarding subscriptions to the respective publishers.

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EDITORIAL

Q. P. EXTENDS FROM COAST TO COAST

When Radio Service Registry licensed Wm. H. Price of Riverside, California, as a Radioneer a few days ago, the Qualification Project spanned the continent; and licensed Radioners are to be found from the Atlantic to the Pacific.

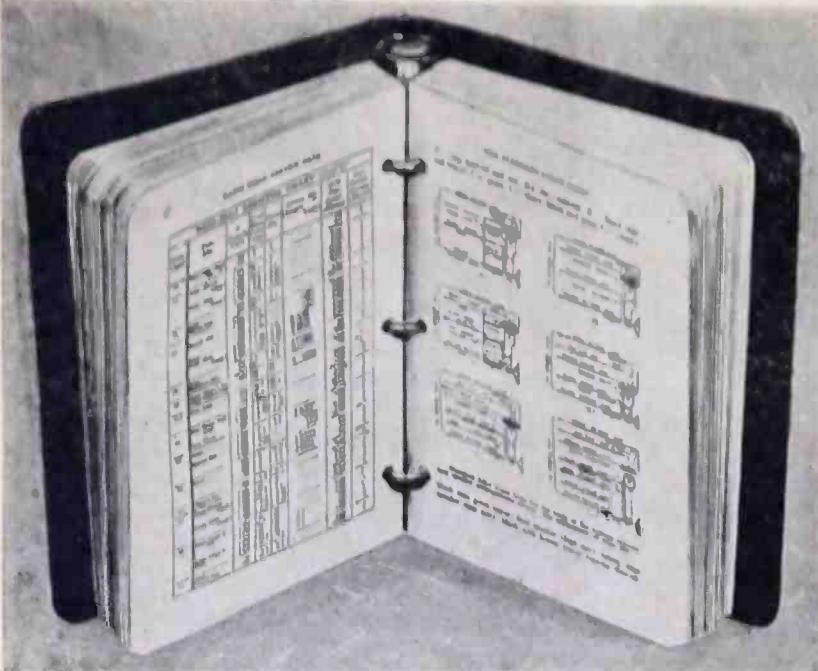
Subsequent to the giving of the examination in which Mr. Price qualified to obtain the license as stated, arrangements have been made to hold examinations in the San Francisco area, so that within the next few weeks there will no doubt be several on the west coast who join with their fellow Radioners on the east coast and intermediate joints.

As early as last fall there were Radioners up and down the eastern seaboard. Some of them took the examination at the time of the New York Convention last September. More recently with examinations conducted in Washington, Newark, New York, and Boston, the number is increasing.

But the interior is not lying idle, either. Several examinations have been conducted in Chicago, and approximately 100 have earned the right to be considered service men, and have been licensed to use the term Radioneer. These examinations have been taken by men in Rockford, Freeport, and St. Louis; men who traveled to Chicago to take the examination. Ft. Wayne, Davenport, Detroit, Milwaukee, Rochester, Binghamton, Reading, Scranton, and other cities have either held the examination or have set definite dates on which the applicants will take the examinations.

As was anticipated, the percentage of failures among the initial group is low, about 6.5 per cent. It was felt at the beginning that, generally speaking, those who were confident of their ability to pass the examinations would make their applications, and that those who were not so confident would delay. Experience has shown the assumption to be correct. The same logic applied to the matter of the code of fair practices; that those who recognized the importance of fair dealings would file their applications without delay and that others would hesitate.

That the Qualification Project has been able to spread itself from one end of the country to another in so short a time is remarkable. In a progressive movement such as this, the inertia that must be overcome is tremendous, and then, too, applicants have to have an opportunity to study in order to prepare themselves on some of the details that may come before them when they take the examination.



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Trouble symptoms and remedies for over 1,500 receiver models.

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Electrical wiring diagrams, ignition system data and interference remedies for all American cars.

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The new loose-leaf edition of Ghirardi's handy job data book has more of everything! The very dope you need for servicing in the shop or outside. Twice a year SUPPLEMENT SHEETS will keep it always up to date for you. Send coupon today for this great time and money-saver! MONEY-BACK GUARANTEE.

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Name

Address

IR-37

Don't try to GUESS
a radio set into balance!

*It's so easy
with this new
Series 3710*

\$49²⁵

complete



BENDIX-DAYRAD SCOPE

Make your balancing tests swiftly and surely. You'll get the most out of a receiver in the least possible time with this new Bendix-DayRad Scope. At its low, big-production-price, it's a splendid investment for any radio service department.

Here's What You Can Do With It

1. The alignment of radio receivers. (Built-in amplifiers to adjust for the sensitivity of the receiver).
2. The measuring of peak voltage A.C. with or without amplifiers.
3. The measuring of audio quality in audio amplifiers, thereby locating causes of distortion.
4. The measuring of modulation, percentage of transmitters, or oscillators.
5. Checking phase shifts in various devices.
6. Modulation percentages of received signals by phase shift method.
7. Testing of auto radio vibrators.
8. The adjustment of transmitters.

Brief Specifications:

The Series 3710 has complete controls for adjustment of tube and spot, namely intensity, focus, horizontal, and vertical spot controls. The intensity control is equipped with the AC power switch.

Vertical and horizontal gain controls have switches for connecting the binding posts directly to the ray tube or through the amplifiers.

Maximum peak voltage applied to the binding post input must not exceed 400 volts. Both amplifiers substantially flat in frequency response from 15 to 100,000 cycles.

The sweep frequency range is continuously variable from 15 cycles to a maximum of 20,000 cycles, and is linear through its entire range.

The sweep frequency step control is variable in ten steps.

The variable sweep control provides a means of interpolation between the frequency ranges.

The synchronization control provides a means of locking in step the sweep tube with the voltage supplied externally to be viewed. This control has three positions, internal lock, line frequency lock, and external lock.

Cabinet is 6 1/4" wide, 8 1/4" high, 10 1/2" long. The handle for carrying is the trim at the top of the case and it is concealed when not in use.

The instrument operates on 110 volts 50 or 60 cycles. 25 cycles at a slightly higher price. Weight complete approximately 15 lbs.

Price complete is \$49.25.

Send Coupon below for new Bendix-DayRad catalog

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(Subsidiary of Bendix Aviation Corporation)**

454 Bendix Drive, South Bend, Indiana

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Name

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IRSM CONVENTION COMMITTEE PLANNING NOVEL PROGRAM FOR 5th ANNUAL CONVENTION IN JUNE

The Fifth Annual National Convention of the Institute to be held at the Stevens Hotel in Chicago, June 10 to 13, will be an innovation so far as the type of program is concerned.

It is the consensus of the Convention Committee which is headed by Joe Marty, Jr., that past types of convention programs are monotonous. Long technical sessions are tiring, and the effect of the constant movement in and out of the convention hall is distracting to the speaker, who, though his lecture may be of the highest type, cannot help feeling that he may not be putting over his message in an interesting manner. The object, then, is to shorten the time for lectures and to substitute clinics of an informal nature for some of the major portions of the sessions.

Some of the lectures will not be technical. In fact, the object is to steer away from the technicalities of the art in these parts of the program, yet bring to the conventioners messages that will give them inspiration and the will to do like they never had before.

Underlying the formation of the entire program is a question, "Will this session improve the technique or well-being of those who attend it?" The Committee is considering each session in its relationship with that important question.

Some of the details of the Fifth Annual Convention will be published in the next issue of The NEWS and DIGEST.

SELL-OUT OF SHOW IS NOW CERTAIN

Chicago, March 1—That the 1937 NATIONAL TRADE SHOW being held at the Stevens Hotel in Chicago, June 10 to 13, inclusive, will be a sell-out of 130 booths is assured, according to advices received from Ken Hathaway, Managing Director of the Show.

"It is most difficult to have to tell a would-be exhibitor that there is no more space," said Mr. Hathaway, "but that is exactly what I am going to have to do in a very short time. We have been literally swamped with contracts, and the Exhibition is nearly a third larger than the goal that we had set originally."

When questioned about the possibility of increasing the space or providing booths elsewhere, the Managing Director stated that no such provision could be made. When the Exhibition Hall, which contains 130 booths is filled, that is the limit to

the amount of space that can be utilized at this Show.

RAW MATERIALS MAKERS EVIDENT AT SHOW

New York, N. Y., March 1—The Directors of the Radio Parts Manufacturers National Show are more than pleased with the excellent display of interest on the part of the parts and accessories manufacturers, was the gist of a statement issued by Arthur Moss, Secretary of the Show Corporation, and president of Electrad, Inc.

"In addition to the regular line of exhibitors," said Mr. Moss, "I am glad to see many of the raw material suppliers included in the listing. I am sure that all of us will not only enjoy seeing them at the Show, but from the business standpoint, we will make their presence there well worth while for them. I anticipate that there will be a growing number of the raw ma-

terial suppliers at our subsequent shows."

RCA SHOW COACH AIDS TEXAS CITY

Tyler, Texas, Mar. 1.—Radio added another glowing episode to its long history of rendering aid in time of distress, when transportation was crippled, all communications systems were paralyzed, the power plant was frozen, and the city was covered with an icy blanket, in a freak storm that struck here recently.

One of the RCA Victor Company's giant show-coach trailers, equipped for exhibiting almost every conceivable type of radio apparatus, had rolled into the city the day before. To demonstrate the wide variety of equipment, which ranges from a complete police radio system to home radios, the show-coach carries its own powerful 3-kilowatt electric power generating plant. The dramatic story of the part which this generator played in establishing and maintaining communication between the stricken city and the outside world is best told by quoting from the report of Harold D. Knapp, RCA Victor en-

(Continued on Page 6)

SALES MANAGERS CLUB CHAIRMEN WAX ENTHUSIASTIC OVER SHOW

CHAS. GOLENPAUL, EASTERN GROUP

With a 100% sell-out of the 130 available booths, the Radio Parts Manufacturers National Trade Show promises to set a new record for radio trade shows. It will be held in the Hotel Stevens, Chicago, from June 10th to 13th, inclusive.

"Speaking for the Sales Managers Club", states Charley Golenpaul, Chairman of the Eastern Group, "we are more than pleased with the splendid response of the radio parts industry. Our own membership, which first proposed this non-profit-making trade show for the best interests of parts manufacturers, jobbers, dealers and service men, has hastened to sign up for booths, and we are now co-operating fully with Ken Hathaway, the Managing Director, to make the show a tremendous success to all concerned.

"After all, it isn't simply a show we are most interested in. It isn't a blaze of glory we wish to achieve. Rather, we want all parts manufacturers to present their products and their stories, in order that all jobbers, dealers and service men who visit the show may know what's what in the parts trade. This, therefore, is

not a showman's show. It is a radio gathering for the purpose of transacting radio business. And as such it will appeal to busy men whose time is too important to waste these days of national business recovery."

RALPH HILL, WESTERN GROUP

Jobbers, representatives, service men, and others all through to the West Coast, are planning to attend the 1937 NATIONAL TRADE SHOW at the Stevens Hotel at Chicago, June 10 to 13, according to advice from Ralph Hill, Chairman of the Western Division of the Sales Managers Club, and Sales Manager for Ohmite Mfg. Company, who has just returned from a trip through the west and southwest.

"I never saw such an interest in shows as there is this year," was Mr. Hill's comment. "Not only are the bosses coming, but they are planning to bring their service men and other employees along with them. And this does not apply to those cities within a radius of a few hundred miles, but clear out to the West Coast and down through Texas and Oklahoma. I am sure we are going to see a record crowd at the Show."

BROWN DEVIL

WIRE WOUND RESISTORS



*Built to
Stand Up
says Bill Finit*

BROWN DEVILS make ideal replacement resistors. They are built exactly like the big OHMITE Industrial units . . . wound on a porcelain core and covered with the specially vitreous enamel which insures evenly spaced winding. That's why they eliminate profitless "call-backs."

Tinned lead wires make for easy installation. 10 and 20 watt sizes; resistance values through 100,000 ohms. Ask your jobber or get Catalog 16 — FREE!



OHMITE

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Rheostats, Resistors and Tapswitches
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1910

1937

27 YEARS

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CORNELL-DUBILIER

CORNELL-DUBILIER CORPORATION SOUTH PLAINFIELD, N.J.

(Continued From Page 5)

gineer in charge of the traveling exhibit.

"The rain, which had been falling all day Friday, turned into crippling sleet on Saturday and by 2:00 a. m. Sunday morning Tyler was completely isolated by the failure of all electricity, telephone, telegraph, bus and train communications. At 8:30 a. m., the sergeant of the Tyler police department asked if we could supply the current for operating a transmitter to clear emergency messages. So, I drove the coach to the home of J. M. Burke, Jr., owner and operator of amateur station W5EME.

"Going on the air at ten o'clock, we handled a continuous stream of messages for the telephone and telegraph companies as well as for anxious individuals, until 1:15 a. m. Monday, at which time we were told all traffic lanes had been cleared. We had to go on the air again though for six more hours beginning at 4:00 p. m. for emergency services. All communications were handled by short wave radio, with the local deliveries being made by messenger in the case of telegrams and by telephone otherwise. Our shift was as follows: J. M. Burke, operating his station W5EME, which uses 500 watts of power on 160 meters radiophone, assisted by Heath Lamb, (amateur W5PH), D. E. Chapman, announcer of station KGKB, and the writer, all taking turns at the mike, with the 3-kilowatt generator on our "Magic Coach" purring tirelessly."

Tyler's newspaper, the Morning Telegraph, almost had to suspend publication, but was able to get out a condensed edition which it called a "Short Wave Radio Paper." With all normal outside communications cut off, the paper arranged for a stenographer to copy Associated Press dispatches in shorthand from our station as broadcast from Dallas. All

RMA SERVICE SECTION TO MEET JUNE 12

F. B. Ostman, Chairman of the Service Section of the Radio Manufacturers Association, has announced that a meeting of his section will be called for 10:00 A. M., Saturday, June 12, at the Stevens Hotel.

"These meetings held during the Chicago Show are very important," stated Mr. Ostman. "Practically all of the service managers make it a point to attend the show and the convention of the Institute of Radio Service Men, so that there is a representative attendance to discuss the various problems that confront the factory service departments. Each of the members feels that even though no definite action is taken on any given problem, the round table discussions are distinctly helpful to all who participate."

the outside news subsequently printed in the paper was prefaced "By Radio From Associated Press." The power company was by this time able to supply sufficient power for operating the newspaper plant so that the news could be set in type, cut made of photographs and the presses allowed to roll.

Mr. Knapp gave unstinted praise to the operators of amateur radio stations within radius of the storm-swept city. "A vote of appreciation is due all the stations working the 160-meter band in the fifth district," he said. "They all stood by to relay messages and clear the air of QRM during the entire emergency period. I should particularly like to mention the following stations for their unselfish help — W5AVH, W5EKU, W5PH, W5FGT, W501, W5ZE and of course Burke's station W5EME.

OPERADIO'S PORTABLE JOB

The Model 115 Portable P. A. System is a high grade, 12 watt, Class A System. It is the finest system available requiring moderate power . . . is designed for orchestra and voice reinforcement for soloists and public speakers. Compactly designed, it permits mixing one or two low level microphone inputs such as Crystal type, and phonograph input. Has two variable tone controls; one for high frequencies and one for low frequencies. Furnishes complete power supply for Model 681 Pre-amplifier which makes possible using high impedance crystal microphones or frequency attenuation.

Model 115 comes complete with one (1) 10" heavy duty Electro-dynamic Speaker with rubber covered cord and polarized plug. Provision for additional speaker. Includes high quality dual diaphragm crystal microphone, of the suspension type, with a 25 foot cord. All equipment mounted complete in attractively finished leatherette covered carrying case.

Specifications and further details may be had by writing Operadio Manufacturing Company, St. Charles, Ill., for Catalog.

TRIAD RELEASES NEW OUTPUT TUBE

The release of a new output tube for Auto Receivers by the Triad Manufacturing Company, Pawtucket, Rhode Island, has just been made.

During the past year, the Triadyne Series, made up of the 6B5, the 6N6G and 6N6-MG, has been used extensively in automotive radios. This new member of the family, the 6AB6G, has been designed along similar lines. The major improvement lies in the fact that the filament current has been reduced from .8 amperes to .5 amperes, and the bulb size reduced to the small ST-12 Bulb. The base is of the octal type.

CHAPTER CHATTER

CHAPTER ENTHUSIASM

To print the enthusiastic letters that came from Chapters everywhere after the first issue of the NEWS and DIGEST reached them would take an enormous amount of editorial space. Hence, the editors regret their inability to print them all and rather than cause any of the Chapters to feel slighted because their comments were not published, it seems best to omit all of them.

Through this "Chapter Chatter" column, the editors of the NEWS and DIGEST extend their sincere thanks to each of the Chapters for their congratulatory letters, and take this further opportunity to state that they will do all within their power to make the new paper one that will serve them well.

Supplementing the congratulations from the Chapters are numerous letters from individuals, from manufacturers, and from the Trade Publications that contained the articles condensed in the first issue. One of the publications has already sent an advance article—one that is yet to be published—but unfortunately it was received too late for this issue.

Why this particular type of time-

saver has been overlooked is a puzzling question. That it is most welcome is evident from the start.

BOSTON—

Monday evening, February 15, 1937, the "Flying Squadron" of Boston Chapter, Institute of Radio Service Men, went to Manchester, N. H., for the purpose of establishing a new chapter of the Institute.

The arrangement of this successful meeting was made by Radioneer Arthur B. Sanborn, of Wilton, N. H., a member of the Institute of Radio Service Men, together with the co-operation of Mr. George J. Craig, Jr., and Frank E. Allard of Manchester, N. H.

The meeting was opened at 8 p. m. by Radioneer Arthur B. Sanborn, who introduced a representative of one of the leading manufacturers of test equipment used in radio servicing. A splendid and most constructive talk was given on the latest piece of test equipment recently developed to give the radio service man the opportunity to render much more satisfactory service on radios.

At the close of this talk, Radioneer Guy E. Boodry, Chairman of Boston Chapter and member of the Board of

Trustees of the Institute of Radio Service Men, was then introduced as the guest speaker.

Radioneer Boodry gave a most interesting talk on the conditions prevailing in the radio service industry in 1931; how the inexperienced and untrained man was unsuccessfully attempting to render satisfactory radio service; the unethical methods and inferior replacement parts used by some of these men in their repair work, with the result that the general public suffered greatly, both financially and in having radio sets performing unsatisfactorily.

Then he went on to explain the birth of the Institute of Radio Service Men with their National Headquarters in Chicago, Illinois; its policies to correct these conditions of 1931; the slow and steady progress of the legitimate radio service man to build up the Institute of Radio Service Men throughout the country, and, through this medium see that the general public obtained prompt, efficient and satisfactory radio service.

The explanation of greater value to the service man by being associated with a National Organization which has unlimited possibilities to improve conditions for the service men, in comparison to small, local associations with limited powers, met with great approval.

Finally, Radioneer Boodry brought

Announcing

TWO NEW P.A.UNITS



60 Watt 6L6 Amplifier by THORDARSON

The Thordarson 6L6 amplifier delivers powerful, brilliant tones at full rated output. 4 beam power 6L6's are used in push pull parallel, eliminating grid current and permitting simple driver requirements at 60 watts output. Performance improved by greater gain and frequency response. Wave distortion at minimum. Tube life increased. Power supply regulation effect reduced by decreased plate current fluctuation. Carefully engineered, perfectly designed and powered by Thordarson transformers including Tru-Fidelity.

NOTE: Radio men everywhere acknowledge these two new P. A. units the finest they have heard. Both of these amplifiers available completely wired or in "Build-it-yourself" style with "Foundation Units."

Now Tru-Fidelity Speaks!

Clear audio reproduction—a marvel of modern transformer and amplifier design. You be the judge! Hear the Thordarson Tru-Fidelity P. A. unit in operation. Delivers absolute linear and distortion free audio power at 10 watt output. Ideal as a recording amplifier—speech amplifier for broadcast purposes—general P. A. or sound reproduction work where moderate output levels are sufficient, and quality reproduction is most essential.

ASK YOUR SUPPLIER FOR BULLETIN SD 269. Lists prices, circuit diagrams, and descriptions of units, or write factory direct using coupon. Get your copy today — **FREE.**



Dept. IR73 Please send me Bulletin SD-269
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THORDARSON ELECTRIC MFG. CO.
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out the most important step the Institute of Radio Service Men has accomplished to protect the radio public and the radio service man from the inferior or so-called "gyp" radio service man—namely, THE QUALIFICATION PROJECT.

Radioneer Bernard L. Cook, Vice-Chairman of Boston Chapter, Vice-President of Radio Service Registry, member of the Board of Trustees of Radio Service Registry, explained the Qualification Project in detail.

His explanation of the term "RADIONEER": what it meant to the radio service man who passed the rigid examination required to meet the approval of the Radio Service Registry; the licensing and the use of the term "RADIONEER" granted only to qualified service men, met with great approval and enthusiasm.

Radioneer Ingvar Paulsen, Secretary of Boston Chapter, a member of the Board of Trustees of the Institute of Radio Service Men and the Radio Service Registry, gave a talk on the benefits of co-operation between radio service men, the value of becoming a member of the Institute of Radio Service Men and the Radio Service Registry.

Short talks were given by Radioneer Ralph F. Anderson and Radioneer William H. Remick of the Boston Chapter. Other members of the Chapter attending were Radioneer Raymond C. Wyman, Radioneer Louis Hartley, and Radioneer Wilbur Paulsen.

The meeting closed about 12:30 a.m. with a great majority of the radio service men gathered from Manchester, Nashua, Wilton and surrounding towns signing the Charter application.

After the meeting, refreshments of sandwiches and coffee were served to the Radioneers of Boston Chapter.

Thus, another Chapter of the Institute of Radio Service Men was formed in Manchester, N. H. We all wish them the best of luck.

Boston Chapter, IRSM congratulates

their Vice-Chairman, Radioneer Bernard L. Cook upon his election to the office of Vice-President of the Radio Service Registry. As a member of the Board of Trustees of RSR, Radioneer Cook was one of the first group in the country to take the examination.

* * *

The first "Radioneer" examination was held in Boston, Mass., on January 19, 1937, with a group of Institute members from Massachusetts, New Hampshire and Rhode Island attending. Word has just been received from RSR that these members have passed the examination. Good work, fellow members!

Guy E. Boordy, Chairman
Boston Chapter, IRSM

SOHARSM—

So, you missed the old Soharsm column? Or did you? Well here it is again. It was necessary for the editors of this column to make a special trip to Chicago in January to make arrangements for the return of this essential part of the news to appear again. After several hours of talking at length about every subject except this column it was decided to get it started again.

We could not get any definite information on whether any of our circuits would be printed or not. This will have to be brought up at one of the meetings of SOHARSM which are never held, and voted on, which is never done, so what?

In this article, we are going to take up the subject of the right way to keep books. So much has been said about costs and other things in this radio service business that we feel it is time something was done about it. Here is our fool proof method of keeping books, and if you will follow closely, we are sure you will find it the best way.

The first thing, of course, is to provide yourself with some books. Here is something that all the best accountants and bookkeepers agree on, it makes no difference what kind of

books you get as long as you get some and use the right methods to keep them. We get in our trusty, or rusty, Ford and head for town, naturally, we wouldn't go out in the country as books, strange as it may seem, do not grow on trees even if they do have leaves. Yes, friends, to town we go. As we are going slowly down the street looking in the windows, we finally come across a store that has books in the window. We step inside and tell the clerk that we are in the radio service business and we want some books. Naturally, the clerk is going to ask what kind of books we want and we tell her something to keep, as we have been told that we must be bookkeepers. Well, much to our surprise, and chagrin, she brings out some first readers. We tell her that we are not interested in such things and she shows great surprise, saying that she didn't know that the service men were educated on beyond first readers. Next, she brings out some detective stories. Can you imagine that? Again we explain that these are not just the thing, and she comes right back and says she surely thought these would be just the nuts, as we had to find trouble in radios and she thought sure these would help us in deducing. Deduce with her, we think, and away she goes and comes back with "Anthony Adverse." Well, now, here is something. Here is a book that you really could keep, so we buy it.

Now to arrange a method of keeping it. Sounds easy, doesn't it? Well, that's what we thought until we started devising ways and means. We finally worked out the following method: We got the steel company to make us a good thick box, then we had it plated with non-rusting material. Now we take the book, place it in the box and have the steel company weld the cover on. Next, we take our treasure to a good deep stone quarry. It may be necessary, if you haven't one of these in your locality, to dig one up. Ha, ha, we thought of this ourselves. With a good sharp ice pick, dig a good deep hole just the

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size of the package. This hole should be approximately $6\frac{1}{4}$ by $\frac{3}{4}$ by two by yoistes. Now drop the package, flat side down, into the hole, add two teaspoons of salt and stir.

Darn. We had our radio tuned into a cooking lesson, and now we are all mixed up. Ha, ha, we thought that one up too. Well, tune in again next week—I mean month—and we will have something else for you to worry about—I mean work on. In the meantime, you can practice up on our method of bookkeeping.

"I'VE GOT MY CAPTAIN WORKING FOR ME NOW"

Two of the officers of the Chicago Chapter, Joe Marty, Jr., and R. E. Clarke, hold unique positions. Both of them own the stores in which they were formerly employed as service men; both of them bought out their former employers.

In both instances, the stores are of the best class. In the case of Mr. Marty, the Wilmette Music Company is an old established concern on Chicago's north shore. Huntington's, now owned by R. E. (Bob) Clarke, is located in down-town Evanston, and enjoys a high reputation among the residents of the suburb.

Neither of the transactions involv-

ing the transfer of the business took place recently. Mr. Marty took over the business of the Wilmette Music Company in 1933. Mr. Clarke purchased Huntington's more than a year ago. Both have had an opportunity to show their mettle in the matter of operating a business establishment.

Mr. Clarke holds another distinction, however, in that his former employer—the former owner of Huntington's—now works for Mr. Clarke.

Here then are two alert service men—alive to the possibilities that lie before them confident in their ability to handle a business properly—determined to establish themselves firmly in the business world. They are outstanding examples of what can be done by men who have initiative and who appreciate the fundamentals of business operation.

The miniature cathode-ray tube, the RCA 913, suitable for operation at about 500 volts, is nicely adapted to a comparatively inexpensive and really portable cathode-ray oscilloscope for radio servicing.

—*Successful Servicing, Dec., 1936.*

* * *

Thirty million phonograph records were sold in 1936.

—*Radio Today, Dec., 1936.*

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Installed radios now outnumber any other appliance, with the exception of flat-irons.

—*Radio Retailing, Dec., 1936.*

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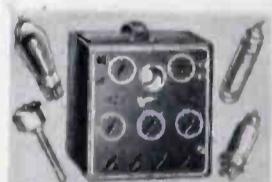
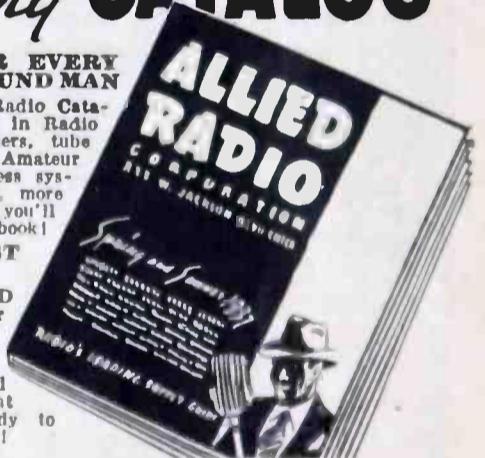
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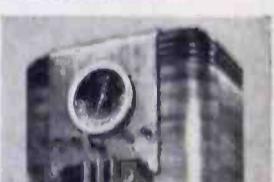
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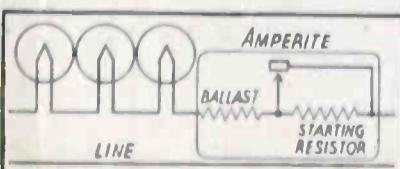


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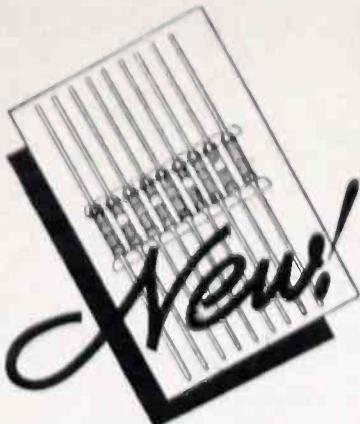
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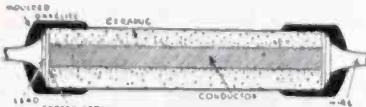
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MOTOROLA BUILDING NEW FACTORY

Construction has been started on the \$250,000 factory and office building at 4545 West Augusta Blvd., Chicago, by the Galvin Mfg. Corporation, which will provide 85,000 additional square feet of floor space for the manufacture of Motorola auto and household radios.

According to Paul V. Galvin, President and Treasurer, the present output of 2,000 auto sets daily in the concern's factory at 847 W. Harrison St., Chicago, will be increased to 3,000 in the new plant, and the new Motorola Home Radio will be produced there.

The new factory is scheduled for completion on April 1, 1937, and will be one and two stories in height with the general offices in the second story section. The exterior walls will be blue and white terra cotta, with exterior corners curved, and there will be almost continuous window lighting on the first floor of this most modern factory.

Back in 1928 the Galvin Mfg. Corporation started in a little space occupying not more than half a floor at 847 W. Harrison St., Chicago, which was office, engineering laboratory, and factory combined.

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LOUDSPEAKER BAFFLES AND CABINET RESONANCE

By McMURDO SILVER

Condensed from "Radio-Craft," March, 1937

The writer is so regularly and continuously surprised by the lack of understanding of what a loudspeaker baffle is that he is taking occasion to dispel the many false impressions.

A dynamic cone loudspeaker functions over most of the audio range as a piston, moving forward and backward, thus displacing surrounding air both in front of as well as behind the cone. It is this displaced air which the ear perceives as sound. In such an operation, the air pushed out in front by the cone moving forward must go somewhere, and as a partial vacuum is created at the rear of the cone as it moves forward, the displaced air in front finds it most easy to flow toward the partial vacuum at the rear. The net result is the generation of sound waves in only the air very near the cone due to this cancellation.

A baffle is any means at all placed between the cone front and the cone rear which lengthens the distance air must travel from front to rear. For

high frequencies, the baffle provided by the size of the cone itself is sufficient to prevent cancellation. The low-tone reproduction range is dependent upon the length of the air path from the center of the cone in front to the center of the cone at the rear. The purpose of the baffle is to so lengthen the front-to-back air path that air displaced by the forward movement of the cone can not reach the near-vacuum at the rear until the "vacuum" has ceased to exist by virtue of the cone having had time to pull backward. The baffle can be of anything from limburger cheese to paper—anything at all that will lengthen the air path cone-center front to cone-center rear. It should be of some acoustically "dead" (non-vibratory) material. If it is hard and stiff (or thin) it will vibrate in itself, which it should never do, for if the baffle vibrates, it contributes to reproductions which were not intended to be in it, thereby causing distortion.

There is a simple rule for figuring sizes of baffles to reproduce down to

any desired frequency. Let us take 40 cycles as the lowest tone to be reproduced. On a 40-cycle note, the cone will move through a complete cycle 40 times per second. It will take one-half of this time, or 1/80 sec., to move from the front to the rear, so we want the baffle to delay the front sound 1/80th of a second before it is allowed to reach the rear. If we now multiply the speed of sound in air, 1,130 ft. per second, by 1/80, we will get the path length that must be interposed between the cone front and cone rear in order for our speaker to reproduce all tones down to 40 cycles, or 14.125 feet. Remember that this is the shortest distance from the cone center at front to the cone center at rear.

Some of the edges of the baffle can be bent backward to save space, as in a radio cabinet. In this case the baffle will be the total distance from front to back, but still measured from speaker cone center around the shortest side of the cabinet and back to the speaker cone center at the rear. A baffle may reproduce frequencies below its own cut-off through cabinet resonance caused by the cavity in which the speaker is installed. Thus cabinet resonance is very necessary to low-note reproduction, but only if it is obtained from a solid, heavy cabinet, and in carefully regulated and controlled degree.

A DIRECT-COUPLED BEAM-POWER AMPLIFIER

By A. C. SHANEY

Condensed from "Service," January, 1937

An amplifier using the direct-coupled circuit is capable of producing equal potential amplification at all frequencies, within the limits set by the interelectrode capacity of the tubes, and equal frequency amplification at all potentials within the audible band. The circuit as originally introduced had two major drawbacks. The amplifiers were subject to trigger action and no adequate push-pull circuit was available. These factors contributed to the unjust condemnation of this truly revolutionary high-fidelity circuit.

Trigger action is a term applied to the phenomenon occurring when an amplifier becomes inoperative due to a strong and maintained signal fed to its input. This effect is caused by a surge in the plate current which in turn lowers the grid bias sufficiently to shift the stage off its normal $E_g - I_p$ curve and maintain itself in this blocked state. This effect may be avoided through the use of a bridge-type

stabilized rectifier and filter system.

Many attempts were made to convert the single-ended direct-coupled amplifier to one of the push-pull variety. The ideal phase inverter will equally divide the amplitude of a signal and separate their phases by 180° . Naturally, this action must take place equally for all frequencies and amplitudes. Any circuit utilizing a coupling condenser cannot accomplish this because of the varying capacitative reactance presented by the condenser to the varying audio frequencies. Transformers are similarly limited in their phase inversion action because of the varying inductive reactance of both the primary and secondary windings. Thus only within very narrow frequency limits will the inverted signal be 180° out of phase with the original signal. Amplitude distortion is also predominant in transformer inverters.

A phase-inverter capable of driving two 6L6 tubes in true push-pull fash-

ion, employs equal load resistors in plate and cathode, with input grids of the push-pull tubes connected directly to plate and cathode of this divider tube. During the positive cycle of the input signal, the plate current increases with a subsequent increased voltage drop in the plate resistor. The increase in cathode current raises the cathode voltage because of the increased current flowing through the cathode resistor. The potentials appearing across the plate and cathode of the tube are opposite in phase. Since the plate resistor and the cathode resistor are equal in value at all frequencies the amplitude of the signals developed across them is always exactly alike. Hence, there is a total absence of capacitative and inductive reactance variations.

A casual study of a direct coupled amplifier schematic will disclose unusual distribution of voltages. Of course, when the plate of one tube is coupled directly into the grid of the next tube, both grid and plate have the same applied potential as measured from ground. If a careful analysis is made, it will be found that the relative voltages from cathode to control grid, plate or screen grid, are all in accordance with accepted tube ratings.

HOW WILL TELEVISION EFFECT THE RADIO INDUSTRY?

Condensed from "Radio Engineering," August, 1936

The question of when television will become an industry merely raises the related question: "How perfect must it be before the public will accept it?" Television has been improved steadily to date. Enormous sums have been expended to achieve these results. But five potent obstacles still stand against public acceptance.

1. **Demand for high quality.** The living-room group calls for a picture that all members can view without unseemly crowding, peering or eyestrain—larger than is available today. Detail must be more than tolerable. Extraneous disturbances will not be tolerated if they exist to the degree of straining the eye. Defects in appeal to the ear produce only psychological dissatisfaction, excessive volume being the only exception. Defective appeal to the eye, however, such as blurring, poor detail, flicker, extraneous flashes or dark spots, in addition to displeasing the mind, strains and hurts the eye, creating actual physical pain.

2. **Difficulties of transmission.** To avoid disturbances and fading, large numbers of transmitting stations, involving capital investment of very large proportions, must be installed.

3. **Increased cost to advertisers,**

considerably in excess of present radio cost.

4. **Competition of facsimile.** Still-picture transmission is available at infinitely less cost.

5. **Resistance of the moving picture industry,** which sees in television a potential threat to its own welfare.

None of these may be as formidable as first glance might indicate. Even high quality is not imperative in the case of "spot news" such as ball games, fights, election campaigns and similar activities. Difficulties of transmission involving definite eyestrain will doubtless be tolerated with programs of that type. The advertiser, or some advertisers, may find the cost of television programs worth while. Facsimile is relatively "dead" for spot news that will doubtless provide the earliest and most important of visual programs. Lastly, the motion-picture industry regarded radio as a potential threat and never was able to do anything successful about it.

One of the few fairly certain things about television is that it will operate on ultra-high frequencies. Transmission in the quasi-optical band requires tuned antennas for satisfactory results even with sound, and the requirements of pictures are more exacting. Hence plug-in-the-wall antennas and bell wire tied to bed springs

will be ancient history when television is an established fact.

A number of details of television receivers also fall within the province of reasonable certainties. The obvious and inevitable location of television broadcast places the design in the class of ultra short-wave receivers with rigid requirements in constructional trivia of placement of parts, wiring arrangements and grounding. The radio-frequency tuning circuits must admit a band hundreds (if not thousands) of kc in width without frequency discrimination that will be apparent in the picture, and yet cut off sharply at both ends in order to accommodate a maximum number of stations. The television cabinet must be sufficiently deep to maintain twilight recess in a well-lit room. The mere bulk of equipment involved indicates that for some years at least, if not forever, the midget or mantel-type equipment is very definitely out with reference both to size and to cost.

Requirements as to synchronization are more vague. Quite possibly power-line frequency will be used. How the amplified signal is to be re-converted into light depends upon the race for perfection in which different mechanisms are involved—and upon the patent office. The cathode-ray tube will certainly have to be larger than at present. It is also unsatisfactory both as to intensity and color. The simplicity of cathode-ray reproduction may be offset by these limitations, and leave scope for competition by other means.

WHEN METERS BLOW

By LOUIS J. FOHR, JR.

Condensed from "Electronics," January, 1937

It is the popular misconception that the meter needle is wrapped around the stop on severe overloads. By means of photographs taken at intervals of 1/600 second, it was discovered that on extreme overloads, the needle was bent in the first 1/600 second but it did not wrap itself around the meter stop. In fact, the needle point never overcame the starting inertia. The coil and movement turned 30° in 3/600 seconds, but the needle point remained stationary. When the movement reached full deflection, the needle point just started to move. In 4/600 seconds the needle gained headway, but, by this time, the coil movement bounced back on the advancing needle, and the bearing points were badly dulled and out of line. After 7/600 seconds, the coil and both hair springs burned up and released the strain on the circuit.

It must be remembered that even small overloads are apt to be the source of everlasting trouble in pre-

cision instruments. Quick shocks to the movement may cause the bearing points to become dull, which would cause the response of the meter to become sluggish. The pointer may be shifted around on the shaft or bent. In this case, the zero adjustment will not bring the indicator into even approximate agreement with the scale marking. In high grade spring-controlled instruments, every effort is made to keep the moving parts in gravitational balance. Severe shocks to the movement will change the action of the unit, which may go unnoticed for several months.

A very simple but effective cure is to fuse the meter circuit. When we consider the speed of "Old Man Overload," we can easily conclude that the fuse must act very fast or the needle will be bent. An overload of .02 amperes will blow a 1/100 ampere fuse in .1 second, but an overload of .1 ampere is interrupted in .0002 seconds, and on an extreme overload the

blowing time is instantaneous. When a fuse is used, there is no quick motion of the needle, for as the current rises, the fuse resistance also rises due to a ballast action. The ballast action and the high speed blowing of the fuse release so little energy into the meter circuit that there is no quick action to damage even the most delicate instrument.

A word may be said about the construction of a 1/100 ampere fuse. Platinum wire .000075 of an inch in diameter is soldered across a bridge of two parallel wires supported by a small glass bead, the entire unit being hermetically sealed inside a 1" by $\frac{1}{4}$ " glass tube. The fuse resistance is 116 ohms. This 1/100 ampere fuse wire is 30 times finer than a human hair; it costs \$11,280,000 per pound, but one pound would measure 25,100,000 feet; it is 16,800 times heavier than air, yet it floats in air like a spider web; it is twice the size of the 1/200 ampere fuse wire, yet both these wires are in commercial use today.

Purchased hours for the presidential election on NBC, CBS, and MBS: Republicans 68, Democrats 56.

—Radio Today, Dec., 1936.

REDUCING CODE AND IMAGE INTERFERENCE

Condensed from "Service," January, 1937

The "image" of a station appears at a point on the dial of twice the i-f peak subtracted from the fundamental frequency of the station causing the "image." The amount of "image response" depends upon the inherent design, the number of radio-frequency stages used ahead of the first detector, the amount of shielding used around the oscillator and intermediate amplifier tubes and circuits, and the power of the transmitting station.

The image response ratio for a receiver without a radio-frequency amplifier preceding the converter averages about 4 at 10,000 kc. This means that the image signal would have to be four times as strong as the normal desired signal to produce the same audio output from the receiver. With a r-f amplifier preceding the converter, the ratio increases to about 140. An additional r-f amplifier would increase it to about 5,000. A tuned pre-

selector should reduce the interfering signal by a factor of 35. Adding such a device requires an additional tuning control.

Shifting the intermediate frequency about 10 kc either way will eliminate interference only from a particular signal, and requires careful realignment of all circuits of the receiver to hold substantially the same scale calibration. When the intermediate frequency is shifted 10 kc, the image frequency is shifted 20 kc. It is important that the intermediate frequency is not shifted too much, as this may seriously affect the tracking of the r-f and oscillator.

Probably the simplest method for reducing image frequency interference is to add a wave trap in the antenna circuit. This will be fairly effective if the intermediate frequency is above 450 kc. The trap may consist of a good quality midget variable air con-

denser having a maximum capacitance of 100 mmf., and an inductance of about 4.5 microhenries. It has been found that a 1-inch diameter thin bakelite threaded form (12 turns per inch) wound with 14 turns of No. 18 B & S bare copper wire to be about right for tuning out interfering signals from 7,000 to 18,000 kc. Depending upon the antenna used and receiver coil constants, the trap may be connected with the coil and condenser in series from the antenna post to the chassis, or the coil and condenser may be connected in parallel and this shunt circuit connected in series with the antenna lead. It is desirable to shield the coil and condenser. For best results the trap should be mounted very close to the antenna terminal using short leads.

The trap may be adjusted by tuning in the desired signal on the receiver and adjusting the midget trap condenser for minimum interference from a station on the image frequency. Or, the interfering station may be tuned in at two times the intermediate frequency above the desired signal and then adjust the trap tuning for minimum response.

FEEDBACK AMPLIFIER DESIGN

By F. E. TERMAN

Condensed from "Electronics," January, 1937

The feedback amplifier can be thought of as an ordinary amplifier in which a certain amount of negative regeneration (or degeneration) has been deliberately introduced. Regeneration is introduced by superimposing upon the amplifier input a fraction β of the output voltage, so that the actual input to the amplifier consists of the signal voltage and a negative feedback voltage. If the gain of the amplifier is A , then the quantity $A\beta$ can be termed the *feedback factor*. When the feedback factor is large, the effective amplification is substantially independent of the gain actually produced by the amplifier itself. This remarkable behavior is a result of the fact that when the feedback is large, the voltage actually applied to the amplifier input terminals represents a small difference between relatively large signal and feedback voltages. A moderate change in the amplification therefore produces a large change in the difference between signal and feedback voltages, thereby altering the actual input voltage in a manner that tends to correct for the alteration in amplification.

Inasmuch as the quantity β depends upon circuit elements such as resistances that are permanent, the amplification with large feedback is substantially independent of the tube characteristics and electrode voltages. Furthermore, if the fraction β of the

output voltage that is superimposed upon the input is obtained by a resistance network, the amplification will be substantially independent of frequency and will have negligible phase shift, a property of importance in certain types of measuring work and in television. On the other hand, if it is desired to have the amplification vary with frequency in some particular way, this can be readily accomplished by making the feedback network have the same transmission loss characteristic as the desired gain characteristic.

The presence of negative feedback also greatly reduces the amplitude distortion and crosstalk produced in the amplifier. This distortion can be thought of as being generated in the amplifier, usually in the output stage. Some of the distortion is fed back to the amplifier input through the feedback circuit and reamplified in such a way as to tend to cancel the distortion originally generated. If $A\beta$ is made large by employing a large amount of feedback, the result is a very great reduction in the distortion. Noise introduced into an amplifier likewise tends to be reduced by feedback in the same manner as distortion. The reduction of noise is greatest when the point of introduction is in the output circuits of the final tube.

Amplifiers in which there is feed-

back from the output to input circuits of the same tube (or push-pull pair) use feedback from plate to grid circuits, or feedback is obtained by the use of a resistance in the cathode circuit. In two-tube feedback circuits, since there is more gain available between feedback points, it is practicable to use higher values of the feedback factor and thereby to realize to a greater extent the potential advantages of feedback. The two-tube circuit also takes care of amplitude and frequency distortion in the driver stage as well as in the power stage. When feedback is introduced in a three-stage amplifier, it will generally oscillate unless especially designed. Two of the stages should have a frequency response no wider than necessary, while the remaining stage should have uniform gain and substantially negligible phase shift to much higher and lower frequencies than the other stages.

Feedback makes it possible to operate a power tube with sufficient excitation to produce under normal conditions 25 per cent or even more distortion and so greatly increase the power output yet with low distortion in the actual output. Distortion in the driver stage such as occurs when the grid of the power tube is driven positive or when large exciting voltages are required, is likewise reduced. The presence of feedback makes an enormous improvement in the flatness of response, and causes the amplification to be virtually independent of tube voltages. The cost of this improvement, loss of gain, is readily overcome by using more amplification.

SIDE BAND SUPPRESSION IN TELEVISION

By W. J. POCH AND D. W. EPSTEIN

Condensed from "Proceedings of the Institute of Radio Engineers," January, 1937

Early television development followed the precedents established in sound broadcasting. A radio carrier was amplitude modulated by the video signals resulting from scanning and the transmission included both side bands. In the receivers, the selectivity or band width was made such as to pass both upper and lower side bands when the carrier was modulated with the highest desired modulating frequency. However, it was early determined experimentally that a better picture was obtained when the receiver was slightly detuned. Thus, by detuning, the picture carrier was placed near one edge of the selectivity characteristic.

Suppose we deliberately design a receiver so the resulting intermediate frequency is placed near one edge of the intermediate frequency circuit selectivity characteristic and so that carrier and all of one side band but only a small portion of the other side band is accepted, with the over-all selectivity being insufficient to remove entirely the second side band. We shall term this a selective side-band receiver. An immediate advantage is that we nearly double the modulation

frequency range that the receiver will pass. For circuits passing broad bands, the gain per stage is inversely proportional to the band width. If the gain per stage of the selective side-band receivers were eight, the double side-band receiver must have three additional stages to have the same over-all gain.

An experimental transmitter and receiver system, whose condition of operation could be controlled and upon which measurements could be easily made, was set up to make further investigation of this problem. Measurements of fidelity and phase characteristics were made in the video frequency range between 10 and 1,000 kilocycles. The over-all curve for double side-band operation showed a loss in response above 500 kc, due to trimming of the side bands. The over-all curve for selective side-band operation showed a nearly flat frequency response to above 1,000 kc. Tests were made on the system using picture modulation for both double and selective side-band operation. Due to additional high-frequency response, changing from double side-band to selective side-band operation

means an approximately two-to-one improvement in detail which results in a distinctly clearer and sharper picture.

If one of the side-bands is but partially suppressed, then for high percentages of modulation, any detector will reproduce not only the original modulation but also a great many others resulting from various combinations of the modulating frequencies. The introduction of these harmonics would be objectionable in the case of sound reception. However, in television it is not the frequency *per se* but rather the wave form of the signal that is important. With this effect of the second detector in mind, picture signal was again put on the experimental transmitter operating to suppress one side band and effects due to this type of distortion looked for. All observers agreed that up to the value where saturation in the modulator began to be noticeable, no difference in the picture compared to one at a lower value of modulation could be noticed. This indicates that distortion of this type causes no appreciable harmful effect in the picture and that the amount and type of distortion which can be tolerated in a picture signal is quite different than that in a sound signal.

The suppression of one side band at the transmitter becomes a very difficult problem at the frequencies which are used for television. If this can be successfully done, there will be a considerable saving in channel requirements.

A VOLUME EXPANDER THAT WORKS

By L. A. DE ROSA

Condensed from "Electrad Contact," November, 1936

One of the most noticeable faults with radio reception is that variations in loudness as they occur in the broadcast studios, are not faithfully reproduced at the receiving end. An orchestra, when it goes from a very soft passage to one in which every instrument is playing as loudly as possible, increases its power about ten million times. Even a man in ordinary conversation may change the level of his voice by 500,000 times. There is no evidence of these differences in radio or photographic reproduction.

It is evident that in the broadcasting station if the transmitter were adjusted so that it would not overload on the loudest parts of the program, then, when the softer passages were being transmitted the modulation would be so small that static and other noise interference would drown out the program. For the same reason if the phonograph recording were made with all amplitudes recorded in their proper levels, the needle scratch and mechanical noise would drown out the soft passages. In order to overcome these difficulties and still be able to reproduce these dynamic

changes in their true proportions, engineers have devised systems of amplifying the louder signals more than the softer signals, thus increasing the contrast and improving the reproduction enormously.

The operation of one system of expanding the signal is based on the change of resistance of a tungsten filament as its temperature is raised by the passage of a large current. Two bulbs form opposite sides of a Wheatstone bridge and each half of a dual variable resistor form the other two sides. When the voltage across the input to the bridge is increased, the current in both sides is increased and more heat is evolved in the lamp filaments, and, because of the high temperature coefficient of this wire, an unbalance occurs causing a current to flow between the output terminals of the bridge.

Since the change in resistance of a bulb filament is limited by its temperature coefficient, it is obvious that, in order to secure a large increase in unbalance current by a minimum increase in input voltage, the bridge should be operated at a point very close to balance. The bulbs used re-

quire an appreciable time to heat up and change their resistance. This introduces a delay and does not allow all the expansion to occur in one or two lobes of the signal wave. If the system responded instantly, the result would be a peaked wave highly distorted.

Operating the expander at low levels and near its balance point is accomplished by inserting the expander after the first tube of the audio amplifier, and following it by additional amplification and the output stage. If the bridge is balanced for a just audible signal, then any slight increase in signal amplitude will result in a huge change in contrast. If the resistances are made less than the bulb resistances at low volumes, then the expansion will not be as great. If, on the other hand, the resistance arms are made greater than the bulb resistances, then an increase in signal will result in a decrease in output and compression will result.

Until broadcast transmitters incorporate compressor circuits, the use of an expander at the receiving end is apt to be a bit disappointing, especially if the control man at the transmitter is over-zealous. However, the expander will assist greatly in improving the naturalness of recordings and also of some types of broadcast programs.

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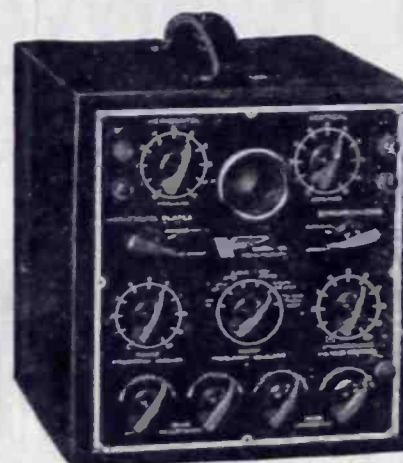
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