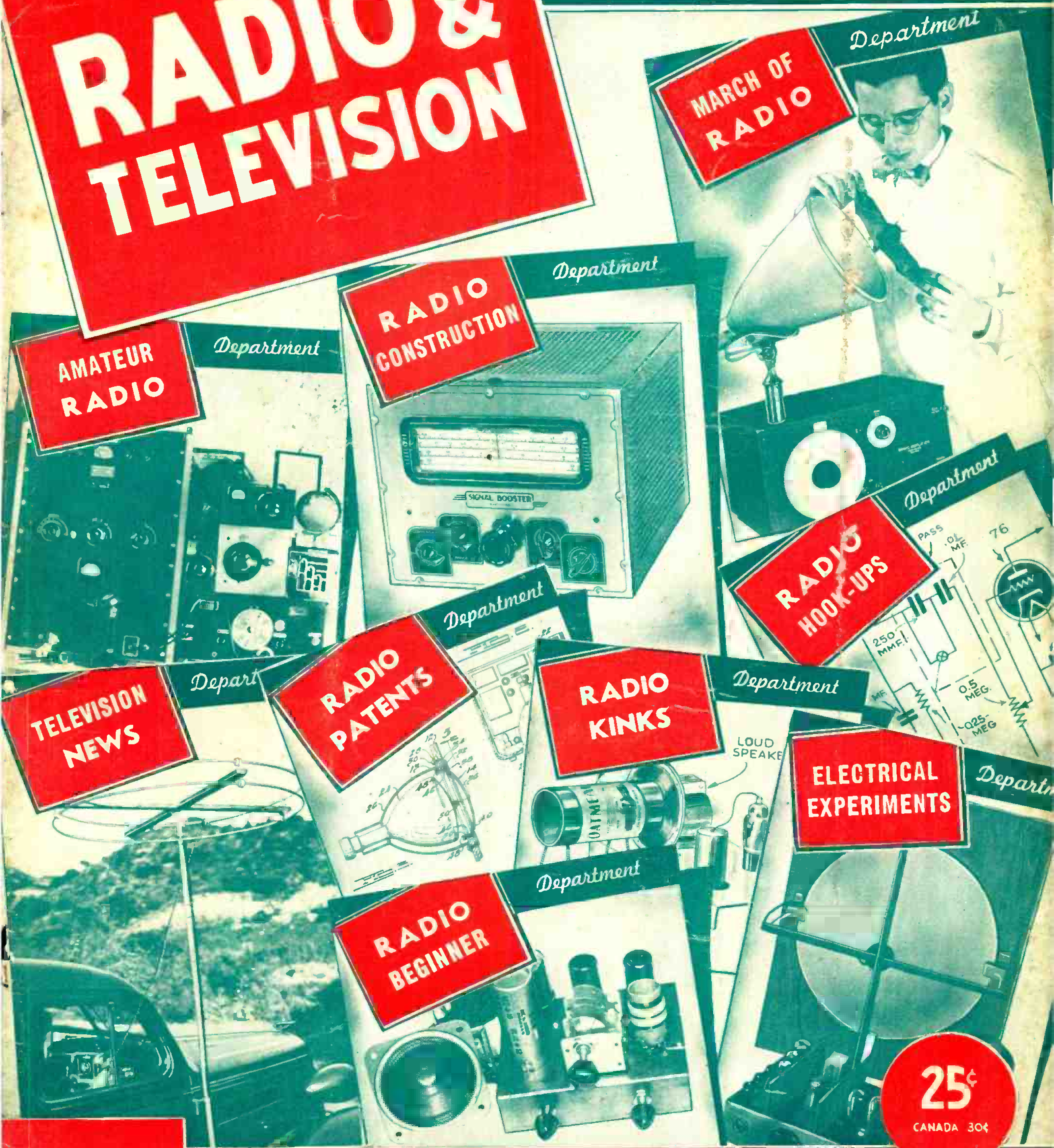
RADIO'S *Complete* MAGAZINE

RADIO & TELEVISION



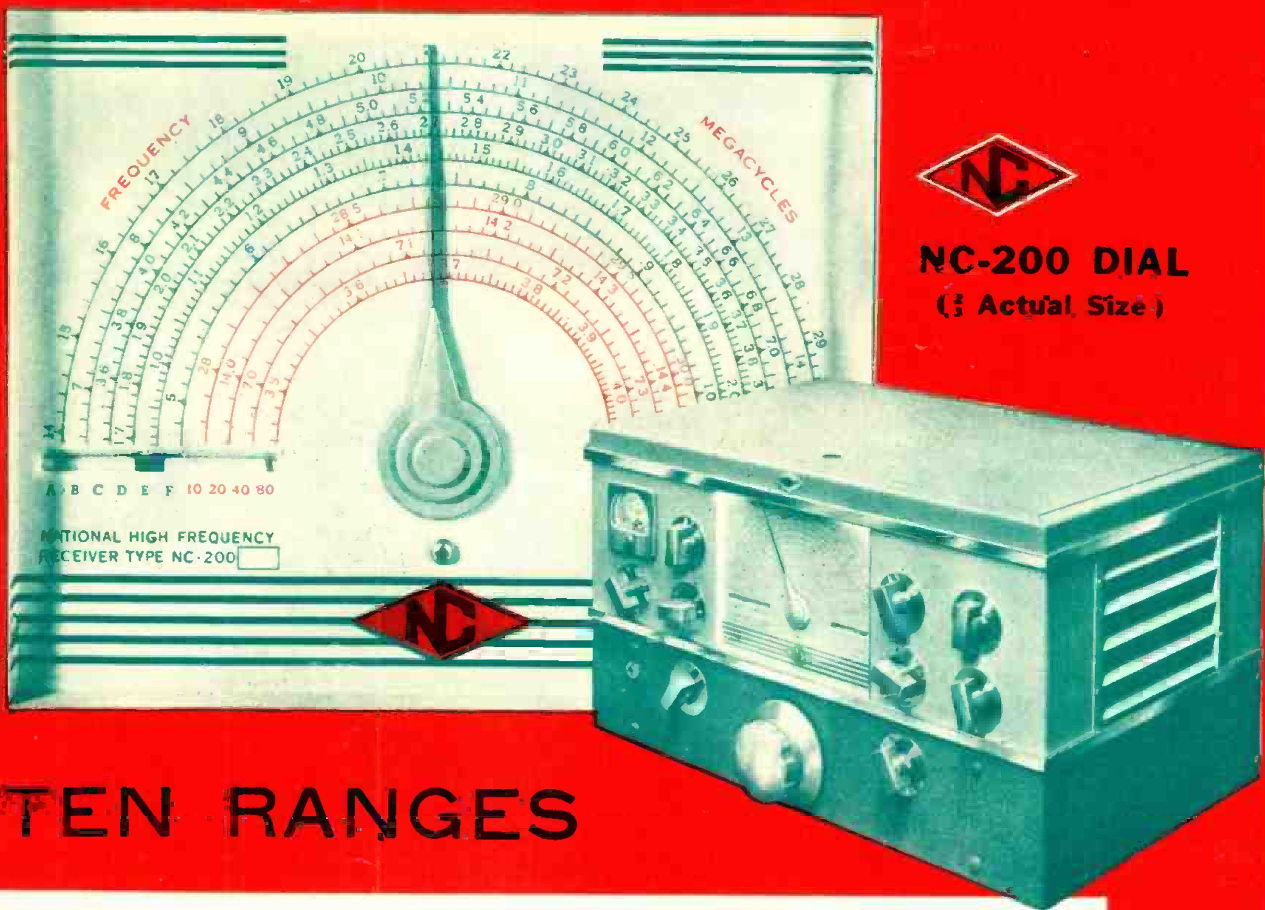
25¢
CANADA 30¢

HUGO GERNSBACK
EDITOR

AMATEUR & EXPERIMENTAL RADIO

CONSTRUCTIVE RADIO ARTICLES

APR.
1941



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(½ Actual Size)

TEN RANGES

The NC-200 has ten calibrated coil ranges, as shown on the dial above. Six of these ranges provide continuous coverage from 490 KC to 30 MC. The remaining four ranges cover the 10, 20, 40 and 80 meter amateur bands, each band being spread out over the major portion of the dial scale. Each bandspread range is independent of the other ranges. Its calibration is fixed, it is tuned by the main tuning control, and its frequency is read by the big sweep pointer on the dial. And as a final assurance of logging free from errors, automatic indicators are always in view opposite each end of the scale in use.

OTHER FEATURES OF THE NC-200

- Sensitivity better than one microvolt
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NATIONAL COMPANY, INC.
MALDEN, MASS., U.S.A.

J. E. Smith, Pres.
National Radio
Institute
Est. 25 Years

I WILL TRAIN YOU TO START
A SPARE TIME OR FULL TIME
RADIO SERVICE BUSINESS WITHOUT CAPITAL

I Trained These Men

I Trained These Men

N. R. I. MEN WORK IN THESE BRANCHES, TOO

(Above) Broadcasting Stations employ operators, installation, maintenance men and Radio Technicians in other capacities and pay well.

(Above) Radio Jobbers and Dealers employ installation and servicemen at good pay.

(Above) Loud Speaker System is another field for Radio Technicians.

(Left) Police, Aviation and Commercial Radio are newer fields for which we give the required knowledge of Radio.

These Men Have SPARE TIME BUSINESSES

"I repaired many Radio sets when I was on my tenth lesson. I really don't see how you can give so much for such a small amount of money. I made $600 in a year and a half, and I have made an average of $10 to $20 a week—just spare time."
JOHN JERRY
1529 Arapahoe St., Room 17, Denver, Colo.

"I am now making from $10 to $25 a week in spare time while still holding my regular job as a machinist. I owe my success to N.R.I."
WM. F. RUPP
611 Green Street, Bridgeport, Pa.

"I am doing spare time Radio work, and I am averaging from $700 to $850 a year. Those extra dollars mean so much—the difference between just barely getting by and living comfortably."
JOHN WASHKO,
97 New Cranberry, Hazleton, Penna.

These Men Have FULL TIME BUSINESSES.

"For the last two years I have been in business for myself making between $200 to $300 a month. Business has steadily increased. I have N.R.I. to thank for my start in this field."
ARLIE J. FROEHNER
300 W. Texas Ave., Goose Creek, Texas

"Before taking your Course I earned about 17½ cents an hour as a truck driver. When I had completed 20 lessons I started service work. During the last two years I have made about $3,000 in Radio. I now own my own shop."
KARL KELLY,
409 W. Calhoun St., Magnolia, Ark.

"I am making between $50 and $60 a week after all expenses are paid, and I am getting all the Radio work I can take care of, thanks to N.R.I."
H. W. SPANGLER
126½ S. Gay St., Knoxville, Tenn.

The world-wide use of Radio has made many opportunities to have a spare time or full time Radio service business of your own. Over 28,000,000 homes have over 40,000,000 Radios. There are more Radios than telephones. Every year millions of these Radios go out of date and are replaced. There's an opportunity to earn good commissions selling new sets. Millions more need new tubes, servicing. I will train you at home in your spare time to sell, install, fix all types of Radios; to start your own Radio service business and build it up on money you make in your spare time while learning. You don't have to give up your present job, or spend a lot of money going away to school to become a Radio Technician.

BEGINNERS QUICKLY LEARN TO EARN $5 TO $10 A WEEK EXTRA IN SPARE TIME

I start sending Extra Money Job Sheets the day a student enrolls—start showing how to do Radio repair jobs. Throughout the Course I send additional plans and directions for doing increasingly complicated, better paying jobs. That's why many students make $5 to $10 a week extra in spare time; why many start building their own Radio service businesses while learning.

I TRAIN YOU FOR GOOD JOBS TOO MANY PAY $30, $40, $50 A WEEK

Anyone can tune a Radio set, but few can service one. That's why many Qualified Radio Technicians make such good money installing, fixing, selling home and auto Radio Sets, operating and maintaining Broadcast, Police, Aviation, Commercial Radio stations; selling, installing, servicing Loudspeaker systems. That's why many open their own Radio sales and repair businesses and make $30, $40, $50 a week. Why others hold their regular jobs and make $5 to $10 a week extra fixing Radios in spare time.

HOW I GIVE YOU PRACTICAL EXPERIENCE

I send you special Radio equipment; show you how to conduct experiments, build circuits illustrating important principles used in modern Radio receivers, broadcast stations and loudspeaker installations. You work out, with your own hands, many of the principles you study in our lesson texts. YOU ALSO GET A PROFESSIONAL ALL-WAVE, SET SERVICING INSTRUMENT.

YOU LEARN TELEVISION, "F-M", ELECTRONICS

The N. R. I. Course is up-to-date. You are taught how to install, adjust, service Television receivers and antennas. You learn about Frequency Modulation transmitters and receivers; you learn the principles of electronic control equipment, such as photoelectric counters, safety devices, electric eye burglar alarms, etc.

FIND OUT HOW I TRAIN YOU AT HOME

Act Today. Mail the coupon now and I will send my book, "Rich Rewards in Radio," and a Sample Lesson free. Find out what Radio offers; what opportunities are coming in Television. Read the details of my Course in Radio and Television; read more than 100 letters from men I have trained: what they are doing, earning. Read my Money Back Agreement. MAIL COUPON BELOW in an envelope or paste on a postcard—NOW.

J. E. SMITH, President
National Radio Institute, Dept. 1DB3
Washington, D. C.

DRAFT REGISTRANTS!

Hundreds of men who know Radio when they enter military service are going to win specialist ratings in the Army, Navy and Marine Corps. These ratings pay up to 6 times a private's or seaman's base pay, in addition to carrying extra rank and prestige! If you ARE NOT called, you are getting into Radio when the Government is pouring millions into the Radio industry to buy Defense equipment, on top of boom civilian Radio business. Whether you enlist or wait for conscription—IT'S SMART TO LEARN RADIO—NOW!

SAMPLE LESSON FREE

I want to prove our Course gives practical, money-making information, that it is easy to understand—what you need to master Radio. My sample lesson text, "Radio Receiver Troubles—Their Cause and Remedy," covers a long list of Radio receiver troubles in A.C., D.C., battery, universal, auto, T.R.F., superheterodyne, all-wave, and other types of sets. And a cross reference system gives you the probable cause and a quick way to locate and remedy these set troubles. A special section is devoted to receiver check-up, alignment, balancing, neutralizing, testing.

You can get this lesson Free by mailing the coupon.

Mail Now

GOOD FOR BOTH 64 PAGE BOOK SAMPLE LESSON FREE

J. E. SMITH, President, National Radio Institute
Dept. 1DB3, Washington, D. C.

Without obligating me, mail your Sample Lesson and 64-page Book FREE. I am particularly interested in the branch of Radio checked below. (No salesman will call. Write plainly.)

- ☐ Radio Service Business Of My Own
- ☐ Service Technician for Radio Stores and Factories
- ☐ Spare Time Radio Servicing
- ☐ Auto Radio Technician
- ☐ Operating Aviation Radio Stations
- ☐ Operating Broadcasting Stations
- ☐ Army, Navy Radio Jobs
- ☐ Operating Police Radio Stations
- ☐ Operating Ship and Harbor Radio

(If you have not decided which branch you prefer—mail coupon for facts to help you decide.)

Age ....

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Address ....

City .... State 14X1

RADIO & TELEVISION

The Popular Radio Magazine

April — 1941
Vol. XI No. 12

HUGO GERNSBACK, Editor
H. WINFIELD SECOR, Manag. Editor
ROBERT EICHBERG, Television and Digest Editor

In May Issue

A Simple Signal Tracer

A Universal Antenna Tuner for the Ham—Herman Yellin, W2AJL

Recording on Acetate Discs—A. A. Schmitt

The "Musicaster"—H. G. Cisin

A Fixed-Frequency "Booster Amplifier" for Television—Thornton Chew

A Simple 100-Watt Exciter or Transmitter—Harry D. Hooton, W8KPX

How Superhets Work

In This Issue

GENERAL FEATURES

RADIO CONSTRUCTION

AMATEUR RADIO

NEW FEATURES

TELEVISION NEWS

MISCELLANEOUS

Certified Circuits

When you see this seal on a set it is a guarantee that it has been tested and certified in our laboratories, as well as privately in different parts of the country. Only constructional—experimental sets are certified.

You need not hesitate to spend money on parts because the set and circuit are bona fide.

This is the only magazine that renders such a service.

Cover Composition by Hugo Gernsback and Thomas D. Pentz

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What Do YOU Think?

Liked 3-Tube Construction Article

Editor:

I am a beginner in radio and enjoy reading RADIO & TELEVISION. In your April 1940 issue I was impressed with an item written by H. G. Cisin on "Tips for Radio Beginners." I built the three-tube battery set with little difficulty, and the reception I accomplished with a 5" P.M. speaker is more than I expected. I think many others had the benefit of Mr. Cisin's ideas.

I am looking forward to finding more helpful information in your future issues.

CHARLIE ROMANO,
Northfield, B. C., Canada.

He Finds Everything in R.&T.

Editor:

I think you have a very good publication, because I have found everything from the simplest circuit to the most complex in it. It's good to be able to pick up your magazine and get an idea of how *Television* and *Frequency Modulation* are progressing. Although amateur radio is off the air here, it is still of interest to a beginner, like myself, and I'm beginning to understand a little about transmitters and all the amateur jargon.

D. CRONER,
Vulcan, Alberta,
Box 528,
Canada.

He'll Subscribe for 3 Years

Editor:

To tell you the truth, the magazine is a "dandy." In fact, I think that it is one of the best radio magazines on the market today, but I am now in the California National Guard and going away for a year's training. I probably won't find much time in which to read the magazine, but I will buy it at the newsstands while on maneuvers.

When my year's training is up, I only hope that you will have me back in your ranks as a steady customer, because I am going to subscribe to it for at least three years. RADIO & TELEVISION can't be beat.

EDDIE DARBY,
Oakland, Calif.

One-Tuber Works Fine

Editor:

I am a constant reader of your magazine and I have built one of your one-tube receivers and it works fine. I have heard KC4USA, CE1AO, CO8MP, CO2GL, KA7LZ, VK2ME and several others.

I agree with Charles Mourmouris, that you should have a picture contest for SWL's.

I am a 100% SWL and will QSL for anyone with any kind of a card.

VERNON LEE GIBBS,
Route 5, Lexington, Ky.

Of Interest to SWL's

Editor:

I have read your magazine for exactly nine months and I appreciate it a great deal. I started sending out SWL cards about a month ago. I get my complete lists from your magazine. I find that not all listed in your SWL column send out cards.

I have joined a club for the SWL swappers and I believe that we have a good plan.

All members of the club keep track of their cards sent out and received. We send these lists into the head office. We publish a bulletin every two months that contains the names and QRA's of those who have answered 100%. This enables every member to get 100% verification of his cards. Please include the contents of this letter in your magazine and thus a great many SWLers can get in touch with me to join our club, the SWLR. I QSL 100%.

Thanks a million.

CLYDE MOSS, JR.
586 Lynn Street,
Chillicothe, Ohio.

He Likes Our Circuits

Editor:

I like RADIO & TELEVISION magazine—especially the three- and four-tube receiver and the phono-oscillator circuits. I should like to see more of these circuits in future issues.

I am wondering if you couldn't include, in some future issue, diagrams for obtaining a power-supply for D.C. circuits, by making use of some rectifier tube.

LEWIS ORLOWSKI,
856 Nott Street,
Schenectady, N. Y.

(*Continued on page 767*)

Radio City, New York, world center of broadcasting, where several thousands of radio's 400,000 workers are employed

Your Radio Helps Employ 400,000 People!

As you listen to the radio, do you ever stop to think of the thousands of people employed because you own a radio set—because you are listening? The radio industry employs directly 400,000 persons, and indirectly hundreds of thousands of others. From the research laboratory to the song on the air, the employees of radio are at your beck and call. They earn their living in jobs which only two decades ago did not exist.

An Endless Procession of Workers

Long before the radio set "went on the air" in your home it helped to give employment to an army of workers from lumbermen to cabinetmakers, from the miners who mined the copper and iron, to the electrical engineers who designed the circuits that perform the magic. And, of course, there are those who fashion the metal chassis; those who make the plastics and the vacuum tubes.

Radio employment is an endless procession—as endless as the production belts that constantly carry new instruments to the public, or the research that constantly plans improved instruments for the future. There are factory workers, salesmen, advertising men, artists, printers, wholesalers, retailers, and many others who work in radio because people in the United States have installed 50,000,000 radios in their homes and automobiles, and will want 10,000,000 more radios this year.

The People Behind the Programs

Each broadcast program has its actors, but behind every voice or song you hear, behind every comedian, opera and drama, are the program planners, script writers, technicians, announcers, sound-effects men, control operators, and thousands of clerical helpers. Broadcasters alone employ many thousands of men and women in 850 stations, while radio-telegraph stations ashore and afloat, aircraft and police radio, add greatly to the roster of radio and to the payrolls of America.

New Gateways of Employment

Constantly developing new products and services through research, radio is ever widening the gateway of employment. Television holds the promise of another new industry developed by American enterprise, to create employment and raise the American standard of living.

Through the purchase of a radio you did your bit as an employer of people unseen, and that role is always yours as long as you own a radio—while it works for you it enables others to work, too.

RCA RADIO CORPORATION OF AMERICA

RADIO CITY, N. Y.

RCA Manufacturing Co., Inc. • Radiomarine Corporation of America • RCA Laboratories
National Broadcasting Company, Inc. • R. C. A. Communications, Inc. • RCA Institutes, Inc.

Readers' Editorials

What Amateurs Can Do

RADIO IN DEFENSE

● RADIO can aid materially in our defense against "fifth columnists," the spore taking root in this country. Insignificant as it may seem—why not an army of selected amateurs and radio men, armed with special monitoring equipment, whose sole job will be tracing suspicious "bootleg" signals to their source, investigate the real motives for their (operator's) actions, and report their findings to the proper authorities?

ANTHONY GUIDE,
15 Wolcott Street,
Malden, Mass.

GOOD OPERATING PRACTICE

● MANY amateur radio operators, both young and old, look upon the amateur regulations with disgust and think of them only as a set of rules which should not be applied frequently. Just how many amateurs do you hear on the air today who have unmodulated carriers, who fail to sign their call when throwing off the carrier, or who let some visitor (especially when working "break-in") in the shack, sign their call when they themselves should sign the call letters of the specific station? These certain types of amateurs are too numerous to mention. If you do not believe this statement to be true, just listen in on the 160 meter amateur band some afternoon, and try to count the number of amateur stations that have these faults. It is true that an amateur might not be in a position to improve his modulation, or get rid of a harmonic, but the least he can do is to *abide by the regulations* which are in his power to control—such as using a dummy antenna when testing, or testing with a modulated carrier. We must think of the *Federal Communications Commission* as our employer, who grants us certain rights or privileges, but who in turn expects the best that he can get out of us. If we abide by the Federal Communications Commission regulations, we might be ahle to get an extension in frequency of our amateur bands—or better yet, get a few *new* bands.

In order to improve our amateur standing in the eyes of the Commission, let us look over the amateur regulations, but don't only read them, *put them to use,* and I am sure that the radio amateur will be recognized as a *radio operator,* and not frowned at as just "hams." Please remember, fellows, that you took an oath to abide by these amateur regulations. *See to it* that this oath remains unbroken.

JOHN FITZPATRICK, W2NPL,
18 First Street,
Port Reading, N. J.

> **Prize Award**
> **PILOT**
> **"The Clipper" Receiver**
> **15-53 M. & B.C. Bands.**
> **Value $52.50**
> **Awarded to Anthony Guide for his Guest Editorial**
> **All others receive a year's subscription**

PLEASE QSL!

● HOW often I have heard this simple but age-old request and given it myself. Yet how often we fall down on our promises. One of the chief values of Ham radio is the fraternity it offers with all types of boys and girls, and surely no O.M. or Y.L. is old! Amateur Radio was what Ponce de Leon was unknowingly searching for in his fountain of perpetual youth!

But what fun is radio, if there is no one you can think of who will hear you, slap on his carrier, call your name, know your habits, your likes and dislikes, and treat you like an old friend? What better way of cultivating such a friendship than beginning with a QSL? You've begun your friendship with a QSO—now bind it with a "veri."

Not only do I want QSL's from my DX contacts, but from my neighbor as well. It affords a wealth of information concerning the particular Ham and Ham radio. See what big dividends can be reaped from a one-cent stamp and thirty seconds time? It perpetuates the memory of you and your signal in the minds of fellow Hams, and more than likely they will give you a call next time you're on.

I don't know who sent the first QSL; who started this fad of papering the shack with "veris"—colorful, exciting and reminiscent of happy hours—but praise be his name! Let's erect a statue of him in the town square!!

ROBERT HARRISON,
Obion, Tenn.

HAMS FOR AIR DEFENSE

● WE all know that the Ham is always ready to do all that he can to help out in any emergency that may come up at any time. Just at present there is a wonderful opportunity to help out the army in its new defense program. They should form an organization of all operators to aid in the air defense warning system. This could easily be done by having an operator, with a portable set, at all lookout stations to send information to the army base, and at other posts along the courses taken by the planes. In this way all stations and bases, at the same time, will know at once just where the planes are heading, and not have to depend on the telephone, which only lets the army bases know where they are. If there are not enough operators to go to all the different stations, have short-wave listeners take over some of the stations, so that they will know the course that the planes are taking, and they can be on the lookout for them and be prepared to warn the bases, by telephone, that they are in their location.

LESTER F. CHESSMAN,
4 Pleasant Street,
Dorchester, Mass.

RADIO AND A FUTURE WORLD

● OF the thousands of cards I have received from amateurs and short-wave listeners throughout the world, none has left such a vivid impression on my mind as a five-word phrase contained in the SWL card of Niccola Cannata, well-known Chicago experimenter and listener. *"Worldwide Friendship Is My Aim."* Contained in this simple, homely phrase is the amazing reason for the fact that within our own lifetime, amateur and experimental radio has risen from nothing to a position of universal dignity, with a background of ethics, cooperation and fair play.

What is it that has made this hobby such a notable contribution to contemporary twentieth century life? The central idea to the short wave listener and the amateur is the means of communication with others on equal terms, of finding friendship, adventure and prestige, while seated at his own fireside. In picking his human

(Continued on page 768)

FCC Observes Television Progress

Members of the Federal Communications Commission, accompanied by members of the National Television Standards Committee, saw virtually all major television developments in the East during a two-day trip of NBC, CBS, Du Mont, Bell Laboratories and Scophony. If you had been a member of the FCC, the following is what you would have seen:

At 10:30 on a Friday morning the tour commenced in the Du Mont Labs. Mr. Du Mont believes that the future of television will be better established through the use of fewer frame frequencies, his demonstration was largely concerned with a presentation of this principle. The first part of the demonstration was of some amateur motion pictures, one film being taken at 24 frames (which is roughly the present television standard frame frequency) and another reel taken at 16 frames (15 frames being the Du Mont proposed standard). The company engineer who gave the talk accompanying the picture showing stated that there was no noticeable flicker introduced at the lower frame frequency. While this was perfectly true of slow moving objects or those at some distance though moving perpendicular to the camera, some observers commented on the fact that there was noticeable jerkiness when objects close to the camera moved across its plane.

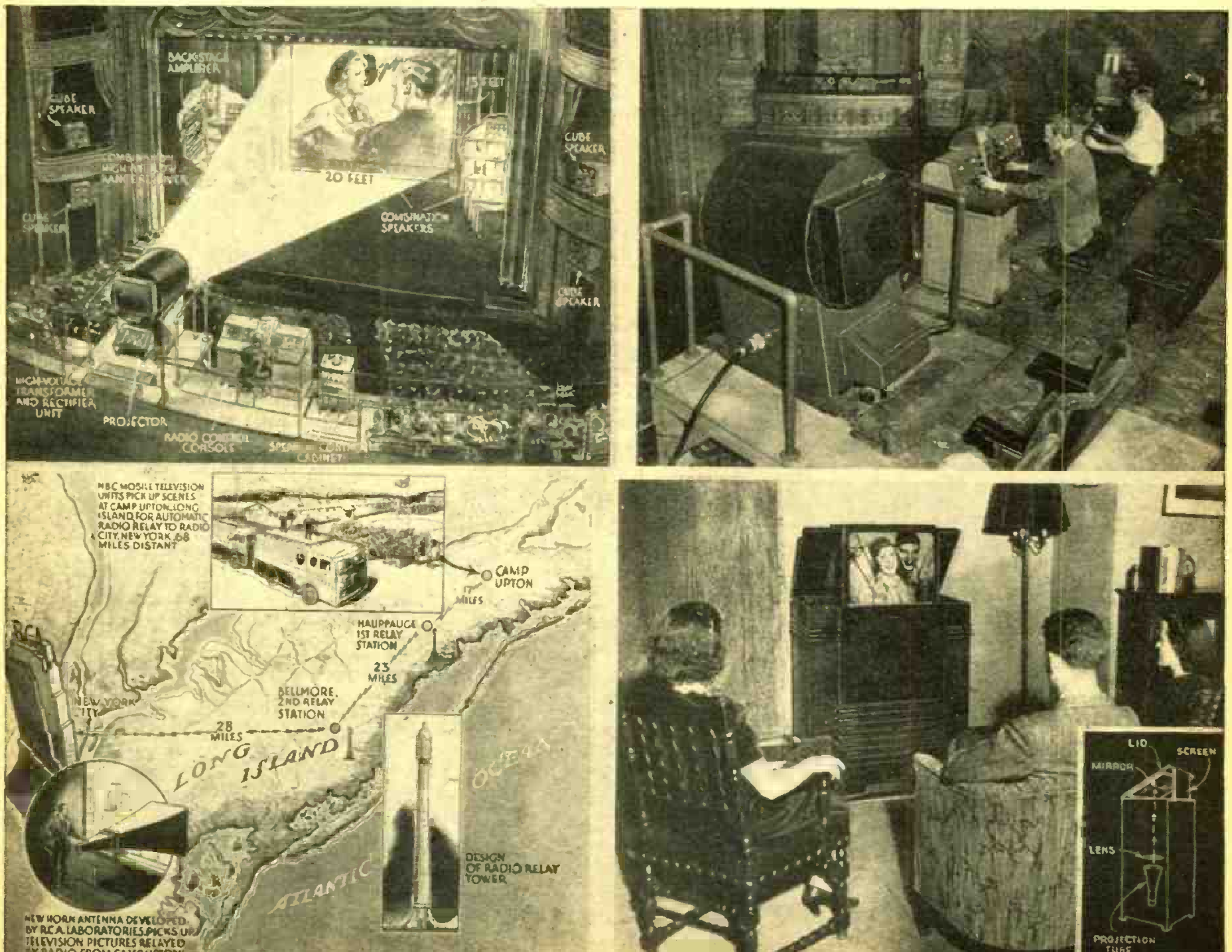
In the demonstration of the Du Mont receiver using the longer persistence screen which this company advocates, the subjects televised were principally stationary objects, so it was impossible to determine what effect rapid motion such as is sometimes encountered in a television play—and always in a sporting event—would have had. The image shown was on the 20-inch tube and its size apparently impressed most observers favorably.

The next stop on the television tour was at NBC, where a new developmental type of home receiver was shown. In this receiver the projector tube working at 28,000 volts threw excellent images on a translucent screen measuring 13½ x 18 inches! The receivers used were standard TRK 120's (the standard 12 inch cathode-ray type) changed only in that the screen was installed, the 12-inch tube replaced with a small *projection tube* and projection lens, and a higher voltage power-pack substituted for the 7,000 volt one usually employed. An ingenious system makes it unnecessary to use any heavy filtering on the high voltage power pack. Observers were impressed by the size, brilliance, and contrast range of the pictures, which included subjects of various types from maps and charts to fast moving dance acts. The images approximated home motion pictures in size, apparent detail and brilliance, and observers were enthusiastic. One interesting feature of the demonstration was a pick-up from an army camp 68 miles away, the transmission being conducted by *radio relay*.

Following a buffet lunch, the tour next went to the New Yorker Theater, where motion picture *screen size* television had been installed by RCA. So sensational was the excellence of the pictures that even the hard-boiled newspapermen present broke into spontaneous applause. The screen was 15 x 18 feet in size, apparently as brilliant as standard theater movies, and with all the detail and contrast range that one could desire. The projection tube was operated at approximately 60,000 volts. As a special demonstration, an image picked up in Radio City was relayed around a loop of approximately 100 miles and received in the theater with very little loss of contrast and detail. This is important in that it demonstrated the possibility of using television for important news coverage to remote points.

Bell Labs. and Scophony progress was described before; CBS on the next page.

Upper left, RCA theatre installation; upper right, close-up of projector. Lower left, layout of television relay; lower right, large screen home receiver.



CBS MAKES LIVE PICK-UP IN COLOR TELEVISION

The first public showing of color television in which the program material consisted of *direct pick-ups* using the CBS system designed by Dr. Peter C. Goldmark, the company's chief television engineer, was made for the New York convention of the Institute of Radio Engineers. The transmitter was located on the fifth floor of the CBS building and the images were transmitted by co-axial cable across the street to the basement of another Columbia building. Three receivers were used—a special large table model with a built-in Goldmark color wheel, a standard console model with the wheel installed as an accessory, and a standard black and white model. A 9-inch C.-R. tube was used in each set.

As standard black-and-white pick-ups generally require illumination of 800 to 1200 foot-candles on the subject, some television engineers believed that so much heat would be generated in providing enough light for color television that actors would find it unbearable. Nevertheless, it was stated by persons in charge of the demonstration that the illumination used for the color transmission ranged only from *110 to 200 foot-candles*. This was explained as being made possible by the use of an orthicon tube. Specially sensitive orthicons, to require even less light, are in the process of development, according to CBS informants.

The specially designed and constructed table model receiver incorporates two important features not previously demonstrated to the public. The first of these is a method of synchronizing the color disk in the receiver with the color disk in the studio by the synchronizing impulses ordinarily transmitted. This means it is no longer necessary to rely upon 60-cycle current for synchronizing the disks, and permits reception of color pictures when a receiver and transmitter operate from different power supplies.

This receiver also has a simple method of phasing the color disk so that the colors shown at the receiver can be "locked" to the colors being picked up. The viewer at home has only to push a button on the cabinet's side until the picture appears in its proper colors, then release the button. The colors remain properly synchronized with those of the original scenes.

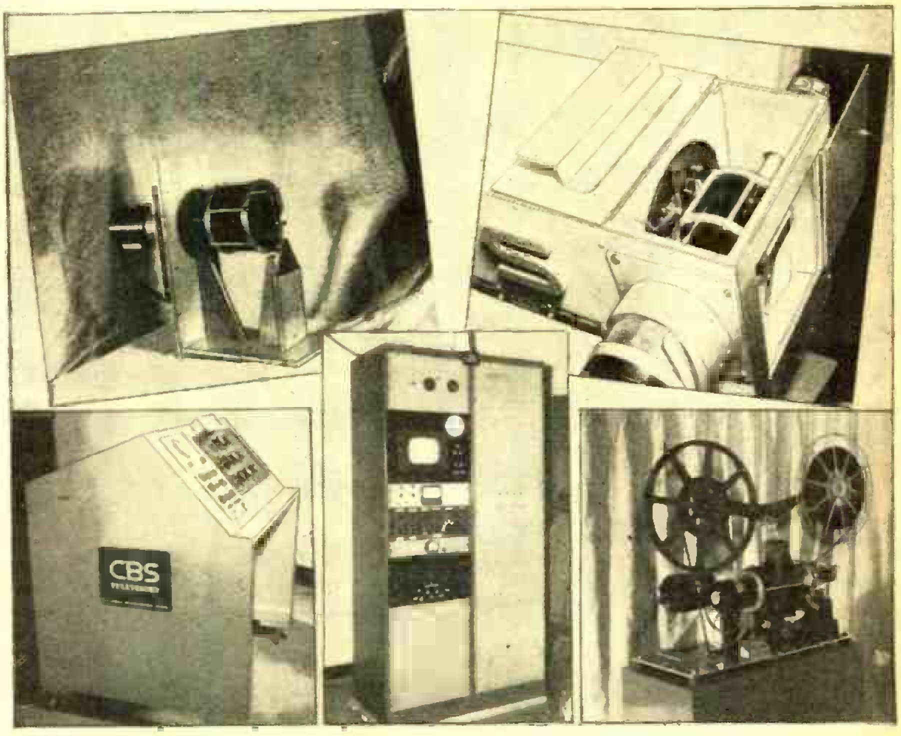
During the demonstration, a new system of low intensity fluorescent lighting was used. These lights eliminate most of the glare from the eyes of the person in front of the camera and are "cold light" so that no discomfort is experienced. They were developed in the Columbia Broadcasting System television laboratories.

The demonstration showed substantial progress along new fronts such as: direct pick-up itself; synchronization of color disks; phasing of color disks, and new lighting methods for color television.

Among the material televised was a test chart, maps and globes of the world, fabrics, sheer stockings, confetti, a pair of gloves (1 green and 1 lavender glove were worn by the model—the fact that they did not match could not be observed on the black and white image tube), an ink chart, an experiment in dyeing, a magician's trick in which silks changed colors as they were drawn through the performer's hand, a kitchen scene with a salad being mixed, and a girl's head. Various color effects were introduced on the latter.

In conclusion Dr. Goldmark stated: "The results, thus far, in all phases of color television are most encouraging and it would appear that an answer has been found to every fundamental problem. From now on, I think, we can progress steadily, even if we have nothing more than straightforward engineering effort looking toward commercial application. Today color television is in the laboratory, but with the co-operation of the industry, I do not think it will be there long."

"Engineers'-eye view" of CBS studio during a color television program. This shows rear of apparatus. Insert is front view of equipment, as seen by person being televised.



Upper left—the color filter drum which forms the heart of the CBS television scanner. Upper right—the drum in position around the orthicon. Lower left—control bench. Center—the amplifier rack, with CR tube for monitoring programs. Lower right—the film scanner for color television. Note: The receiver looks just like any black and white receiver from the outside, but inside there is a color filter wheel about twice the diameter of the viewing screen. This was described in a previous issue of RADIO & TELEVISION.

NEW F.M. STATION FOR ARMSTRONG

Three more licenses for frequency modulation *broadcast* stations were granted March 5th by the F.C.C., making 42 such awards to date. Major Edwin H. Armstrong is authorized to erect at Alpine, N. J., a Class D F.M. broadcast station operating on 43,100 kc. It should reach a population of 12,200,000. The Stromberg-Carlson Telephone Manufacturing Co., Rochester, N. Y., received a grant to operate on 45,100 kc. A new Chicago F.M. station will be operated by the Moody Bible Institute on 47,500 kc.

F-M Continues Progress Ashore, Afloat, and Commercially

Three additional F-M stations have recently been authorized, making the total about 30 okayed by the FCC for full commercial service. CBS has received a construction permit for a 46.7 mc. station to be located in Chicago. Station WJJD of the same city has received a like permit for 44.7 mc. The third permit is to Westinghouse, which will operate on 44.5 mc.

In Syracuse, New York, the Central New York Broadcasting Corp. will operate an F-M station on 46.3 mc. The Commission waived certain technical requirements to expedite the operation of this and other stations. It also announced certain modifications in the New York and Philadelphia areas. For example, WCAU in Philadelphia will operate on 46.9 mc. instead of 46.7 and CBS will operate on 46.7 instead of 48.8 mc. The call letters have been changed accordingly.

At the same time, General Electric announces a new F-M station monitor which acts as a center-frequency monitor, modulation monitor, high-fidelity audio monitor and flasher-type modulation-limit indicator.

This company also has installed F-M radio equipment for two-way communication between United States quarantine tugs and Quarantine Administration Headquarters at the Customs House, Boston, Mass. The tugs go out five miles to inspect all vessels entering the port of Boston and the F-M equipment will permit them to communicate with the Custom House when returning to shore to check records. The radio equipment in each vessel consists of a 25-watt F-M transmitter and a receiver. This is shown in one picture with Dr. J. M. Chisholm, Quarantine Officer, U.S. Public Health Service, Boston, Mass., talking from a tug to Quarantine Administrative Headquarters. The other illustration shows Dr. R. E. Bodet, Senior Surgical Medical Officer in charge of U.S. Quarantine Station, Boston, Mass., talking to the tug over Headquarters equipment. The antenna is on the 20th floor of Headquarters building. Tests have shown that the two-way transmissions are noise-free for distances up to 30 miles—six times the distance they will normally be required to cover. The ship picture is at the left, headquarters at right, below.

BRITISH STATIONS KEEPING COOL UNDER FIRE

If ever a country at war kept its head and went along in its usual way despite the fact that enemy bombs were wrecking its cities, that nation is Great Britain. Very calmly Air Marshal Sir Philip Joubert told listeners why in certain parts of the country good reception had to be sacrificed.

"You may have had difficulty," he said, "in getting the news on nights when there have been air-raids. The reason for this is that a broadcasting station is a very good navigational help to anybody flying towards it. To avoid giving this help to the Germans, we, at the outbreak of war established a system which confused the transmissions from the navigational point of view. This system, I'm sorry to say, is apt to spoil reception in this country at certain places, but the Royal Air Force must accept the responsibility. Remember that in Germany they stop broadcasting altogether at certain hours, in order to avoid giving us any navigational help . . . . this trouble is not due to BBC inefficiency, but to a wise precaution that has to be taken."

It is significant that not only German stations go off the air when the R.A.F. is carrying out its nightly attacks, but that stations in adjacent countries under Nazi domination or influence are also shut down. There is, in fact, a *radio curfew* over the greater part of the continent of Europe.

The accuracy of Air Marshal Sir Philip Joubert's statement was conclusively proved only five days after his broadcast, when Deutschlandsender, the German long-wave station, broadcast a statement to the effect that special war conditions had made it necessary to close down certain German stations "rather early" in the evening hours. Then followed the names of twenty-eight transmitters—Berlin, Bremen, D a n z i g, Munich, Vienna, Prague and Warsaw among them—that closed down at 18.15 GMT. Deutschlandsender, it was said, would normally continue transmission until 20.15 GMT, but "German listeners in the entire Reich territory can hear Breslau until midnight (GMT) with certainty."

On the evening of the announcements, Deutschlandsender suddenly closed down at 17.30 GMT, and Breslau was off the air for an hour and a half in the middle of the evening.

RED HOT DEBUNKING

If you have a short-wave receiver capable of picking up Australia, you can get some news broadcasts which have been termed even more pungent than those originating in Germany. The stations are VLQ5 on 30.99 meters at 7:20 a.m., E.S.T., and VLQ7 on 25.25 meters at 7:20 a.m., P.S.T. Their evening transmission times are VLQ7 at 4:55 p.m., E.S.T., and 9:55 p.m., P.S.T.

Australia feels that its special function is to represent and interpret the British Commonwealth of Nations to the countries of the Western Pacific. The programs are intended to strengthen and extend existing bonds of interest and friendship between the United States and its fellow democracy in the southwestern Pacific.

FCC TO SETTLE TELLY

In latter January a television report was made to the FCC and a further hearing was scheduled for March 20th, at which time it is hoped that standards will be definitely established and television given the "go ahead" signal.

WBBQ Goes Off the Air as FCC Cracks Down

Radio listeners around the area of Hubbell, W. Va., were annoyed by the programs of WBBQ. Alleged entertainment from this station interfered with regular broadcasters and with amateur transmissions throughout the area. Knowing that no station had been assigned the call letters WBBQ, field inspectors of the FCC, acting in cooperation with the local United States Marshal, tracked down the illegal station. They found a young man operating a 25-watt transmitter with a vertical steel radiator and promptly arrested him, charging him with violations of sections 301 and 318 of the Communications Act. The illustration at the right shows how an FCC inspector's car is equipped to locate sources of radio interference and illegal stations.

Problems of All Sorts Taken From the FCC Mail File

Federal Communications Commissioners have received a letter from a doctor inquiring as to whether or not there are any requirements that broadcast program continuities regarding food be submitted to medical authorities before transmission. The FCC replies that while it has no such regulations, it will consider complaints regarding specific broadcast material. Other complaints can be referred to the National Association of Broadcasters and, more specifically, to the Federal Trade Commission, which is the government agency authorized to consider alleged misrepresentations in interstate commerce.

A New York company asks whether or not a station may charge extra for broadcasting a program over FM at the same time it is on the standard waves. The Commission has no authority to decide what charges radio stations may make.

A sharp note from the Commission warned the master of a ship which put out to sea without radio equipment, that he was violating the safety provisions of the Communications Act.

From Wisconsin, a law firm wrote to ask FCC aid in obtaining a copy of a telegram to be used as an exhibit in a divorce case. The Commission suggests that the only action which the lawyers can take is to subpoena the wire through the local courts in the regular way, as the Communications Act treats all personal messages as *confidential*.

And so the world wags on!

How Bats Fly in the Dark by Using Supersonic Sound Waves

That bats make use of supersonic sound to enable them to fly through pitch-dark caves without striking obstacles is the theory of Robert Galambos and Donald R. Griffin of the Harvard Biological Laboratories. Using super-sensitive high frequency sound detectors developed by Professor G. W. Pierce, they found the bats' cries to be loudest at 50,000 cycles per second (the average human ear cannot hear much above 20,000 cycles).

The cries emitted during the apparently silent flight sound like machine-gun fire when translated to lower frequency sounds which the human ear can hear. In normal flight the bat utters about 25 cries per second, but when it approaches an obstruction, it raises the rate to about 50 per second. Flying bats which do not vary the number of cries almost always collide with wires or walls in a room.

To prove that the sound is what enables the bat to guide himself as it is reflected from obstructions, scientists covered the bats' ears to prevent their hearing, or their mouths to prevent the sounds from being uttered. Animals thus handicapped batted blindly into walls and wires. On the other hand, bats with their eyes covered could fly just as well as those who could see. Persons who are fond of animals will be glad to know that the bats were not injured in the least by these experiments. This problem has awaited solution many years.

A study of bats' flying has been recorded as early as 1793, in which year an Italian scientist found that blinded bats could fly perfectly. About five years later a Swiss scientist discovered that deafened bats could no longer fly in the dark. Ladies who are timid of bats can now be assured that any bat who is not hard of hearing will be able to avoid bumping into her, and if a bat should be so clumsy as to alight in her hair, it will be even more eager to get away than she will to have it out.

Bat, held before supersonic sound detector, is found to "broadcast" his own "beam".

Top left—Miss Frances Koenig at the blackboard during lecture in radio theory at the NYA All-Girls' Radio Club, Brenham, Texas. Lower left—Miss Sadie Simonds of Forth Worth, Texas, looks on, Miss Carol Rodesney of Huntsville, Texas, practices sending and receiving code on a practice set. Top right—Miss Fannie Raye Massey, of Dallas, Texas, "receiving" at the Brenham, Texas, NYA Girls' Center. Lower right—Miss Massey repairing an audio oscillator.

How NYA Girls Learn Radio

● BRENHAM, in east central Texas, is a city of 6,000 population, not unlike many other southwestern communities. But Brenham has a unique place in radio—it is the home of what is believed to be the first *all girls'* radio communications club in the world, established as part of the nation-wide radio project of the *National Youth Administration.*

The 25 young women of the Brenham radio club (call W5JNA) not only transmit and receive code messages, but they wield a soldering iron with as much dexterity as the average woman handles a curling iron. They tear down and put together receivers and transmitters with as much ease as they do the family wash.

Texas, however, is not the only southwestern state in which the NYA employs young women on radio projects. Both Oklahoma and Kansas have their fair share of young women employed in radio work, doing everything young men do and doing it equally well. In Topeka and Tonkawa, in Shawnee and San Antonio, NYA girls are giving a demonstration that they can be just as good "hams" as the next man.

But back to Brenham for a moment. The idea of forming an all girls' NYA radio club originated with Robert R. Burton, radio engineer in the Washington office of the National Youth Administration. J. C. Kellam, State Youth Administrator for Texas, took up the idea with the result that the project was established on October 1, 1940, under the supervision of Kathryn Porter.

Miss Porter virtually grew up in a radio control room, choosing to work at the controls rather than appearing before a microphone. She was operating her own "rig" while a student at the University of San Antonio. Although only 19 years old, she has had her commercial operating license for about a year and a half. Prior to going to work for the National Youth Administration she was control room *engineer* at KCMO, the Kansas City Journal station, and was production manager and *engineer* at Station KVIC in Victoria, Texas.

The transmitter used by the Brenham girls' club is a 6L6 oscillator and an 807 amplifier with an output of 50 watts. The antenna is a 66 foot Y-matched doublet, center-fed with a twisted pair. The rig operates in the 40 meter band, at 7,202 kilocycles. Other equipment includes a Hallicrafter receiver and a telegraph key, and for practicing receiving and sending, an Instructograph and an audio oscillator with built-in speaker.

In Oklahoma the NYA in January established a project at Tonkawa which will provide 200 youth with basic technical experience in all phases of radio construction and communications. While this new project is getting under way, 24 youth, 17 boys and 7 girls, who received their radio experience on a project at Shawnee, will be busy establishing a "state-wide" NYA network, which it is planned to place in operation in the near future.

The NYA in Kansas has already laid the ground work for an extensive radio project with two transmitters, one fixed and one portable, ready to go on the air and receivers installed at 25 resident projects throughout the state. Through the cooperation of radio dealers this organization in Kansas has developed a very worthwhile program for providing radio reception facilities for public institutions and welfare agencies. Under this arrangement the radio dealers turn over to the NYA old receiving sets acquired by trade-in on new models. These sets are then repaired and issued to charitable and to welfare institutions.

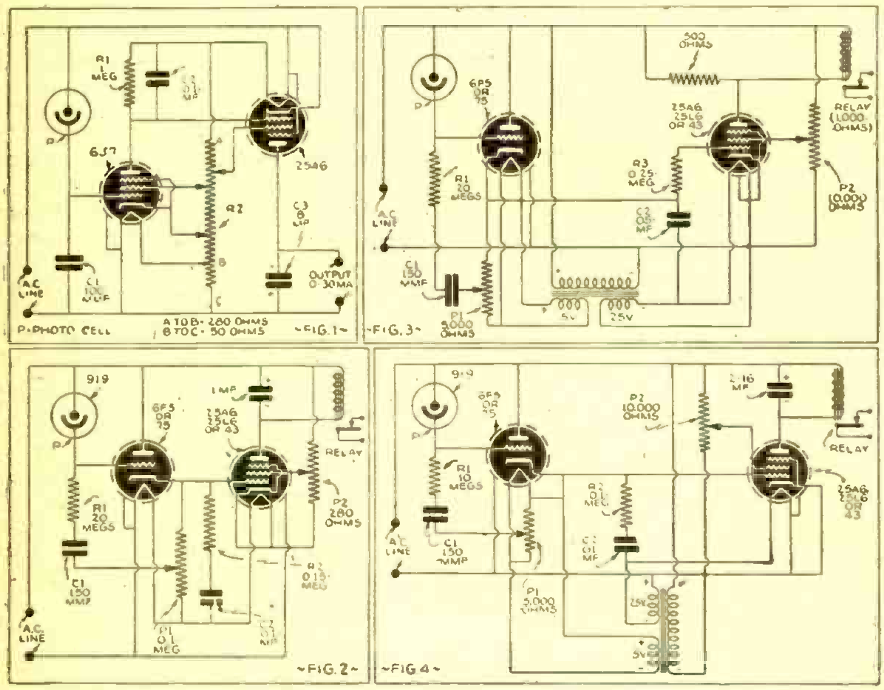
In Texas, 28 short wave radio stations are already operated on National Youth Administration projects and 24 more transmitters are proposed. All told, more than 400 boys and girls are engaged in NYA radio communications, construction and service work in the Lone Star State.

Each unit at which a transmitter is operating averages about 15 youth. Thus far, since the first NYA station went on the air from the Ranger Boys' Center, under license W5IVA, in March, 1940, fifteen young men have found jobs in private employment as a result of their work experience in constructing and maintaining short-wave transmitters.

British P. E. Cell Circuits Perform Variety of Functions

● A NUMBER of circuits for photo electric cell operation are described in *Electronics and Television and Short-Wave World*. In Fig. 1, a simple 2-stage A.C. operated photo amplifier relay, the bias is obtained by the rectifying action of the grid itself which tends to keep the plate potential constant and independent of large fluctuations between the grid and cathode. The impedance of condenser C1 acts as a load for the P.E. cell, the condenser being charged to a definite negative potential on ½ cycle and discharged through the cell on the other half. The amount the condenser is discharged by the P.E. cell determines the working potential on the grid of the buffer tube. Condenser C1 may be adjusted to any desired value depending upon the sensitivity of the relay.

Three variations are shown in Figs. 2, 3 and 4. These circuits will respond to a pulse of light having a duration as short as 1/60 of a second or one-half cycle of A.C. Briefly their operation may be explained as follows: On the negative half of the cycle the cathode of the 6F5 goes negative with respect to the grid and passes current to the grid while the tube is dark. During a period of several cycles C1 receives a charge equal to the peak value of the A.C. voltage applied between the grid and cathode. Added to the instantaneous A.C. voltage, this reduces the plate current of the output tube to zero. When light strikes the P.E. cell, first an instantaneous drop appears across the load R1, and second the P.E. cell current into C1 opposes the current fed into this same condenser from the amplifier grid, balancing the potential across C1 at some negative value between zero and the A.C. peak voltage between the grid and cathode. The potential across C2 is obtained similarly by a balance between the charging grid current and the discharging buffer tube current. In Figs. 2 and 3 a flash of light causes an instantaneous drop across R1 and triggers the circuit. In Fig. 4, due to the current drawn by the buffer tube, there is a slight amount of potential across C2 which is slowly increased through R3 during several cycles. Thus a pulse of output current has sufficient duration to operate even a slow relay though the light pulse may be extremely brief. The only difference between Fig. 2 and Fig. 3 is that, in the latter, heater voltage is supplied by means of transformers. This affords a far more efficient circuit and one that is thoroughly flexible.



2-Tube Reflex Uses 7½ Volts "B" and Flashlight "A" Batteries

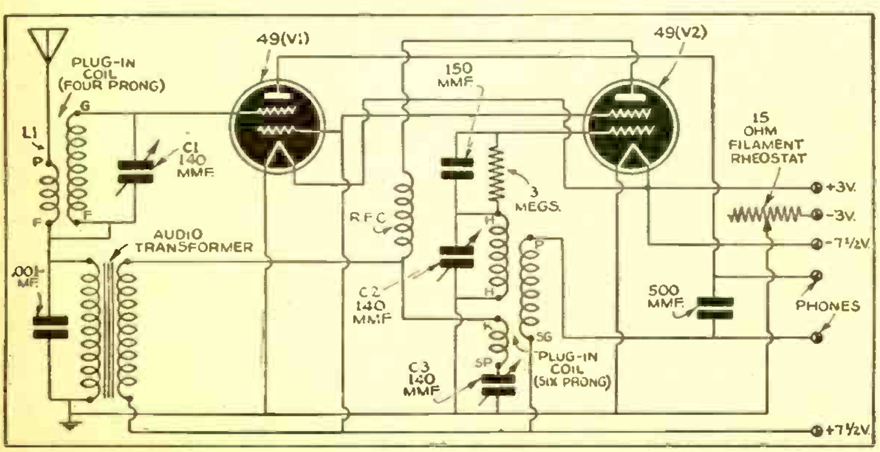
● A 2-TUBE reflex that affords a stage of radio, detector, and a stage of audio and uses but 7½ volts of "B" battery was recently described in the *Australasian Radio World*. The set uses two type 49 tubes and the circuit is extremely simple. The signal is fed from the antenna to the R.F. stage and through it to the second tube, which is a tuned regenerative detector; from there it is fed back to the first stage, which also functions as audio amplifier. The only batteries required are 2 volts for the "A" battery and 10½ for the "B" and "C," 7½ being used in the plate circuits. This great economy in dry battery cost and weight makes the set virtually ideal for portable use. The materials required are one 4-prong socket and one 6-prong socket for the detector and antenna coils, respectively, and two 5-prong sockets for the tubes. Variable condensers C1, C2 and C3 are 140 mmf. each and are provided with trimmers. C4, 5 and 6 are mica condensers having capacities of .001, .0005, and .00015 mf., respectively. R1 is a 3 meg. grid-leak and R2 15 ohm filament rheostat. T1 is a 1 to 5 ratio audio transformer; L1 is a set of 4-prong plug-in coils and L2 a set of 6-prong plug-in coils. RFC is a radio frequency choke of about 30 microhenries.

Very few points are necessary to watch in wiring this apparatus. One is to experiment with the primary and tickler windings. Since commercially-made coils vary, it will sometimes be found that using the primary as tickler and vice versa will improve results. It may also be necessary to reverse connections to any or all of the windings.

The constructor must also make sure that the control grid is employed as screen-grid in the R.F.-A.F. stage, while wiring of the detector tube is standard.

In tuning, C1 acts as a vernier control as it tunes more broadly than C2. If C1 fails to cover the entire range of C2, the value of the former may be increased to 350 mmf. and a few turns removed from the secondary winding of L1 (the 4-prong plug-in coil). While best results are obtained with a 5 to 1 ratio audio transformer, others may be employed at some sacrifice of volume or quality.

The set was designed for use with a 75-foot antenna and the constructor suggests that if a shorter aerial is used, volume can be increased by connecting the antenna directly to the grid of the R.F. tube through a 100 mmf. midget condenser, in which case about 1/3 of the turns are removed from the secondary of L1.



Interference Reduction Systems Improved by British

● THE Comte de Monge, a noted radio inventor, has devised an ingenious system of balancing out interference which is described in *Wireless World* of Great Britain. This system is shown in Fig. 1. In this A is an ordinary single wire antenna and B is a second wire running parallel to it about two inches away from it for half its length. By adjusting the variable resistance R, two points of balance will be found in the voltage fed to the grid of the next tube in the receiver. The first point of balance is a neutralization of the wanted signal; the second point is due to neutralization of the interference voltage. If the signal-to-noise ratio in the two antennas is different, these points of balance will not coincide. Thus, by adjusting R to the second point, a considerable improvement of signal-to-noise ratio is possible, although complete interference suppression cannot be secured.

Writing in the magazine, R. I. Kinross points out several disadvantages in the de Monge system and suggests a simpler means which is usable on long-wave and medium-wave reception (the broadcast band). His circuit is shown in Fig. 2. While the de Monge system cannot be easily added to a receiver already built, the Kinross circuit can be thus employed. By adjusting the value of "C," the interference voltage from A and B can be neutralized out at one setting, while the signal is neutralized at an entirely different setting. Both these points of neutralization are established in the primary of the transformer "T." The improved signal is fed into the antenna and ground terminals of the receiver through the secondary winding of "T" which is tapped to match the input impedance of the receiver.

In designing the transformer, care must be taken to keep the setting of "C" constant on all wavelengths in the broadcast band, and to make the efficiency as high as possible. The *first* is achieved by keeping the leakage inductance of the primary at a low level, and the *second* by using a high permeability core. In addition to suppressing interference, improved intelligibility of speech or code is had when interference would otherwise drown out the signal.

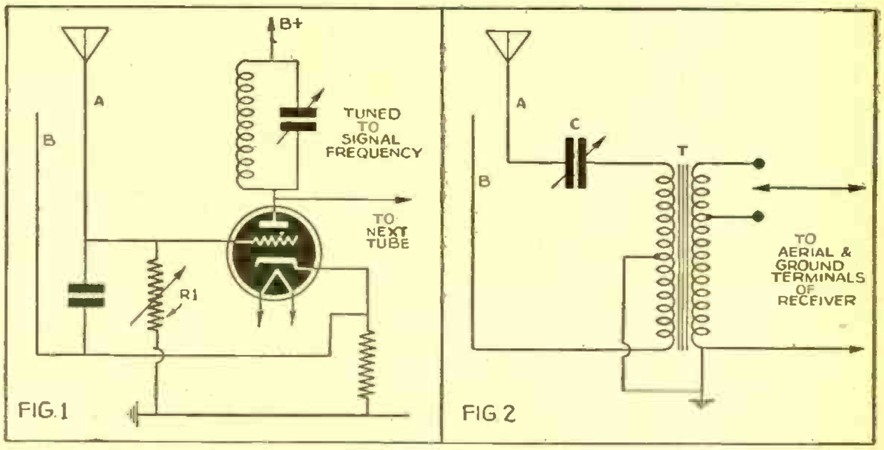


FIG. 1 FIG 2

OUR TELEVISION GOOD

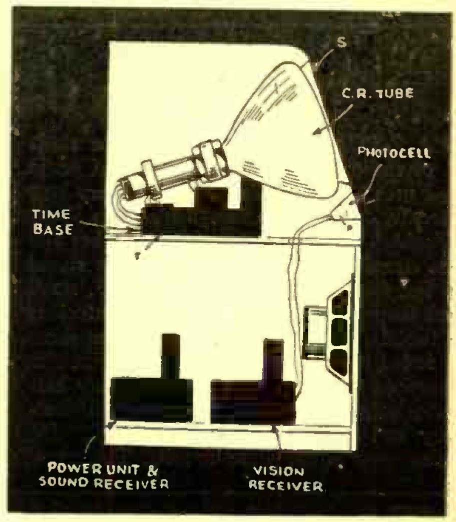
● RECENT refugees from France, Germany and England, interviewed by the *R. & T.* television editor, expressed their amazement at the quality and steadiness of American television images. Those from the former countries state that far more publicity was given to television transmissions in these places than actual achievement warranted, while those from England state that the 441 line American standard gives vastly superior images to Britain's 405 line pictures. They also commented favorably on the extreme steadiness of American transmissions. The French and Germans state that there were virtually no regularly scheduled programs in their countries before the war. All agree that America is the last stronghold of television, at least until the war is over, and hope that it will be permitted to advance, in order that the art may not be handicapped irremediably.

We often wonder what some of the foreign "lookers-in" would say if they could see the fine color television images which CBS and others have broadcast in the U. S.

AUTOMATIC CONTROL OF TELEVISION BRIGHTNESS

● WHEN television reception is being witnessed in a darkened room and somebody turns on the lights, it is necessary to re-adjust the brightness and contrast controls so that the picture can still be seen under the new lighting conditions. A further adjustment must be made when the room light is switched off again. A new system has been designed by British engineers to perform this readjustment task automatically.

As shown in the diagram from *Electronics and Television & Short Wave World* of Britain, a photo cell, P, is mounted on the front panel of the television receiver where light which falls upon the screen of the viewing tube from varying room light will also strike the active surface in the photo-cell. As the resistance of the cell is changed, due to alterations in room lighting, the resultant output of the cell is used to vary the biasing voltage of one of the amplifiers, through which the video signals pass. This controls the gain, and therefore automatically varies the brilliance of the image to compensate for any changes in room lighting. The photo cell thus finds one more useful role.



Can YOU Answer These Radio Questions?

1. What is the name of the special image pick-up tube used in the recent color television demonstration by CBS? *(See page 711)*
2. What is the purpose of a short-wave Signal Booster and where is it connected with respect to the ordinary receiver? *(See page 718)*
3. What is the purpose of degeneration in an audio amplifier? *(See page 726)*
4. Name one of the undesirable effects that auto ignition causes in television reception. *(See page 741)*
5. How can the range of a voltmeter be increased? *(See page 731)*
6. Why should the complete radio transmitter be grounded? *(See page 736)*
7. What is the purpose of the parabolic reflector used in connection with a super-sensitive sound detector to be used for spotting airplanes? *(See page 752)*
8. How can the band-pass circuit in an F-M system be adjusted? *(See page 739)*
9. What is a "set" relay, and how is it used? *(See page 760)*
10. How is relative signal strength judged and evaluated? *(See page 755)*

THERE'S MORE DRAMA and excitement packed into amateur reception when your communications receiver is a Hallicrafters. Back of Hallicrafters precision engineering is long experience, and it is this that accounts for the finer, broader, more accurate and dependable reception amateur owners enjoy. Lafayette Radio offers a complete line of latest Hallicrafters models. Time payments make owning one easy. Send for FREE catalog today, or visit branch nearest you.

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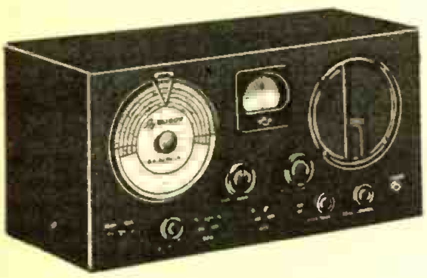

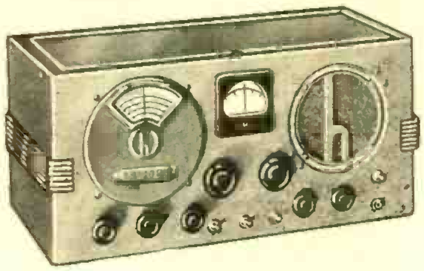

MODEL S-19R

Efficient superheterodyne circuit employs 6 tubes, of which two are double-purpose types, providing 8 tube performance. Complete tuning range of the receiver from 545 kc. to 44 mc. in 4 tuning bands. Electrical band spread on each band. Broadcast band coverage, beat frequency oscillator, automatic volume control switch, built-in speaker and a separate band spread dial. Designed for operation from any 110-120 volt 50-60 cycles a.c. line. Antenna connections provided for both doublet and Marconi type antennas. Cabinet beautifully finished - $17\frac{1}{2}$" x 8" x $8\frac{1}{2}$".

$\$29^{50}$

MODEL S-20R

New improved 9 tube model. Covers the complete range from 545 kc. to 44 mc. in four bands. Employs a stage of pre-selection on each band for added sensitivity and selectivity. Controls: r.f. gain, audio gain, tone control, a.v.c. switch, B F O switch, band switch, main tuning control, separate band spread control, and "stand-by" switch. Built-in speaker. Circuit features electrical band spread, automatic noise limiter, r.f. amplifier. Designed for 110 volts 50/60 cycles a.c. operation, (plug and jack provided for batteries or vibrapack operation). Steel cabinet measures $18\frac{1}{4}$" x $9\frac{3}{8}$" x $8\frac{1}{2}$".

$\$49^{50}$

MODEL S-29

Precision-built communications receiver in portable form. Operates on either 110 volts AC or DC or from self-contained batteries. Self-contained telescopic antenna. Receiver covers four complete bands: 11.26 mc. to 1490 kc. Employs an r.f. stage on all bands, incorporates an automatic noise limiter; electrical band spread. Built-in speaker. Controls include: main tuning—band spread—r.f. gain—A.f. gain—band switch—power switch—a.v.c. "off-on" switch—BFO "off-on" switch—ANL "off-on" switch—send-receive—standby switch. Dimensions: 7" high, $8\frac{1}{2}$" wide, $13\frac{1}{4}$" deep.

$\$59^{50}$

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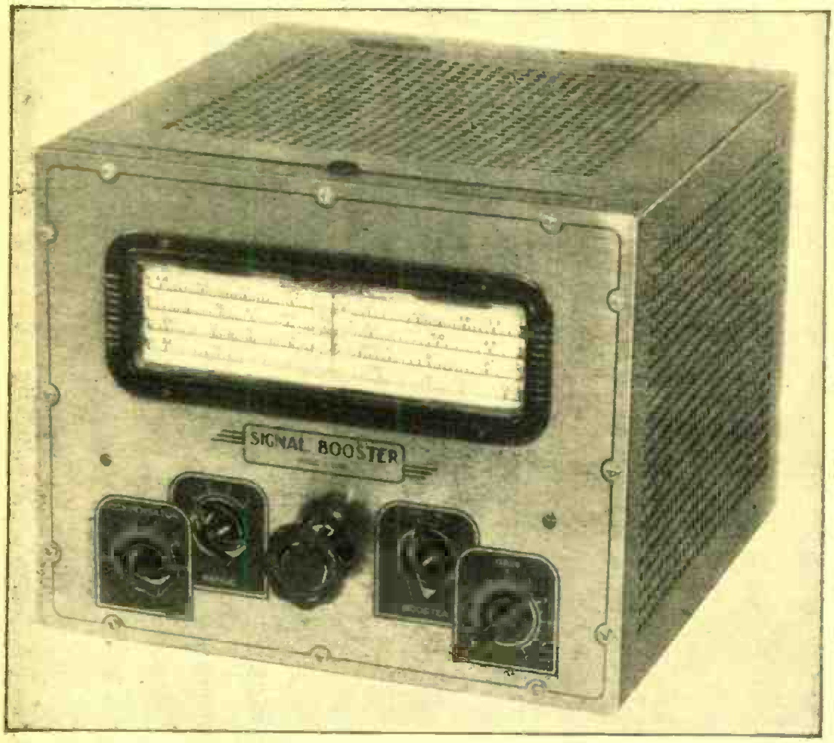
THE WORLD'S LARGEST RADIO SUPPLY HOUSE

How to Construct a

Short-Wave "Signal Booster"

Charles R. Leutz

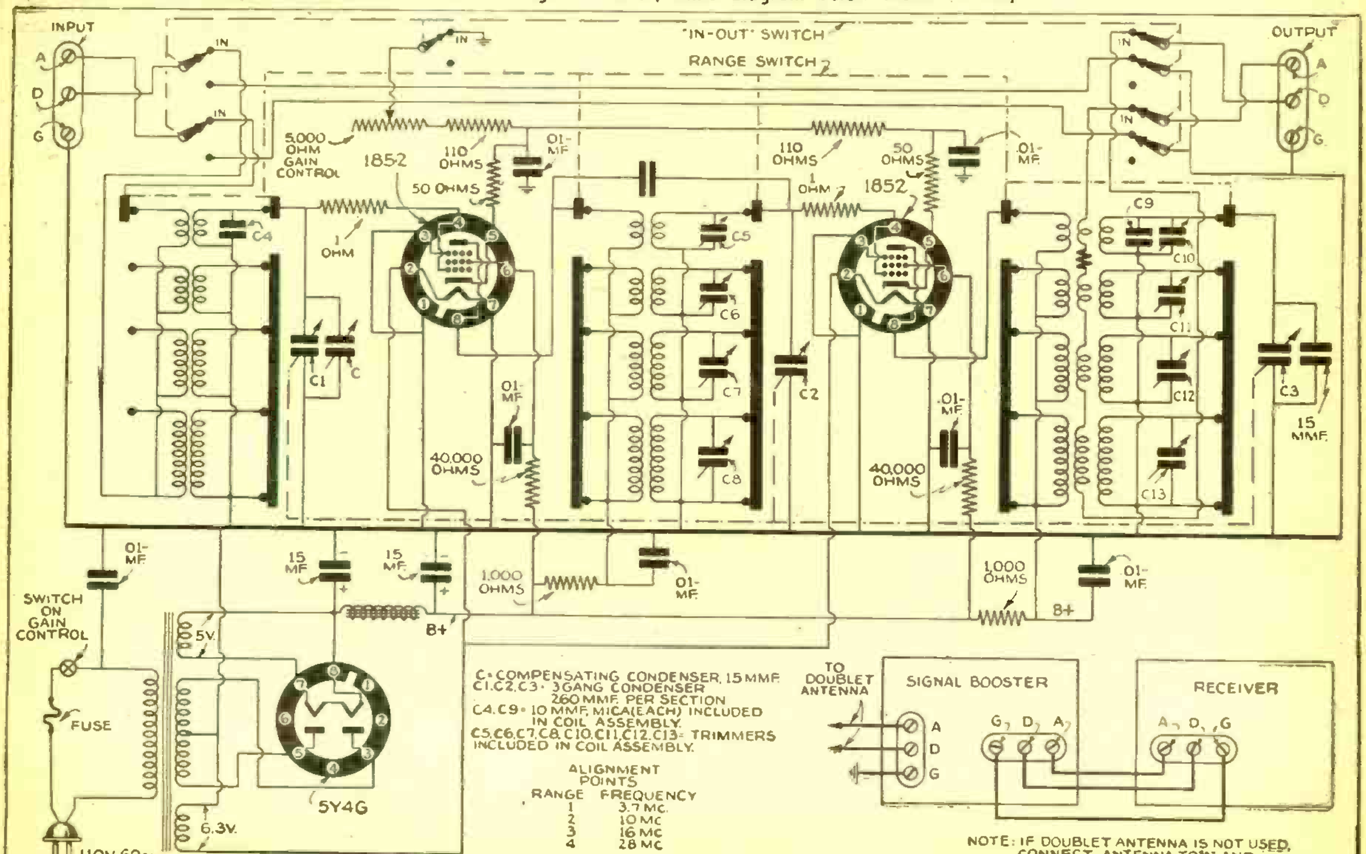


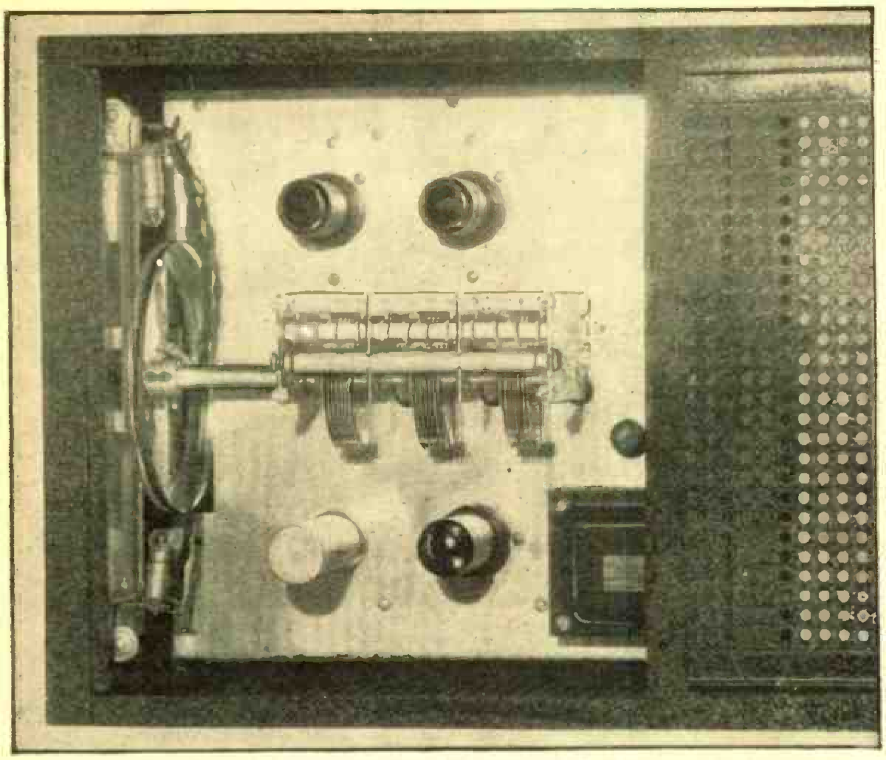
This article describes the construction of an efficient pre-amplifier. It is easy to build this pre-amplifier as it is available in kit form. Complete diagram and construction data are included herewith, for the benefit of experimenters in general, as well as set-builders who prefer to follow kit instructions.

● MODERN super-heterodyne radio receiver circuits include at least one stage of tuned radio frequency amplification at the signal frequency and preceding the mixer tube. Special designs call for two and even three stages of T.R.F. at this point.

The advantages of one or more stages of T.R.F. ahead of a straight super-heterodyne circuit have been known for many years. Years ago this T.R.F. addition could not be effectively applied, due to the fact that tubes then available were unsatisfactory as tuned radio frequency amplifiers, especially on the higher frequencies. Now

Photo above shows the finished signal booster, while diagram below shows its simple construction.





Top view of the pre-amplifier with cover of cabinet swung back.

that efficient T.R.F. amplifier tubes are available, the application is applied to all good receiver designs where cost is not a first consideration.

The addition of one or more stages of T.R.F. to existing receivers permits improving the *signal-to-noise* ratio, the sensitivity and probably most important, also provides a more favorable image ratio. The last mentioned feature is a most desirable addition if the existing receiver does not have a T.R.F. stage or if the T.R.F. stage included is inefficient. A signal booster can of course also be used with a T.R.F. receiver or with a regenerative short wave receiver, to obtain the improvements available, mentioned above.

The Meissner *signal booster* to be described in this article is ordinarily marketed as a completely constructed and wired instrument ready for operation. For the benefit of radio experimenters, the manufacturer has given permission to publish the design details of this modern instrument.

Two Stages of T.R.F. Boost Signals

The signal booster consists essentially of two stages of *tuned radio frequency amplification,* with provision for antenna input and for a matched output to standard receiver antenna circuits. To make the instrument most useful, it has been designed for a wide frequency coverage, viz. 1.6 to 31 megacycles, in four bands.

The R.F. transformers used to cover the above mentioned range are machine wound and accurately adjusted using precision measuring instruments, in order to secure accurate tracking and also so that the frequency coverage will indicate properly on the calibrated scale. In view of this it is a very difficult proposition to duplicate the coils by hand and not suggested, accordingly the winding data is omitted. If desired, standard R.F. transformers can be used for one or two stages experimentally, for example for a broadcast band booster using the circuit described. However, in the case of requirements calling for complete short wave coverage, the manufacturer's tuning unit can be secured at a reasonable cost; considerably less than it would cost to duplicate one by hand. The tuning unit consists of the four point multiple switch, the twelve R.F. transformers and eight trimmer condensers, all assembled, wired and pre-aligned, ready for wiring into a booster circuit. This unit is tuned by a three-gang 260 mmf. variable condenser.

4-Band Switch Tunes in Signals

The accompanying schematic wiring diagram is complete in every detail and clearly shows the special four-band switch together with the associated R.F. transformers, tuning condenser and trimmers. For each of the four bands, the three R.F. transformers are different, the first transformer is the antenna or doublet input, the second transformer a high gain interstage and the last transformer an output unit. *The latter has an output winding of proper characteristics to match the input circuit of standard receivers.* As all the transformers and the associated gang condenser are designed to track accurately, the output circuit delivers maximum possible energy to the associated receiver over the entire frequency range, the main purpose being to over-ride the tube or circuit noises which may be generated within the receiver. Accordingly, in tuning in a weak distant signal using the signal booster, the over-all response is similar to that obtained when tuning to a strong local signal on a receiver alone. Under these conditions the signal is clear and strong and *background noise at a minimum.*

By designing the circuit for the 6AC7/1852 "television" tube for the R.F. amplifier stages, excellent gain is obtained even at the highest frequencies, together with good circuit stability and a low noise factor.

This useful instrument is not difficult to build. Accompanying drawings give full dimensional details of the chassis and front panel. It will be noted that a standard chassis is not suitable for the design, first because of the 4" depth required and secondly due to the fact that one side of the chassis must be removable in order to complete internal connections.

Construction Details

After providing the chassis and panel, assembly is started by mounting the power transformer and the tube sockets, noting that the two ceramic sockets are for the R.F. amplifiers. Next mount the electrolytic filter condenser above the chassis and the filter choke underneath the chassis and also mount the fuse extractor post. On the rear of the chassis mount the two 3 terminal connection posts. On the front of the chassis mount the compensator condenser (a 15 mmf. variable) to the extreme left position and the volume control-switch to the extreme right position.

Two 4 terminal tie lugs are mounted underneath the chassis, to the left of the R.F. sockets and two 3 terminal tie lugs are mounted to the right of the R.F. sockets. The above tie lugs accommodate all the small fixed condensers and resistors with the exception of the one .01 mf. condenser connected at the power transformer primary. One side of the small resistors or fixed condensers should be connected directly to the indicated socket terminals or ground where possible, using the tie lugs for the "live" anchors. The R.F. leads should be kept to minimum lengths and the R.F. leads separated as far as possible.

The parts installed so far can now be wired, including the line cord and making sure all connections are well soldered and as indicated in the schematic diagram.

The next step involves placing the three gang condenser in position followed by mounting the dial assembly. When the gang condenser is fully meshed, the dial pointer should be at the extreme right or low frequency end of the scales.

The R.F. transformer-switch assembly can now be placed into position, the front end being held into place with the shaft bushing and the rear end held with the bracket provided. The connections to the above assembly are then made, including connections to the gang condenser stators, as indicated in the wiring diagram.

The antenna switch is placed into position, also fastening the front end to the chassis with the shaft bushing and the rear end to the back of the chassis with screws and spacers. The switch is then wired.

To this stage, the assembly and wiring has been confined to the chassis. The front panel is held to the chassis using four dowel spacers together with screws and nuts. With the front panel in place, the dial assembly can be completed by adding the escutcheon and wiring the dial lights. This completes the assembly and tests for operation and alignment should be made before inserting the unit into a cabinet.

Provided a high resistance or vacuum tube voltmeter is available, a preliminary check can be made by inserting the tubes, connecting the power and measuring the voltages at the R.F. tube sockets. The plate voltage should be about 260 to 300 volts and the screen voltage about half that amount. The control grid voltage will vary depending upon the Gain Control adjustment, same giving minimum reading with the gain adjustment full on clockwise.

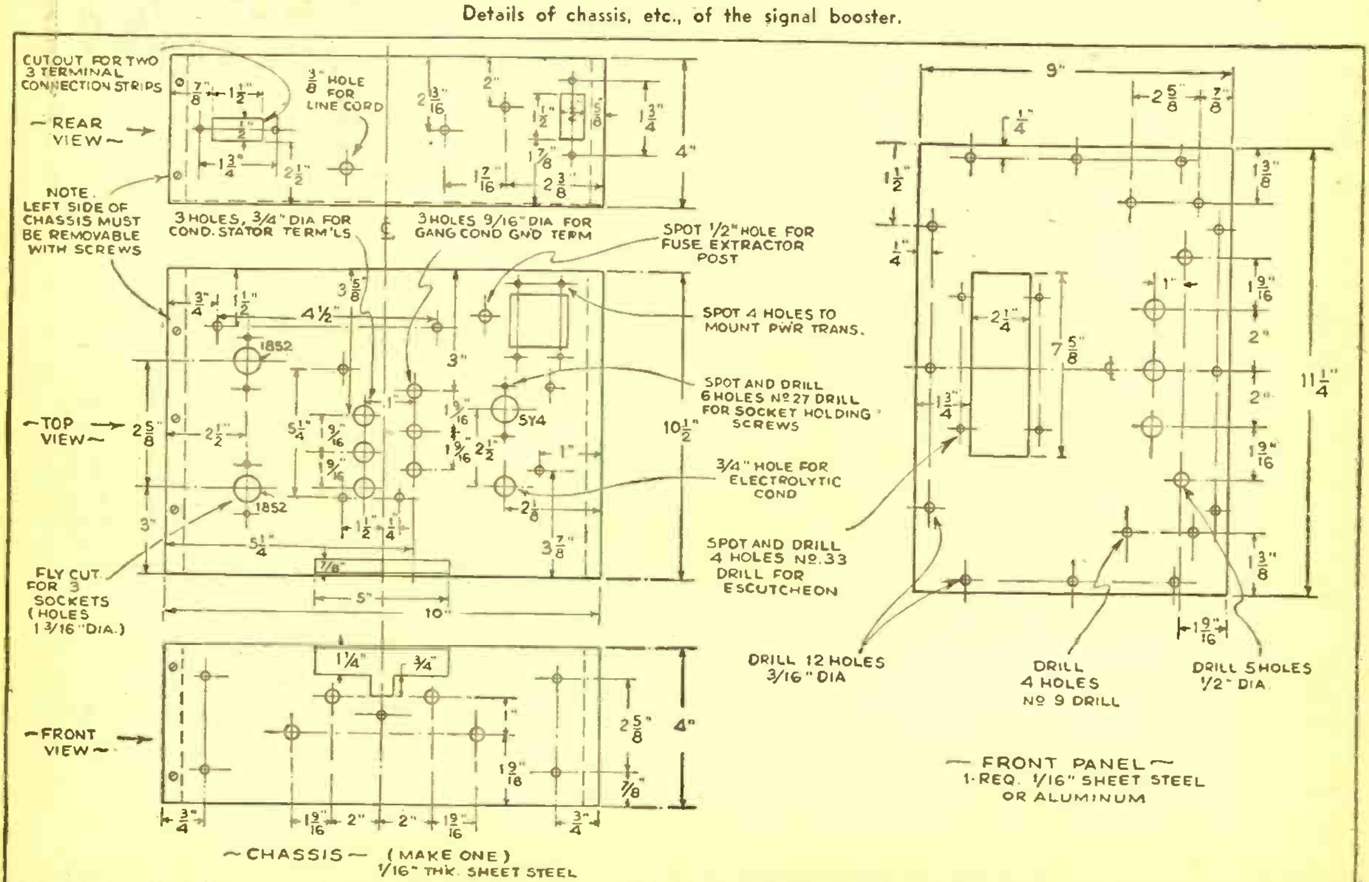
Testing the Booster

Final tests and adjustments are made with the *signal booster* connected to the receiver. If a doublet aerial is used, same is connected to posts A and D on the booster input terminals and a ground connected to G. Assuming the associated receiver also has provisions for doublet input, the booster output terminals A, D and G, are connected to corresponding terminals on the receiver input. However, if the receiver is only arranged for a single aerial, then a wire is run from booster output terminal A to receiver antenna post. Posts D and G on the booster output terminal are connected together and to the ground post on the receiver input.

When the booster is to be operated from an ordinary aerial, the aerial is connected to A on the booster input. Posts D and G on the booster input are connected together and to ground. The inter-connections from booster to receiver are the same as previously indicated. Best results will be obtained when the booster is located immediately to the left of the receiver input connections, so that the connecting leads between the two units will be at minimum length. A piece of low-loss concentric cable, such as Amphenol No. 72-12 is ideal for the inter-connections "A" and "D".

Turning the Booster Switch to the "Out" position now connects the aerial directly to the receiver without any booster action. The desired signal can now be tuned in on the receiver alone and assume the signal frequency involved is 8 megacycles; then the Booster Switch can be turned to the "In" position, the booster Range Switch

Details of chassis, etc., of the signal booster.



turned to band 2 and the booster dial tuned to 8 megacycles or to the desired signal. With the booster action in operation, the booster gain control should be adjusted as high as possible and the receiver gain retarded correspondingly, in order to obtain the most favorable *signal-to-noise* ratio. The booster "In-Out" switch controlling the aerial does not turn the booster tube filaments off, so that the booster is always ready for immediate operation.

In some instances, it may be found that a signal received on the receiver alone, disappears when the booster is connected into circuit. In that case the signal being received was an image and disappeared when the booster was switched in, as the added tuned R.F. stages discriminate against images. Therefore it is always important that the receiver and booster both be tuned to the true signal frequency for true maximum results.

The *gain control* on the booster permits variation of amplification right up to the oscillating point. This is important because the input and output loads on the booster vary, according to the types of aerials and receivers used, and no one fixed adjustment of booster gain could possibly be suitable for all conditions.

Use on T.R.F. and Regenerative Sets

When using the booster with a T.R.F. set or with a *regenerative* receiver, it is important that both the booster and receiver be tuned closely as possible to the signal frequency, so that the booster gain can be advanced substantially without the booster circuit oscillating.

Alignment can be checked by either using a signal generator or on received signals. Each of the four bands must be aligned. If a signal generator is available the alignment points are as follows. for range 1 (3.7 mc.); range 2 (10 mc.); range 3 (16 mc.) and range 4 (28 mc.). If received signals are used for alignment, the same should be selected approaching the above values. With the received signal coming in steadily, first adjust the booster *compensator* condenser and then adjust the trimmers on the R.F. and output transformer for the range position involved. These trimmers are adjusted for maximum response, at the same time keeping the receiver gain control at a minimum, in order that corresponding changes in signal strength are readily discernible.

While a *signal booster* substantially improves the DX reception possible, using only an ordinary aerial and average receiver, greatly improved results will be obtained by erecting the *best possible* aerial, preferably of the *doublet* type. By erecting two doublets at right angles to each other, each with separate low-loss co-axial cable lead-in, a switch can be provided to connect to either one of the two doublets. Depending upon the direction of arrival of the desired signal, one of the doublets will invariably collect more signal strength than the other and give a better *signal-to-local noise ratio.*

List of Parts

1—Cabinet, 11¼" long, 9" high and 11¾" deep, No. 9781
1—Front panel, etched dial markings, 11¾" x 9" x 1/16", No. 9779
1—Chassis, (as per detail drawing, No. 9657)
1—Power transformer, primary 110 volt 60 cycle A.C. secondaries, 6.3 volt fil., 5 volt fil. and 350-0-350 volt, No. 19255
1—Filter choke. 20 hy.. 20 mil. No. 19256
1—Filter electrolytic condenser, 15-15 mfd.. 450 volt No. 16124
7—.01 mf.. 400 volt paper condensers. No. 14110
1—Compensator variable condenser. 15 mmf. No. 17150
Following ¼ watt resistors, 2—110 ohm, 2—one ohm, 2—1000 ohm. 2—50 ohm 2—40.000 ohm
1—5000 ohm gain control with A.C. switch. No. 19514
1—3-gang, 260 mmf. variable condenser. No. 17151
1—Shield for gang condenser. No. 9783
1—Special switch. 2-gang. 4-position. No. 19494
1—4-band, R.F. transformer assembly, with special switch and trimmers, wired and pre-aligned. No. 9782
1—Moulded Octal socket. No. 9349
2—Ceramic Octal sockets. No. 8437
1—Line cord and plug. No. 12434
1—Tuning knob. No. 25-8225
4—Bar knobs. No. 25-8222
1—Dial mechanism. No. 19322
1—4-band calibrated scale dial. No. 19513
1—Dial escutcheon. No. 19516
2—Dial lights. No. 19262
2—3-terminal connection blocks each marked "A," "D" and "G." No. 16738
1—Littelfuse fuse extractor post and ½ ampere fuse

MISCELLANEOUS HARDWARE

4—Wood dowel spacers. ⅜" O. D. x ⅛" I. D. x 11/16" long
25 feet push back connection wire
2—4-terminal tie lugs and 2 3-terminal tie lugs
4—Rubber feet for cabinet
1—Rubber grommet for line cord
12—No. 8 rd. hd. drive screws ⅜" long for front panel
7—No. 6 rd. hd. drive screws, ¼" long for removable chassis side
4—No. 6 32 x 1" rd. hd. mach. screws with nuts and lock washer, for front panel
4—No. 2 56 x ⅜" rd. hd. mach. screws, nuts and lock washers for dial escutcheon
3—No. 8 32 x ⅜" rd. hd. mach. screws, nuts and lock washers for gang condenser
14—No. 6 32 x ⅜" rd. hd. mach. screws, nuts and lock washers for sockets, filter choke and ties

TUBES

2—RCA 6AC7/1852 R.F. amplifiers
1—RCA 5Y4G or 5Z4 rectifier

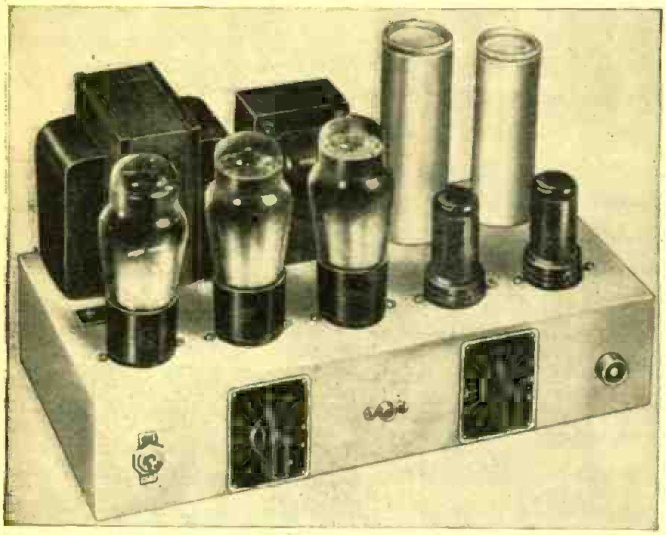
Manufacturers' numbers given in the list of parts are those of the Meissner Manufacturing Co. Substitutes, if identical in electrical characteristics and quality may of course be used.

See Page 759

A Modern "Hi-Fi" Amplifier

John T. Wilcox, W2CLS*

This very excellent audio amplifier can be used with phono pick-up, a microphone, radio tuner, etc. It has a wide frequency response—from 25 to 15,000 cycles. The final stage is of the "push-pull" type—the phase inverter is self-balancing, with very good regulation. The amplifier has a measured output of 12 watts, with very low distortion.



The complete high-fidelity audio amplifier is shown at the left, with the controls and switches mounted on the chassis. Standard parts are used and it is easy to wire.

● HERE is an amplifier that is well suited to present-day needs, it has an extremely wide band response and a very low distortion level. The measured range of this amplifier extends from 25 to 15,000 cycles. It is down 1½ d.b. at 25 cycles and up 1 d.b. at 15,000 cycles, measured in the low-gain channel, tone control off.

This makes an ideal amplifier for frequency and amplitude modulation reception, P.A. work, recording and other special applications such as measurement work, etc. Other features are compactness (chassis size only 6" x 12" x 2½") and low cost to construct and ease of construction.

Controls are provided to fade from the high-gain channel to the low-gain channel, and also a very gradual change tone-control. A switch to change impedances quickly is provided, which eliminates soldering and resoldering speaker plugs.

The circuit line-up is as follows: a 6SJ7 is used as a high-gain pre-amplifier; a 6SC7 is used as a phase-inverter, this is a dual triode tube (the low gain input also feeds this tube); a pair of 6V6G tubes are the final push-pull amplifiers. The rectifier is the old reliable 80. The phase inverter circuit is self-balancing and has very good regulation, which accounts for an output of 12 watts measured, with very low distortion.

The circuit as shown should need no further explanation to wire, even to a novice, as the socket terminals which are the main cause of confusion are clearly marked. Any one who can handle a few simple tools and a soldering iron can easily build this amplifier and derive a lot of pleasure out of the time spent.

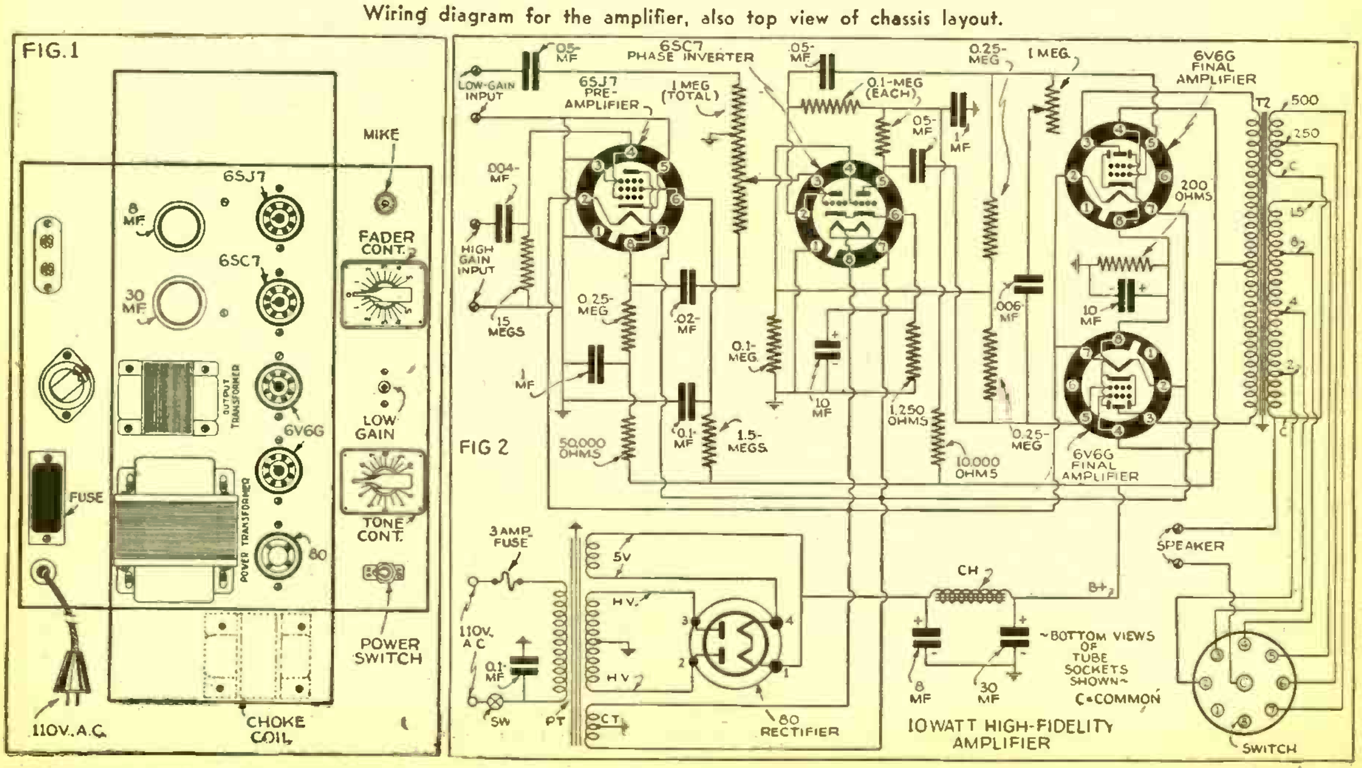
The parts are so laid out that the leads are very short and when wiring in the various resistors and condensers, the extra length of wire should be cut off. Keep all the parts flat to the chassis. This will make a very neat wiring job and helps in re-checking any parts or wiring.

The hum-level of the amplifier is very low, and a bottom metal plate with felt feet is included with the complete kit, to preclude the possibility of stray A.C. fields from inducing hum.

Any good P.M. speaker or separately

*Engineer, Lafayette Radio Corporation.

Wiring diagram for the amplifier, also top view of chassis layout.



excited speaker can be used with the amplifier. It should, however, have a very good frequency response curve. Buy the best you can afford as this amplifier will do justice to even the best of speakers. A P.M. speaker is preferred because some A.C. type speakers may produce hum. A 5 or 6 inch P.M. speaker can be used as a tweeter (high frequency response) as shown in Figure No. 4. However, it is recommended that a special P.M. tweeter speaker be obtained for the best results.

A tweeter is not needed to note the difference between this amplifier and the usual run of amplifiers. The difference is really amazing on any good single speaker.

The low-gain channel is used for phono pickups, also frequency and amplitude modulation tuners, and the high-gain channel is used for mike input. Any high impedance mike can be used with good results.

The various types of recorders can be connected as shown in Figures Nos. 5, 6, 7.

Adjust the series resistor on the crystal cutters while making a few test records until best results are obtained; after it is once adjusted it can be left set. This resistor varies the response and while it is not too critical it should be adjusted to give a good high frequency response.

Parts List

10-12 Watt Hi-Fi Lafayette Amplifier

1—Power transformer; K1460
1—Filter choke; K1578
4—Octal sockets; K13050
1—Speaker switch; K11510
1—Amphenol mike plug; K13359
1—Special chassis (punched) with bottom plate
1—Line cord and plug; K13285
1—1 megohm fader; K9004
1—1 megohm tone control; K9129
1—Terminal strip; K13145
2—Knobs; K13053
1—Crowe dial scale; 437
1—Crowe dial scale; 439
1—Toggle switch; K12836
1—On-off plate for above; K12818
1—Fuse holder; K12325
1—Phono plug and socket; K13311
1—Special output transformer
1—Special 15 megohm resistor, ½ watt
1—1.5 megohm resistor, ½ watt; K4248
3—0.25 megohm resistors, ½ watt; K4285
3—0.1 megohm resistors, ½ watt; K4281
1—0.05 megohm resistor; K4277
1—1250 ohm resistor; K4257
1—10,000 ohm resistor; K4269
1—200 ohm resistor, 10 watts; K4439
1—0.004 mf. condenser; K2634
1—0.02 mf. condenser; K3188
3—0.05 mf. condensers; K3189
2—0.1 mf. condensers; K3182
2—1.0 mf. condensers; K3172
1—0.006 mf. condenser; K3186
1—10.0 mf. condenser; K3381
1—8.0 mf. filter condenser; K492
1—30.0 mf. filter condenser; K2766
Hardware assortment including wire and solder
Diagram and instruction sheet
1—4-prong socket; K13057
1—Amphenol mike socket; K13361
1—3 ampere fuse; K12381

TUBES

1—6SJ7
1—6SC7
2—6V6G
1—80

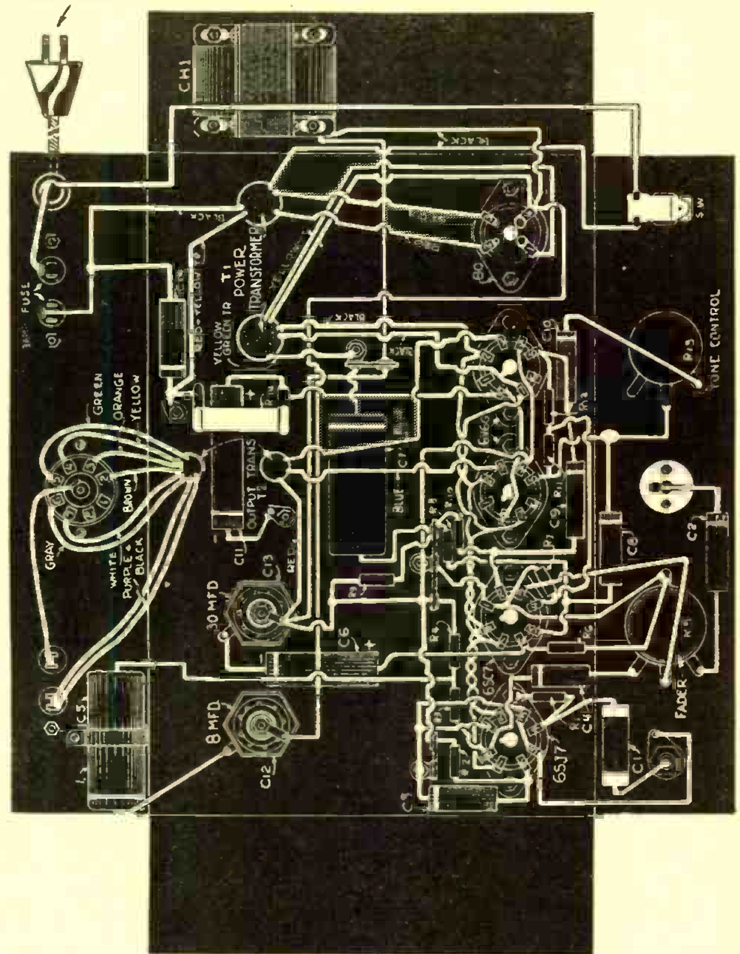
Building a "Home" Diathermy Machine

by

Ricardo Muniz, E.E., and S. Morton Decker

in next issue

110 V. A.C



(Ω = OHMS)

-LEGEND-

R1 - 15 MEG	R8 - 0.1-MEG	C1 - .004-MF	C8 - .05-MF
R2 - 1.5 MEG	R9 - 10.000 Ω	C2 - .05-MF	C9 - .05-MF
R3 - .25-MEG	R10 - 0.1-MEG	C3 - 0.1-MF	C10 - .006-MF
R4 - 50.000 Ω	R11 - 0.25-MEG	C4 - .02-MF	C11 - 10 MF
R5 - 1 MEG	R12 - 0.25-MEG	C5 - 1 MF	C12 - 8 MF
R6 - 1.250 Ω	R13 - 1 MEG	C6 - 10 MF	C13 - 30 MF
R7 - .1 MEG	R14 - 200 Ω	C7 1. MF	C14 0.1-MF

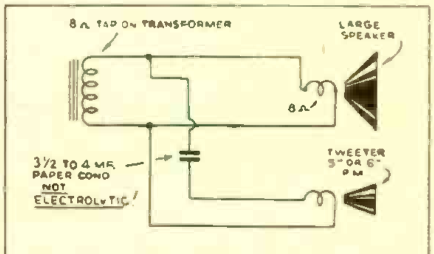


FIG. 4 TWEETER CONNECTIONS

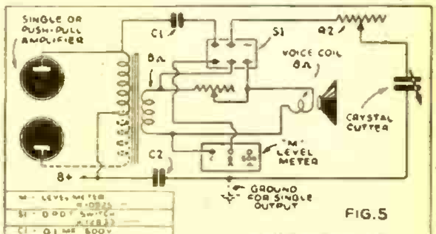


FIG. 5 — SIMPLE METHOD OF CONNECTING CRYSTAL CUTTER —

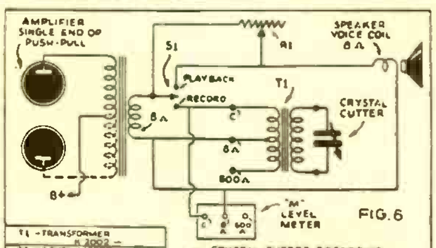


FIG. 6 — CRYSTAL CUTTER RECORDING HOOKUP WITH SET SPEAKER AS MONITOR AND USING OUTPUT TRANSFORMER TO CUTTER —

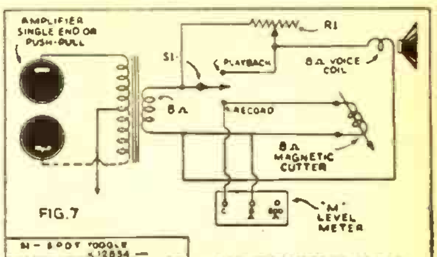
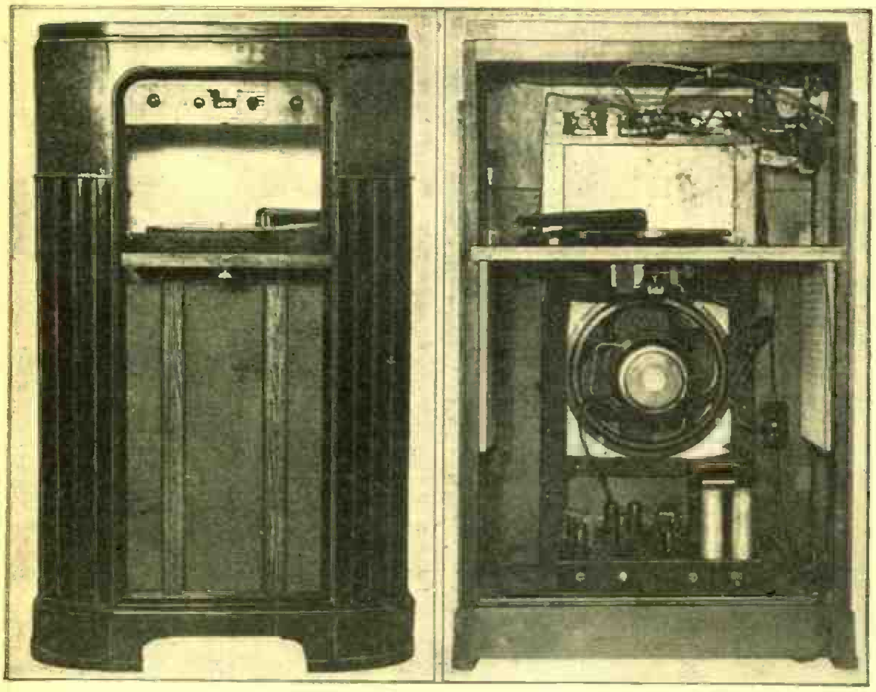


FIG. 7 — MAGNETIC CUTTER RECORDING HOOKUP WITH SET SPEAKER AS MONITOR —

In the drawing above, the wiring diagram of the "high fidelity" audio amplifier is shown, together with picture diagram. This amplifier has been carefully tested in the laboratory, and the results of course depend a great deal upon the quality of the loudspeaker used with it. Either a high-fidelity loudspeaker should be used, or else a tweeter should be used in conjunction with an average range, good quality speaker.



This high-fidelity audio amplifier can be built at very moderate cost. It has been tried out thoroughly by the engineers in a radio broadcast station, measurements having been made as to the quality of the reproduction with suitable measuring instruments. Not only is this amplifier useful for microphone or phonograph pickup, but it may also be employed in connection with a radio tuning unit.

Left—front and rear views of the cabinet containing phono turntable, loudspeaker and the high quality audio amplifier here described. The amplifier is seen at the bottom of the cabinet and a radio tuning unit is mounted in the top of the cabinet.

Milton T. Putnam
Chief Engineer, Station WDWS, Champaign, Illinois

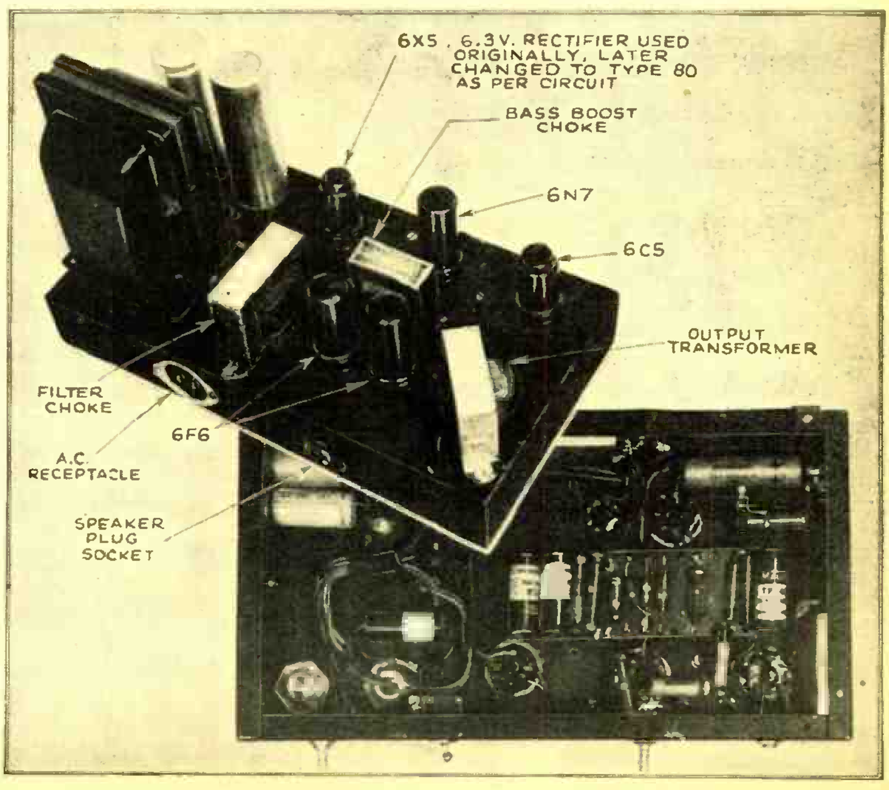
High-Fidelity Phono Amplifier

● THE amplifier and combination described was designed and built first of all because high-fidelity reproduction of phonograph records was desired. In view of this fact, most of the lower-priced commercial combinations, which could be purchased for anywhere near the construction cost of this amplifier, offered very little satisfaction, as far as high fidelity goes. Almost any kind of a radio-record player would cost a great deal more than the type we have constructed here, and by no means compare in quality of reproduction. I do not intend to imply, however, that there are not any number of good combination assemblies on the market, but only that for those who care to construct their own amplifier and tuner assembly, they can do far better from the standpoint of *high fidelity*, dollar for dollar, with the equipment we are about to describe. Most of the lower priced commercial units have single-ended output, with a pentode used for high gain, and thus add considerable distortion, not to mention the use of a five or six inch speaker. The layman can see that this makes for poorer reproduction.

Pickup and Speaker

Probably the most expensive units in our entire amplifier and associated equipment are the speaker and pickup. As you can readily see, it is important that, first of all, you should choose a decent pickup and lastly that the speaker should be parallel in quality. The choice of these should be made dependent upon the result you expect and, of course, the amount of money you care to spend. There are any number of good pickups on the market at very reasonable prices which may be equalized with the circuits given here to produce excellent quality. These range in price from $3.00 to $5.00. The speaker used in the original was a twelve inch model, and it is advisable to use at least a ten inch unit if you wish to get reproduction of the lower bass notes. A satisfactory speaker may be purchased from any one of the leading radio supply houses, ranging in price from $4.00 to

Top and bottom views of the Hi-Fi audio amplifier are shown below.



$6.00, and up. It need not be of the permanent magnet type, except for convenience. As a matter of fact, it would be considerably cheaper to buy an electrodynamic and add filter to the power supply circuit by using its field as a choke.

"Phase Inverter" Used

Ordinarily the other important factor which limits frequency response of an amplifier, outside of its fundamental design and circuit components, is the use of transformers throughout the circuit. In this particular case, we have used only one transformer in the entire audio line-up, this being facilitated by the use of the *phase inverter* circuit. With the use of a special bass and/or hi-frequency *lift* circuit, the response remains substantially flat over a range of the audio spectrum greater than that recorded on the average phonograph records. We will later go into more detail on the normal frequency response of the average crystal pickup, and how it may be equalized for other response characteristics. Also the use of the phase inverter circuit and the bass and hi-lift equalizer circuit will be discussed and explained more fully.

Tuner: As for the *tuner*, well, that again depends upon what you may expect or desire in the way of radio reception. You have any number of choices there, and I have made no attempt to go into detail on construction or choice of a tuner. In this case, I happened to have access to one of the four tube "A.C.-D.C. orphans," which worked out very well for size. By eliminating the output stage entirely, the overall distortion is decreased and the frequency response is improved. One thing in favor of the smaller, super-het "fidgets," used as a tuner, is that probably they will not have over one I.F. stage and though their gain may be less, the frequency response may be considerably better, due to the use of less tuned circuits. Incidentally, if you do desire better audio frequency response from the tuner and do not mind losing considerable gain, the resonance curve of the I.F. stage may be flattened with the proper value of resistors connected across the I.F. transformer. In the case of those who desire a receiver to have a great deal of selectivity and sensitivity, the above suggestions are very irrelevant, since it is impossible to have a high-fidelity receiver with a great deal of selectivity and gain. High fidelity depends upon the flatness of the response curve of any given tuned circuit, and a receiver which has a great deal of selectivity and gain is required to have a very narrow, and sharp resonance curve. The method of connecting the tuner to the amplifier is shown clearly in the diagram.

P.A. and Other Applications

Many of you who happen to want a good amplifier for one purpose or another, may desire to use it in conjunction with a *portable record player*, or perhaps connect a *pre-amplifier* to it and have a high quality P.A. system capable of ten to twelve watts output. You might even connect a crystal microphone in place of the pickup; however, it will not drive the 6F6 grids to full output. There are any number of applications for the amplifier. You may use the same circuit for a modulator in your "ham" rig, simply by changing the output transformer to match the class "C" load impedance.

The tube line-up is straight-forward. The input tube is a 6C5 which has a high-transconductance and a comparatively high amplification factor, which makes it excellent as an amplifier in this particular application where the signal voltage may be fairly high from the pickup. Actually the voltage peaks generated across one megohm grid resistor from full output of the pickup may reach fifteen volts or more during loud passages in recordings. This danger of overloading in the grid circuit is partially eliminated in the equalizing circuit for the pickup, and by using a volume control in the first stage.

The 6N7 was chosen for the *phase inverter* since two triodes were required for the balance circuit, as explained later on.

The 6F6's are triode connected, class AB^2, capable of approximately ten watts output with very low distortion, ranging from three to four per cent. It is generally accepted that we hear nothing less than eight to ten per cent distortion. The plate-to-plate load impedance under these operating characteristics is 10,000 ohms, and the cathode bias resistor is approximately 750 ohms, with 300 to 350 volts on the plate.

There has been a lot said in favor of and also against *phase inverter* circuits replacing inter-stage transformers. Any engineer will concede, first of all, that phase inverter circuits are cheaper than an average trans-

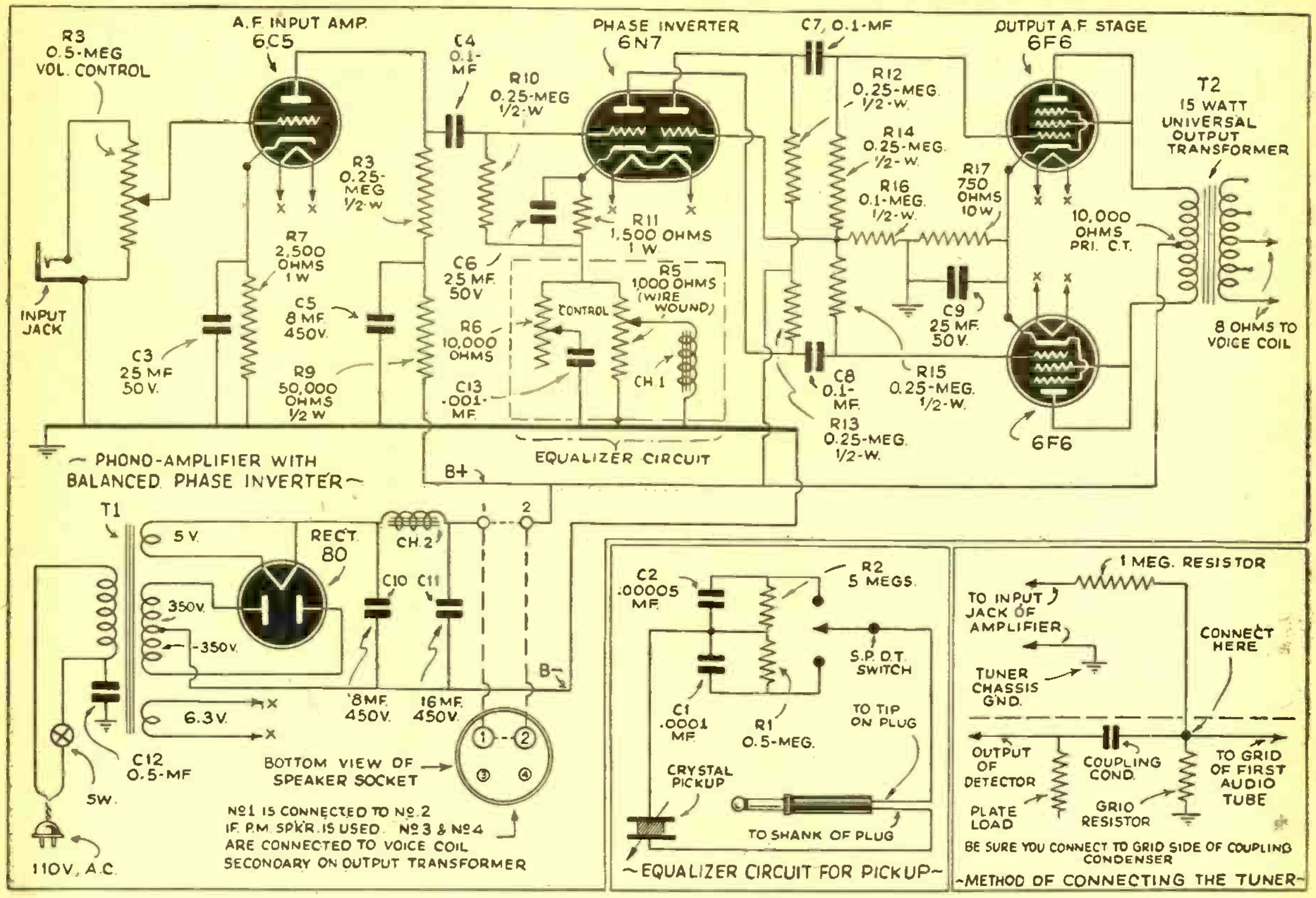


Diagram of the high-fidelity audio amplifier here described by Mr. Putnam. The cost of building the amplifier is very moderate.

former, and very much cheaper than a transformer which will give *high-fidelity* frequency response. Of course, there is the argument of unstability and difficulty in balancing the grid drive to the following push-pull stage; however, in recent circuit designs most of these difficulties have been overcome. In this circuit, shown here, using both triode sections of the 6N7 operating 180 degrees out of phase, we have a *self-balancing phase inverter*. The usual difficulty in these circuits is that of obtaining the same amount of grid drive on each of the output tubes; however, with the values used here for grid resistors and plate loading resistors, you will experience no difficulty in getting the circuit to work with excellent results. To allay most criticism from the engineers, I had better explain that I do not imply that the grid drive on both of the output tubes is EXACTLY equal; however, with the values of resistance ordinarily used, the ratio of signal voltage on one 6F6 grid to the other is approximately 1.1 to 1, or less. A ten per cent unbalance in the pushpull output stage is easily tolerated.

Incidentally, for those who may appreciate inverse feedback, degeneration, negative regeneration, or whatever you may please to call it this amplifier has it, since part of the output of one triode section of the 6N7 is fed back 180 degrees out of phase to its own grid. I might add, for those who are not familiar with the far-flung attributes of degeneration, that briefly it stabilizes the amplifier, decreases phase and frequency distortion, reduces the noise generated in the amplifier, and makes the amplifier independent of electrode voltages and tube constants, i.e., slight differences to be encountered in tubes of the same type from the same manufacturer, but perhaps slightly different in electrode characteristics. Actually, there is a small amount of gain lost in any degenerative circuit, this being a function of the voltage fed back and the original gain of the amplifier. The actual amount of inverse feedback in the circuit is comparatively small. This degeneration is one explanation for the difference in signal potential on the grids of the two 6F6's.

The *bass* and *high lift* circuit in the grid and cathode return of the 6N7 was designed by Wayne Batteau, one of our engineers here at the station, and we have used it with excellent results in the audio equipment here at WDWS. The effectiveness of either circuit depends upon the settings of the potentiometers connected across the inductance and the resistance in series with the capacity. To increase the "lows," you turn R5 to greater resistance, and to increase the "highs" you must decrease the value of R6.

Pickup Equalizer Circuit

Now we will consider the equalizer circuit in the pickup itself. It is characteristic of any crystal pickup to have a rising bass response, i.e., it has greater output on the *lower* range of frequencies. The equalizer circuit, or tone control, shown here, for the pickup will tend to flatten the response curve of the device and extend its response range to 6,000-7,000-8,000 cycles per second, depending upon the particular pickup you are working with. It is generally accepted information that the average popular-priced phonograph records are recorded in the range extending from about 70 to 6,000 or 6,500 cycles per second. Some of the better classical recordings extend into a slightly higher audio range. Usually it is true that the higher fidelity the reproducing equipment, the more audible surface noise and record "scratch" becomes. If, however, there is no "scratch" at all to be heard through the speaker, it is a pretty good indication that the amplifier is definitely *deficient* in the higher tonal range. Again it is a matter of choice and taste and presents no small problem around a radio station. Good engineering practice says that the response from the turn-tables should be substantially flat, even to 9,000-10,000 cycles per second, but the public in general says, "No, too much scratch." It is still a matter of taste.

Circuits All Tested

In concluding, I would like to assure you who are about to construct this complete assembly, or any part of it, that it is simple to build, the circuits are tried and tested, and the results will be excellent if constructed properly. All of the claims made herein have been verified with measurements taken with equipment here at the station. The distortion measurements were taken with the RCA 69B, direct-reading distortion meter at 400-1,000 and 5,000 cycles per second. All readings indicated less than four per cent overall distortion. Frequency response measured with the RCA beat frequency oscillator and Weston meters showed the amplifier flat within plus or minus 2DB, from 50 to 7,500 cycles per second, dropping off slightly to 9,000 cycles per second.

As we are primarily interested in reproduction of sound, a great deal of time will not be spent describing the cabinet. There are many possible arrangements for this assembly, such as a portable record player in a case, with the speaker and amplifier in a large cabinet. It is important to keep in mind the fact that a large cabinet is necessary if the speaker is expected to reproduce the lower bass notes. At least it should have a large baffle. In the case of the writer, I purchased the cabinet shown here for $1.50 and lined it with Celotex to reduce cabinet resonance or "boom."

The A.C.-D.C. *tuner* is connected through an old car radio dial by flexible shafts and mounted out of sight in the top of the cabinet. The shelf was put in to facilitate the mounting of the turn-table.

This is only one idea, and I am sure you will have better ones for a cabinet or arrangements to suit your own particular application.

Parts List

I.R.C. (Resistors)

R1—.5 megohm, ½ watt
R2—5 megohm, ½ watt
R7—2,500 ohms, 1 watt
R8—250.000 ohms, ½ watt
R9—50,000 ohms, ½ watt
R10—.25 megohm, ½ watt
R11—1,500 ohms, 1 watt
R12—250.000 ohms
R13—250.000 ohms
R14—250.000 ohms, ½ watt
R15—250.000 ohms, ½ watt
R16—100.000 ohms
R17—750 ohms, 10 watts

STANCOR (Transformers and Chokes)

T1—700 volt, center tap, 70 mills sec. with 5 volt at 3 amps. and 6.3 at 2.5 amp. filament winding, type P6011
T2—Type A3852, universal output transformer connected for 10,000 ohm primary 8 ohm voice coil
CH1—Type 1707, 10 henry choke
CH2—Type C1708, 9 henry choke, 85 mills

CENTRALAB (Volume Controls)

R3—Standard midget radiohm, 500,000 ohms, taper No. 1 with switch
R5—Wire wound radiohm, 1,000 ohms, part No. VF129
R6—Same as R5

MALLORY (Condensers)

C1—.0001 mf. mica condenser
C2—.00005 mf. mica condenser
C3—25 mf., 50 volts, type 14, electrolytic condenser
C4—.1 mf., paper tubular, type TP
C5—8 mf., 450 volts, type 61, electrolytic condenser
C6—25 mf., 50 volts, type 14, electrolytic condenser
C7—.1 mf., paper tubular, type TP
C8—.1 mf., paper tubular, type TP
C9—25 mf., 50 volts, type 14, electrolytic condenser
C10—8 mf., 450 volts, type 61, electrolytic condenser
C11—16 mf., 450 volts, type 64
C12—.5 mf., type TP, tubular paper
C13—.001 mf., paper tubular condenser

AMPHENOL (Sockets)

4—Octal sockets
2—4 prong sockets
1—No. B483, male type plug and receptable
1—No. B1625 plug

RAYTHEON (Tubes)

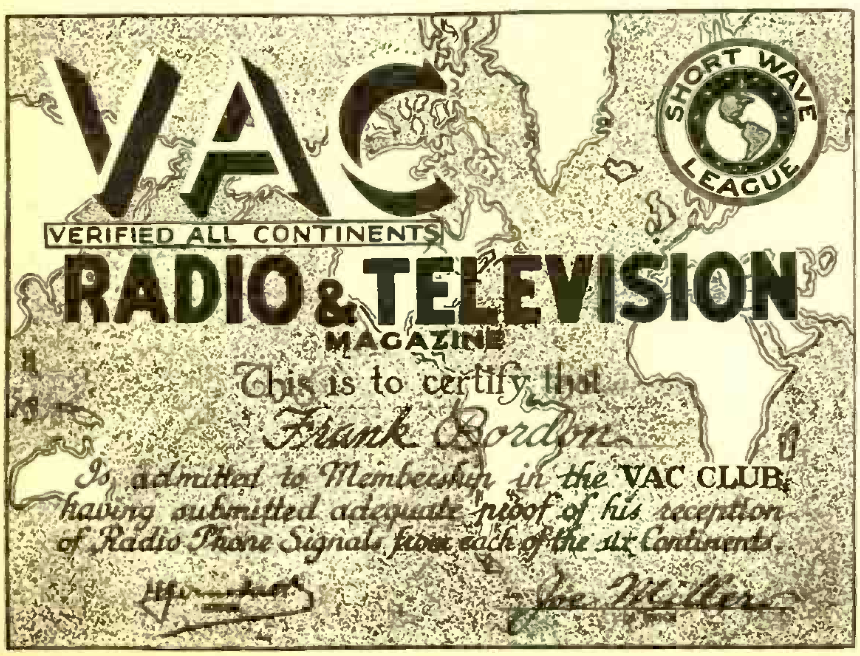
1—6C5
1—6N7
2—6F6
1—Type 80

MISCELLANEOUS

1—Carter closed-circuit phone jack and plug
1—7x13 crackle-finish chassis
1—12 inch dynamic speaker, either permo-dynamic or electro-dynamic, such as Utah model 12P, or any 12 inch electro-dynamic speaker (with 1,000 ohm field)
½ dozen terminal strips for mounting of parts
25 ft. cloth covered push back hook up wire
4-wire cable for connecting speaker, if electro-dynamic is used
Switch 1, single pole, double-throw switch, rotary type
Nut, bolt and washer assortment

Have You VAC?

● THE handsome 9" x 12" VAC Certificates are still available and will grace any DXer's wall. To be eligible for this DX honor, a phone QSL is needed from each of the 6 continents, Asia, Africa, Europe, Australia, North America and South America (Java and Philippines count as Asia). Send in these six QSL's with 25c for handling and costs; after checking, the QSL's will be returned with certificate. Address *V.A.C. Editor*, RADIO & TELEVISION, *20 Vesey St., New York, N. Y.*



Converting "Little Nipper" for Battery Tubes

Lee Garrison

Mr. Garrison, in the accompanying article, explains how he converted the "Little Nipper" 110-volt model receiver of the 9TX-30 series, so that it could be operated on batteries, using the new miniature type 1S4 tubes.

● THIS set was built for use by a friend who lives out in the mountains, a short distance from me. She wanted a set that would be inexpensive to operate, one that would "get" the stations and separate them satisfactorily.

I first built the set, using the "Three Tubes equal six in this superhet" circuit. While it worked good, the results did not satisfy me. There was too much rewinding of the oscillator coil, and as I wanted to keep the expense down and use everything in the set that it was possible to use, I discarded the circuit.

I found the answer to my problems in the new miniature tubes. The new miniature tubes more nearly duplicate the style of construction of the single ended tubes used in the electrical version.

While I did not use any specific diagram for this set, there are three commercial sets which contribute to the building of the finished product: RCA's new portable, Emerson DU 379 and a Montgomery Ward and Company radio.

After the set has been rebuilt, a slight re-adjustment of the tuning condensers and intermediate transformers, and the set is ready to go.

After you have drilled out the sockets which are in the set, cut four pieces of heavy tin to fit over them and drill a five-eighths inch hole in the center of each. After you place the miniature sockets in the holes in the tin, solder the tin pieces over the original socket holes. This is necessary, as the miniature sockets would just fall right through the holes for the original sockets.

Just a word about these sockets, they are so small and are not to be handled like the larger sockets, they won't stand it. My soldering iron slipped and I knocked off two of the prongs on one of mine and had to use a new socket. Don't have gobs of solder on your iron, or you'll have all of the prongs soldered together. How well my kid brother knows that now.

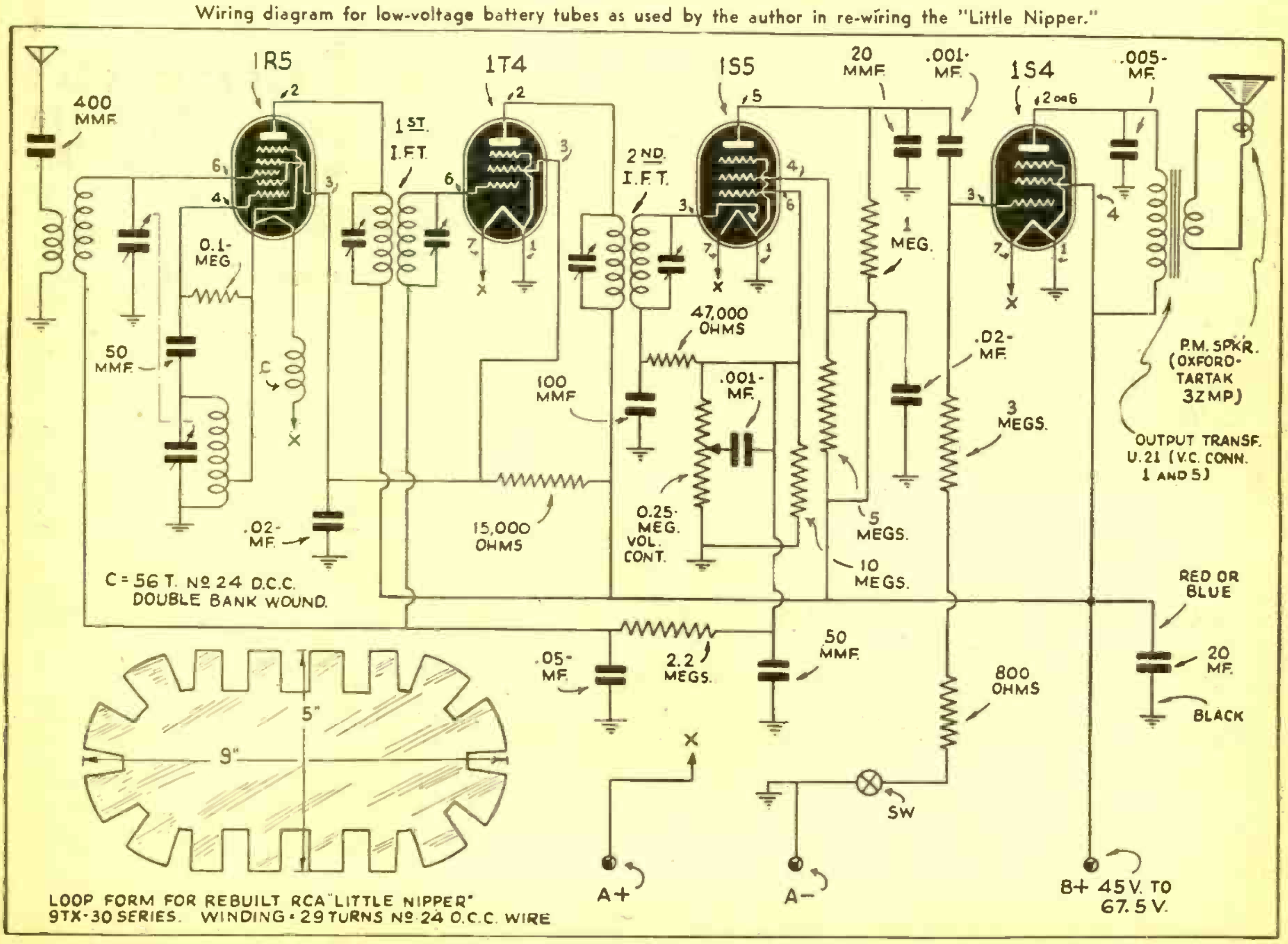
These sockets are so small and dainty looking that they would make dandy ornaments for the YL's or ex-YL's wearing apparel. A word to the wise is sufficient. Hi!

Another thing you will notice in the diagram is that the bias resistor, instead of being *grounded*, is returned to the "A" minus lead. This is necessary, as it keeps the "B" battery from discharging through the electrolytic condenser. Instead of putting the switch in the "A" plus lead I put it in the negative lead, to break the "A" minus and the "B" minus at the same time.

Loop and Oscillator Circuits

I used the resistors and condensers specified in the RCA miniature portable, except

Wiring diagram for low-voltage battery tubes as used by the author in re-wiring the "Little Nipper."



where noted; the oscillator circuit of the Emerson DU 379 and the loop antenna from the mail order portable (Montgomery Ward and Co.)

I have tried several different styles of loops, but this one seems to work the best. It is the easiest to make and the least tricky of them all.

Now, this loop is not needed, but as long as you have to buy the No. 24 double cotton covered wire to wind the choke coil, you might as well have a loop out of what is left. You can wind three loops and several choke coils out of a quarter pound of this wire, so why waste it.

This set gives excellent results with the "B" voltage as low as 35 volts (38 volts no load).

At 35 volts, the total cathode current is between 5½ mills (ma.) and 6 mills current drain. At 67½ volts, the current drain on the "B" supply is between 8 and 9 mills.

At 4 P.M., P.S.T., KSL, at Salt Lake City comes through with excellent volume. After dark, it gets practically all the stations that the set did before it was converted to battery operation.

Antenna May Be Used

In metropolitan areas, the antenna can be anywhere from 15 to 25 feet long. In the country a longer antenna is to be preferred; about 50 feet would be right.

If it is desired to use this set as a portable, the loop can be used.

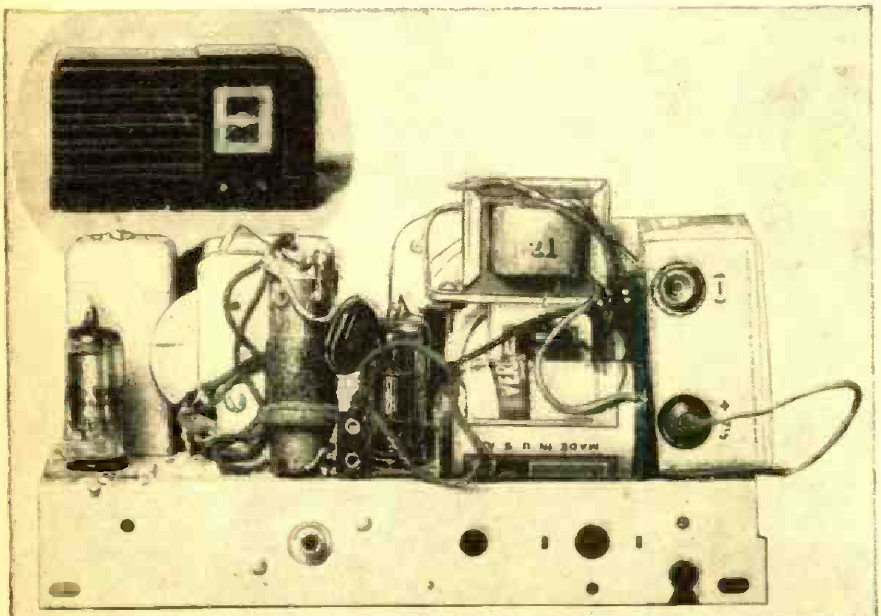
If the loop is used, connect the inner side of the winding to the tuning condenser and the outer end to the A.V.C. line. This loop works the best connected in that way.

The best way to make the loop form is to make a rectangle on heavy cardboard, according to the dimensions given. It may take just a little extra work to make the form, but the results justifies the extra effort.

If this set is to be used as a portable, the information below may interest the builders of this little set. It compares the finished set with four other miniature portables on the market. It is a comparison between the weight of the sets named, their cubic inch displacement, with that of the RCA Little Nipper, converted for battery operation:

RCA BP-10, 94.5 cubic inches: weight 4.5 pounds.

Emerson DU 379, 110 cubic inches: weight 5 pounds.



Appearance of the re-vamped Little Nipper for operation on batteries is shown above, as well as appearance of the front of the set.

Philco Transitone, 200 cubic inches: weight 5 pounds.

Tom Thumb, 412.5 cubic inches: weight 5 pounds.

Rebuilt RCA, Little Nipper, 9TX-31, 186 cubic inches: weight 4.5 pounds.

If the local grocery store scales are correct, and I believe them to be, the Little Nipper is second in weight to none and only third in cubic inch displacement.

Best Battery to Use

If you use this set as a portable, the Eveready No. 467 portable "B" battery can be used in conjunction with a size "D" flashlight cell. All batteries in the cabinet. As a house set, the standard 45 volt Eveready layerbuilt "B" battery should be used in conjunction with a larger "A" battery. You can understand the above better since the No. 467 "B" battery lasts only 40 hours and a flashlight about two to three hours. The larger batteries last longer and are more economical to use, since weight is of no object in a house radio.

To rebuild this set you strip the chassis of everything but the intermediate transformers, volume control, don't touch the A.V.C. line, leave it as it is, tuning condensers and coils. There is an .01 mf. condenser connected between the oscillator section of the tuning condenser and the grid of the tube, remove it and connect the tuning condenser direct to the coil. Leave the phono input as it is, you can use it for playing records through this radio. Save all of the condensers, with the exception of the .25 mf. tubular condenser and one or two others.

All you need to buy is tubes, sockets, speaker with output transformer, batteries and a few condensers and resistors. This set can be built for about $12, according to what you pay for the RCA Little Nipper secondhand, which should not be much; probably $3 or $4; mine cost me $2.50.

The 1R5 is placed in the socket which is over the socket hole of the 12SA7, the 1T4 in the socket which is over the socket hole of the 12SK7, the 1S5 in the socket which is over the socket hole of the 12SQ7 and the 1S4 is placed directly behind the speaker, a five-eighths inch hole being drilled there for its socket. By placing the tubes thus, you will not need to lengthen the existing I.F. leads nor the leads from the tuning condensers.

I specified four pieces of tin, but you will only need three with the miniature sockets placed in holes drilled in them, as the hole for the output pentode is drilled in the chassis behind the speaker. The speaker goes in the same place as the original one did.

I do not think anyone who has had experience in building radios or who can read a diagram, should have any trouble with this one.

There is nothing specified which is not needed.

Parts List

NEW ENGLAND RADIOCRAFTERS
1—Kit of "C" type coil forms (5—no less than this amount sold)
1—Bottle of polystyrene #PQD coil dope for choke and loop

RCA
1—Little Nipper, 9TX-30 series (secondhand)

I.R.C. (Resistors)
1—15,000 ohm, ½ watt resistor
1—100,000 ohm, ½ watt resistor
1—10 meg. ohm, ½ watt resistor
1—3 meg. ohm, ½ watt resistor
1—5 meg. ohm, ½ watt resistor
1—1 meg. ohm, ½ watt resistor
1—800 ohm, ½ watt resistor

AEROVOX (Condensers)
1—20 mmf. mica midget condenser
1—.005 mf., 200 volt condenser
2—.001 mf., 200 volt condenser
1—.0001 mf., mica midget condenser

OXFORD-TARTAK RADIO CORP.
1—3ZMP PM speaker
1—U21 output transformer (voice coil leads 1 and 5, for 800 ohm plate load)

AMPHENOL
4—Sockets for miniature tubes (1SR type)

BELDEN WIRE CO.
¼ pound #24 D.C.C. for loop and choke coil

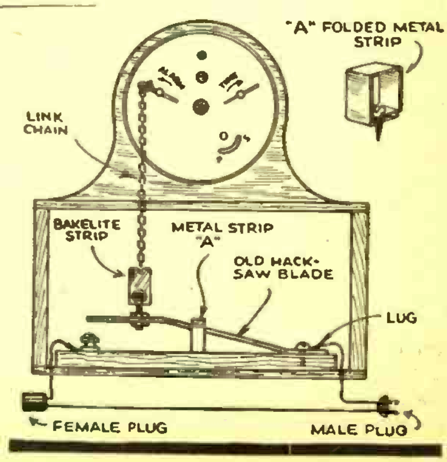
SYLVANIA (Tubes)
1—1R5
1—1T4
1—1S5
1—1S4

EVEREADY BATTERY CORP.
1—Minimax #467 or 1 standard size layerbuilt "B" battery
1—Size "D" flashlight cell or 1—#6 dry cell

MISCELLANEOUS
Choke coil—56 turns #24 D.C.C. double bank wound on ¾ inch form, length of winding ¾ inch; approximate 35 microhenries inductance (for winding of double bank windings, see *Ghirardi's Radio Physics Course* at local library).
Loop—29 turns on #24 D.C.C. wound on form (see drawing for size and shape of loop). One complete turn of wire for antenna and ground winding, wound on outside of loop.
The inside of the loop goes to the tuning condenser, and the outside goes to the A.V.C. line (yellow wire on RCA Nipper). No connection between the antenna winding and the secondary of the loop.
4—Fahnestock clips, which may be obtained from an old "B" battery; while these clips are not needed, they aid in removing the loop and allow one to use either loop or original coil in the set at will.

Automatic Time Switch

This simple but efficient unit may be used around the Ham shack to turn on or off radio sets or other electrically operated devices. A cheese box was cut down for the base and an alarm clock mounted on its top. The spring is an old hack-saw blade and should be sanded to make better contact. A small bakelite strip was used to insulate the switch from the clock. The metal square designated as (A) is shown in a front view; it's used to keep the alarm handle from completing a circle and turning the switch back on. If silent operation is desired the alarm bell must be removed. To turn the switch on, the alarm handle must be reversed.—*Robert W. Pipher.*



Inexpensive Test Instruments for the Experimenter

William J. Vette

● UNLIKE the serviceman who, once established in a business can buy expensive testing equipment and charge it up as an investment which will be returned several times over, the experimenter must count his pennies which will be spent for radio materials; seldom does he have enough to spend for the parts he needs, let alone for test equipment.

Possibly more of us would own adequate equipment, were it not for the fact that such equipment costs quite a little. Some of us have perhaps a meter or two, and anything outside the range of this meager equipment must be met with only a good guess to go by.

For experimental purposes, the elaborate multi-range equipment is not absolutely necessary, I have found in my own work. I have found, over quite a period of time, that a means of checking D.C. voltages of all ranges, and some way of determining resistance values were all I absolutely had to have, though occasionally I had need of an A.C. voltmeter. Since I seldom had need for a meter for checking current values, especially in the lower ranges, I concluded that this feature, heart of the cost of most test instruments, was a luxury I could better be without than afford.

I found that it was not only simple, but easy and inexpensive to provide myself with an instrument capable of performing all the functions I absolutely needed. I was able to take a very low priced voltmeter of very low range, and not only increase its testing range many times, but also to put it to work, in conjunction with a simple formula, to determine resistance values.

Increasing Range of Voltmeter

My meter equipment is the result of the fact that the range of any voltmeter can be extended almost without limit, by merely using external series resistors. Knowing this, it is a simple matter to provide oneself with a voltmeter of low range, at very little cost. While these conversion facts and formulae may be applied to any D.C. voltmeter the experimenter may have, or have access to, my own experiments have been based on the meter which sells for the lowest price of all: the Readrite models 55 and 95. Since these were the meters used by the writer, the resistance readings given at the end of this article are for the meters of this line most suited for use with these formulae.

While these meters are not the most accurate to be had, they are adequate for most experimental purposes, and are as well adapted to service work in many cases. Besides being a vital adjunct to the experimental bench, the meter system described here is ideal for use by the serviceman just getting started, and without sufficient funds for more elaborate equipment right at first. If more precision is desired or needed, the formulae here are as well adapted for use with more expensive and accurate meter equipment, if your pocketbook can stand it, or if a better meter is easily available to you.

It is best to select a meter having a fairly low maximum scale, and this scale will be used for reading voltages within its range. While the ideal arrangement is had with a meter reading to, say, 5 or 10 volts, meters reaching as high as 25 volts or more may be used. My own meter has a basic scale of 0-5 volts, and is extended by four extra ranges, to 20, 50, 150 and 500 volts, as these are the particular ranges I find most useful.

Value of Multiplier Resistance

In order to find the correct series resistor needed for each range, it is necessary that you know the internal resistance of your meter. If this does not appear somewhere on the meter itself, you may often find the values in various radio catalogs, and if not there, write to the makers of your meter. It is for those who must buy the cheapest that the resistance values of the Readrite meters are given.

The formula is simple, and doesn't involve any complicated or difficult calculations. The resistance for external application to your meter is found as follows:

$$R_1 = R \frac{E_1 - E}{E}$$

in which R_1 is the desired resistance, R the internal resistance of the meter, E the present maximum scale reading, and E_1 the new maximum desired to read.

The resistors used to extend the range should be as accurate as possible, although they needn't be held to any closer tolerance than the meter in use.

It will, of course, be necessary to multiply the scale reading with a figure corresponding to the ratio of the scale to the new range; for example, if a meter with range of 10 volts has been extended to read 50 volts, all readings will be multiplied by 5 in order to get the correct voltage values.

The multiplier resistors may be connected to a rotary switch for range selection, or, at less cost, may be connected to small tip jacks, with a small plug used for selection.

Using a Voltmeter for Resistance Measurements

An ohmmeter, highly accurate, and calling for use of a very simple calculation, is at the disposal of all who possess an ordinary D.C. voltmeter and a source of D.C. voltage. A resistor of known and fairly accurate value will be needed, and while the calculation of resistances by this method is not quite so handy as reading them on the scale of an ohmmeter, it is a lot cheaper, and, unless the ohmmeter is an especially good one, more accurate, even to reading fractional values, which is a quantity many ohmmeters leave to the imagination.

The calculation involves merely the reading of a voltage across a resistor of known value compared with a reading across the unknown resistor, which is in series with the known value, and across the same supply, which is selected to be within the range of the meter in use. The formula is:

$$Rx = \frac{R\,E_1}{E}$$

where Rx is the unknown value, R the known, E the voltage reading across the known resistor, and E_1 the reading across the unit under test.

For example, suppose you have a known value of resistance equal to 1000 ohms, giving a reading, when in series with the unknown value, of 100 volts. Then suppose the unknown resistor gives a reading of 10 volts. Applying the above formula to this gives a value of 100 ohms to the unknown resistor.

Internal resistance of Readrite Model 55 and 95 voltmeters (D.C.) for use in conversion to multi-scale meters.

Volts range	*Resistance (ohms)*
0-1	18
0-3	135
0-5	310
0-10	1475
0-25	1625
0-15	2700

Another 0-25 voltmeter is made by this company, with a much higher resistance, 7720 ohms.

Diagrams herewith show how to increase the range of a voltmeter and method of measuring resistance.

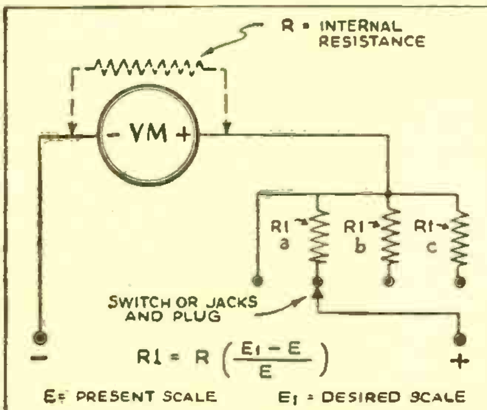


FIG. 1 — MORE VOLTMETER RANGE BY USE OF MULTIPLYING RESISTANCE —

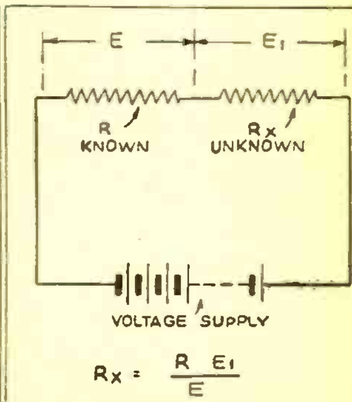


FIG. 2 — FINDING UNKNOWN RESISTANCE WITH VOLTMETER —

"CQ"

Larry LeKashman, W2IOP

IN line with the new QSL spirit Thornton Lyford has formed a new club to be known as the Radio Card Swapper's League. For full particulars SWL's are cordially invited to write to Thornton Lyford at 260 Woodlawn Avenue, Hubbard Woods, Illinois.

Speaking of Illinois, the University of Illinois is planning a Radio Interference Conference to be held in Urbana, Saturday, May 10th. The purpose of the conference is to inform radio service men, radio amateurs, public service interference trouble-shooters and radio engineers of the sources of radio interference and their correction. It is hoped through this conference to clear up many misunderstandings which have caused much friction in the industry.

Some of the topics to be discussed by outstanding engineers are generation of combination frequencies in a non-linear element, diathermy interference, receiver design to minimize strong signal interference, panel discussion on interference between radio amateurs and the broadcast listeners, the adjustment of transmitters to reduce spurious emissions, reduction of appliance interference and other kindred topics.

Our old friend, W9BRD, has just sent out a special QSL card for the QSL party. On the back of each card there is printed the following:

"The exchange of confirmation cards of contact between radio stations or between listeners and radio stations has always been a great tradition of radio. The amateur who refuses to verify communication with his station gains no friends and may lose many by not so doing, since the majority of active amateurs derive a vast amount of pleasure from this phase of their hobby. Your QSL file is a good yard-stick with which to measure the efficiency as well as the activity of your station. This is a much more authentic and colorful proof of contact than a mere log. How many states have you verified separately on each of the ham bands? A station boasting of a confirmed WAS on three or four bands has made no slight accomplishment even if its real DX is limited. There is a wide assortment of objectives to be attained in which the QSL plays an indispensable part. Do you need cards? Ask for other samples of cards by an active ham, W9BRD."

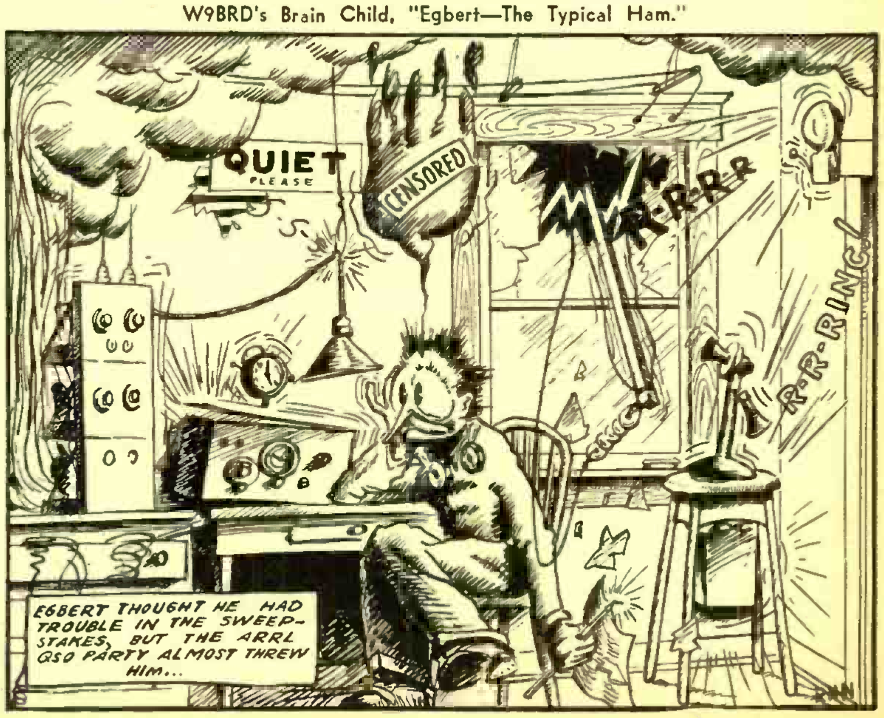
It is a worthwhile reminder that QSLing is by no means extinct—as so many amateurs would have us believe.

W9BRD's letters are worth reproducing in their entirety. Starting with a description of his latest creation, Egbert, as portrayed in the cartoon illustrated, Rod goes on to say (with slight censorship here and there)—

Egbert is the typical Ham. The striking resemblance to an owl is possibly due to Egbert's first year of hamming, when he exhausted all the midnight oil and had to DX in the dark. Egbert did pick up an XYL somehow and now they are both kinda sorry. But she's getting used to it. Egbert is exceedingly pro-ARRL, by the way, and takes part in all ARRL activities. He might even be an A-1 op if his rig would only hold together long enough to let him get used to it. Egbert's time is divided pretty evenly between all phases of radio and bringing home the family bacon.

Well, now that I got that plug in, let's see if I have any dope to bring to light here.

W9BRD's Brain Child, "Egbert—The Typical Ham."



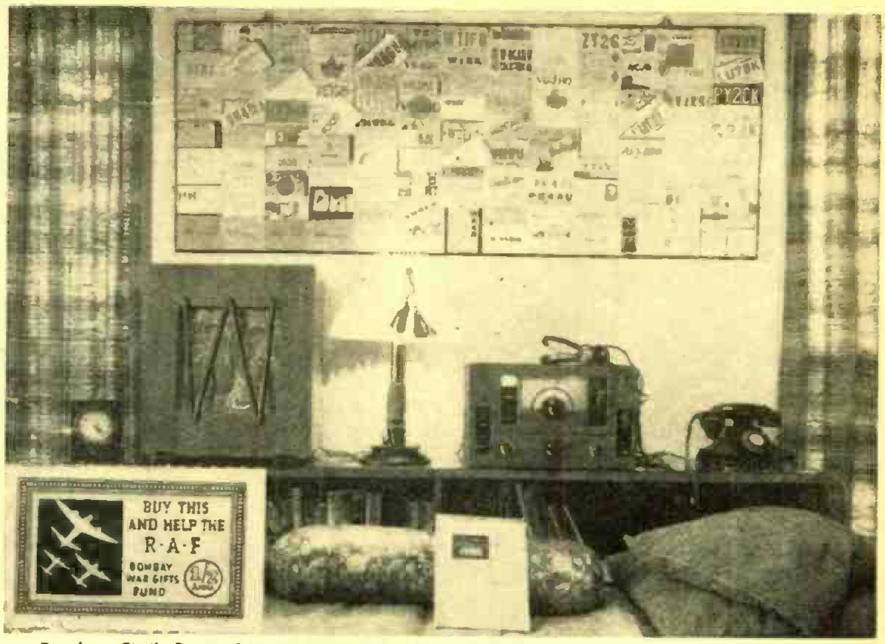
ARRL party scores are scarce up to now. I haven't had too much time to hunt up the boys on 80, but I sent out about a half dozen or so messages to 3BES, 1TS, etc., and when they bring response then I can give you more info. Or maybe you have taken care of that yourself. Anyhow, W9FS had over 400 QSO's in 60 sections, I hear. 3DGM had 355 in 59 for 41,000 some points. 8NDS had 334 in 56 for 40,000. Those are the high scores I've heard from. Poor 9BRD got only 290 in 56 for 35,000. But, needless to say, he is very determined to do better with his 75 watts next time, drat it. Maybe I need a strong second harmonic and another receiver, I dunno.

My input is gonna stay below 100 watts, though, and I don't see how I can put up any better skywires, so I'll just have to brush up on my operating. 3BES suggested I throw out my homemade super and get an HRO or NC-101X. 4DWB and numerous others advised me to QRO. 9ELC told me to quit using the gutterspout for an antenna. Perhaps the best idea comes from 9VES who suggests a new operator.

At any rate, look out for me next month in the 1.7 mc. WAS affair, as I am going to wind a 160 meter final coil and feed about 50 watts into my 40 meter zepp tuned against ground. The last time I wound a final coil for 160 it wouldn't work on 160 but FB on 80, so I threw away my old 80 meter coil. This time I'm going to use small enough wire to fit enough turns on the form, doggone it.

The BBC has a new BC station smack in the middle of 40 meters with an indescribably loud signal when conditions are right for G. Covers about 40 kc. on my pile. How long is this going to continue? It's bad enough that we have XE and CM fones splattering all over our best CW band, but any more of these super-powered European BC (broadcast) jobs are going to ruin it utterly. The effect, of course, will be worse in winter than in summer, and will increase during this part of the sunspot cycle. Will 40 meters become as deserted at night as the low end of 20, since the fones chased out the CW? The signal that G station was pouring in here the other night wouldn't have been touched by our puny heterodynes, even by a sig from W1AW. A local SWL who gets a whack out of foreign BC reception recently told me to quit interfering with his reception from the new 41 meter BC band stations (our 40 meter band) and said he would even go as far as the FCC if necessary. I'm not worried about that, but Larry, if too many people start thinking likewise, GB 40 meters.

Local dope from local dopes: 9KIO is on with a new transmitter using parallel T20's final, 125 watts. 9BUD is working out neutralizing difficulties with his new 100 watt parallel 6L6G's final. 9FWR, physically disabled, challenges any and all to games of checkers on 7210 kc. 9VES was grinding away in ARRL QSO party



Bombay SWL Post of D. R. D. Wadia. Note R.A.F. war sticker in lower left corner.

without his raisin filter! 9ZTX has one, though, and is back on with 200 watts, eco, 7 mc.; also in the ARRL party for a while. 9MUX was pounding away in party with the regular bunch, 9TH, GY, PKW. 9SG holds forth on 7005 kc. CW while 9SGA hits ten fone from same QTH. Chicagoans on ten fone, 9HVS, FXB, GV, IJX, IHI, YUC, VZW, JN, AI. 9AI, by the way, works out like a kw. on both 10 and 20 with nothing over 50 watts, an 8JK on 10, and keeps the CW from getting too rusty on 40 meters. 9UJR has a little ten fone going, along with the 200 watt 40 CW rig. 9QEE has a half kw. and now minus key, clicks on 14 mc. Local signals, on the whole, sound much better since 9BRD got rid of his clicks, parasitics, harmonics, etc., by correctly neutralizing his final. Conditions on 160 are better than ever for this time of year, but the BCL's are as crabby as always. 9IDH blew part of his 7 mc. rig so is QRM'ing on 80 now with a 6L6. 9TTJ continues to shove traffic vigorously on 80. The 160 CW gang continues to go strong, led by 9ZBG, ABZ, CMZ and GRB. Coast-to-coast evening contacts on that band are reported frequently, with QRP, too. The party next month should be hot.

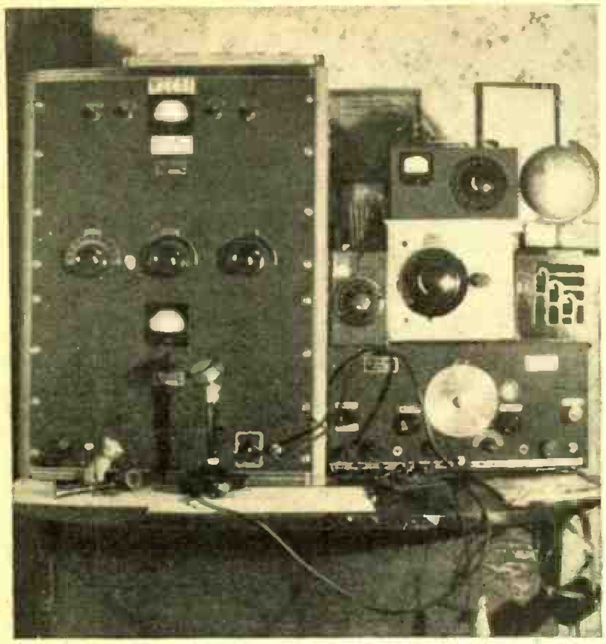
Miscellaneous: The Chess Wireless Association invites all radio chess fiends to join in. Sundays on 7280 kc. in the afternoons and most evenings on 3640. 9NCS, JRI, HMO. VDY, 3EEW and 9BRD can be heard regularly mentally QRM'ing each other.

The YLRL announces a 40 meter QSO party in conjunction with FTS (Forty Traffic System) Feb. 1-2, 8-9. You OM's who wanna meet some snappy and cute YL ops better sign up with FTS quick, as the two organizations have conjunctional parties frequently; drop request for appointment to Nils Michaelsen, W2LSD, if you are interested in 7 mc. traffic work and have a rock between 7200 and 7250 kc. 40 meter traffic handling is an art and a science in itself with erratic skip to combat. Messages for destinations a hundred miles away frequently take journeys of a thousand miles or more and to do so without too much loss of time requires snappy opping. No, you can't join the YLRL!

8QYK, one of the smoothest fists in Michigan, got married and is now working for the Gov't. 6PH misses his ZS QSO's and runs 200/800 w. on 40 from Salinas. He says Bolinas may have KPH, but Salinas has 6PH . . . (College cheer.) 9EYH, one of the middle west's crack ops, still is off the air. How Wally could resist an ORS Party, Sweepstakes and ARRL Party in succession is a mystery to me. W5IGO, Oklahoma's best YL op, now has ECO. This has effectively broken up the stag line around 7220 kc., but has simply moved it elsewhere around the band. K6QUJ gets more calls per CQ than any 7 mc. station (even 5IGO) and he keeps 'em short. Several PY's and LU's are occasionally heard boring in on CW on 40, as well as the usual XE and CM. Judging from the signal strength of Euro fones, K6's and South American fones, 7 mc. would be the ideal DX band right now. Darn Hitler, anyhow! One thing has been proved, though, removing DX does cut down QRM considerably by eliminating all those rock-crushing "CQ DX's" we used to hear. But I'll take my DX, QRM and all. Add BL's: HRK2 on 7100 kc.

One country now on the air is K5AX in Panama proper.

W1CH swings a mean bug for a 20 meter 'phone man. Why don't some of those boys get wise to themselves with W1AW sending out code practice just outside the high end of the band? W9ELC is going to build a new rig which won't be laughed at so much, he sez. Just so nobody laughs at the signal it's OK, and just so there aren't too many exposed hot spots. 9CRK, an 80 meter traffic fiend who has 9EYH's final now, said he is going to K6 with the army. W9ENH, a real OP, has 30 watts on 160 CW and knocks off anything he hears. W9GFF was batting off the ARRL contacts on 7 mc. W9LPS, W9MSS and W9KYX are charter members of the Stancor 1OP club on 160 fone. KYX also knocks off 7 mc. DX. 9MCM had trouble with his modulator and joined the 7 mc. gang.



Photos herewith show Eugene M. Gillespie, operator of amateur station W2EAF, located at Mt. Vernon, N. Y. A Thordarson transmitter line-up is used; the receiver is a Hallicrafter "Sky Challenger". Antenna is Premax "rotary beam," atop a 35-foot steel pole.

"Honor" Plaque Awarded

To Eugene M. Gillespie, W2EAF

For Best HAM Station Photo

Editor:

The transmitter is a Thordarson; tube line-up is 6J7, 6F5 driving a 6F6, which in turn drives a pair of 6L6's in Class B. Plate modulation is used. The RF section of the transmitter is 6L6 crystal oscillator, 6L6 doubler-buffer and a TZ-40 in the final stage. The output is 125 watts on CW and 100 watts on phone.

Operation is mostly on the 20 meter CW and phone band. A Turner crystal mike (VT-73) is used at this station. I am using a Hallicrafter "Sky Challenger." You will also note a frequency monitor and a combination "modulation" and "field strength" meter in the picture.

The antenna is a two-element rotary beam (Premax elements) controlled from the operating table.

A total of about 50 countries have been "worked," on both CW and phone, mostly on 20 meters. The transmitter is designed for operation in the 5 to 160 meter bands.

Have been in the Ham "game" since 1912.

EUGENE M. GILLESPIE, W2EAF,
21 No. 7th Avenue,
Mt. Vernon, N. Y.

•

Here is the new "Award of Honor" Plaque which measures 5" x 7" in size. It is handsomely executed in colors on metal, and is framed, ready to hang on the wall. The name of the winner will be suitably inscribed.

•

Note These Important Rules

Attach a brief description not longer than 300 words, describing the general line-up of the apparatus employed, the size, type and number of tubes, the type of circuit used, name of commercial transmitter—if not home-made, watts rating of the station, whether for c.w. or phone or both, etc., also name of receiver.

State briefly the number of continents worked, the total number of stations logged or contacted, and other features of general interest. Mention the type of aerial system and what type of break-in relay system, if any.

Important — Enclose a good photograph of yourself, if your likeness does not appear in the picture!

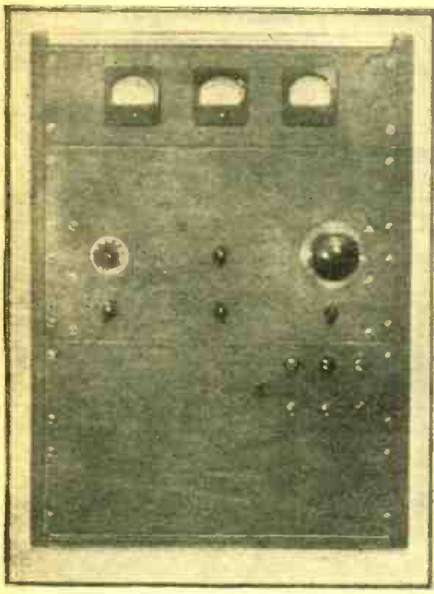
You do not have to be a reader of RADIO & TELEVISION in order to enter the contest.

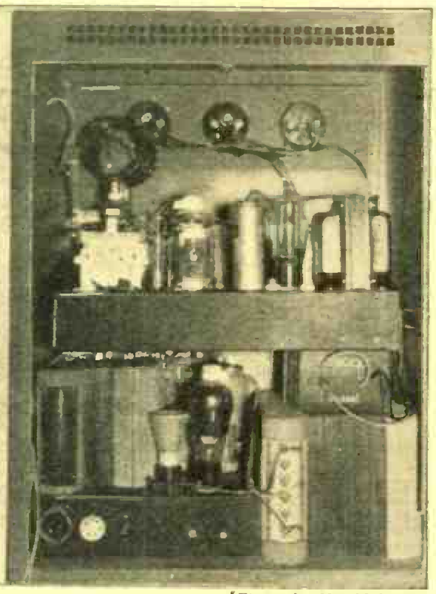
Address all photos and station descriptions to Editor, Ham Station Photo Contest, c/o RADIO & TELEVISION, 20 Vesey Street, New York, N. Y.

Further Notes on the

"Compact Kilowatt" Transmitter

Larry LeKashman, W2IOP





[Photos by Harold Levine

Front and rear views of the Compact Kilowatt transmitter, the revised version of which is here described by Mr. LeKashman.

● AS promised two issues ago, we are presenting herewith the final solution to the technical and mechanical problems that arose in the "Compact Kilowatt." The short-comings of the transmitter, in a broad sense, were lack of excitation on the higher frequencies, parasitic oscillation on the lower frequencies and as a by-product of both these faults, inability of the transmitter to operate with all stages on the same frequency.

It would seem logical enough from the first study of the problem that all the oscillation, both parasitic and R.F. could be traced to the mechanical layout. On the drafting board the first design seemed fundamentally sound but it was not until many hours of research that its faults became apparent. Naturally the construction of a kilowatt transmitter in a 29" rack would involve numerous problems which one might not normally encounter. Working from the design of two months ago we attempted to remove the oscillation by neutralizing the 813s. This, of course, if it worked, would have been the simplest solution of the entire problem. The inter-electrode capacity of this tube is such that for correct neutralization they must be fully shielded. This meant, at once, a mechanical change. The characteristics of the tubes as released by the manufacturers were based on the fully shielded operation, which is extremely important in screen-grid tubes of this nature. The mechanical changes made were—*dropping the tubes below the chassis and completely isolating the input and output circuits.* It was necessary to remove the band-switching assembly in the grid circuit of the 813s, since there was not sufficient room to do a good job of shielding. The Bud type OCL coils, with link completely collapsed, were used in place of the band-switching assembly. The fact that the link was almost entirely removed for normal operation was another point in making the band-switching unit impractical. As further assistance in the control of excitation to the final amplifier, a variable potentiometer was placed in the cathode circuit of the 807. These complex excitation controls have all proved desirable, if not essential, since the 813 is such an easy tube to "over-drive," under correct operating conditions. The Meissner *Signal-Shifter* was capable of supplying sufficient excitation to the 813 on all bands, when a tuned grid was used. This system was not adopted because it made no provisions for doubling. Using the Signal-Shifter into the 807, it was possible to *over-drive* the 813s by over 700%!

Numerous improvements in the circuit for the "Compact Kilowatt" transmitter described in the January issue of this magazine are here outlined by the author. Many helpful suggestions are also included, which the Ham beginner will find valuable. This transmitter was used in the A.R.R.L. QSO party; it performed with very gratifying results. 375 contacts on three bands in 17 hours, proved that it could really "step out and go places."

The physical layout of the transmitter is well illustrated in the accompanying photographs and the mechanical chassis layout. It is essential that these plans be adhered to, if maximum results are to be obtained with these high-power beam-power pentodes. It should be pointed out that the neutralizing condensers used to remove the last trace of oscillation are not standard items obtainable from the shelf. They are Bud 1930 condensers which have the rotating plug cut down to 1/3 its original size, in order to reduce the minimum capacity. To clarify the situation, the accompanying sketch shows the operation performed. Under no circumstances should an attempt be made to neutralize the 813 with a 6L6 or similar voltage-neutralizing condensers. Home-made condensers with a low enough minimum capacity are easily made, but more than likely their physical dimensions will exceed the limitations in this compact transmitter. For break-in operation, *hash-filters* were put on the 866s, but frankly the new shielded type rectifiers are more effective and will prove a worth-while investment.

Except for the *tube line-up* and the physical dimensions for the transmitter, there is little in common between the previous and the current edition of the "Compact Kilowatt." The filament transformer which is one of Kenyon's variable input type, has proved excellent in making possible critical control of filament voltage on the 813s. When one has forty-four odd dollars invested in tubes, it is best to be careful in observing the ratings. By varying the input types on the Kenyon 312, it is possible to obtain the exact voltage on the 813 under varying line-load conditions. Completely "debugged" this transmitter makes an excellent *all-band* job, with no "ands," "ifs" or "buts" attached to its operation.

Needless to say, the transmitter should be completely *grounded* in order to protect the operator against any possible failure of high voltage components, as well as to provide maximum effectiveness of the shielding.

The transmitter as described holds its tuning extremely well over considerable frequency-spread, which is extremely helpful for all types of operating.

We might call your attention to the fact that the proximity of the Simpson Meter to the R.F. amplifier in no way affected its operation. While this might be considered an achievement for Simpson products, we do advise careful by-passing of the meter contacts.

The transmitter, exactly as pictured, was used in the ARRL QSO and operated and performed with gratifying results. 375 contacts on three bands in 17 hours amply proved that the transmitter is *really* working! Not yet tried on phone; look forward to the cathode modulator for 813s and other high-power pentodes.

Compact Kilowatt Parts List

RCA RADIOTRON (Tubes)
807 2—813's 2—866's

JAMES MILLEN MFG. CO.
1—10008 tuning knob
2—37001 safety plugs
4—36001 safety caps
2—33004 sockets
1—33005 socket
1—33008 socket
1—77083 hash filter
3—34100 RCF
1—34150 RFC
Type 31001 standoffs

IRC (Resistors)
All resistors as indicated on circuit
½ watt, type BT½
10 watt, type ABA
100 watt, type HAA

PAR-METAL (Panels & Chassis)
1—MG 3003 meter panel
2—G3605 front panels
1—DL 2613 rack
2—B4536 chassis
2—SB713 chassis brackets

KENYON
1—T385 813 fil. trans.

E. F. JOHNSON
813 sockets

BUD
OCL Grid Coils
3—JL16985 pilot lights
1—OCS 3 band-switching unit
1—SH278 shield
1—SH293 shield
2—NC1929 neut. cond.

BARKER & WILLIAMSON (Coils)
1—HDV base assembly
Type HDVL coils

CARDWELL (Condensers)
1—XG 110 XD, C4
1—EU140AD
1—ZU100AS

SIMPSON (Meters)
Model 27 illuminated meters
0-25 ma.
0-150 ma., M2
0-750 ma., M3

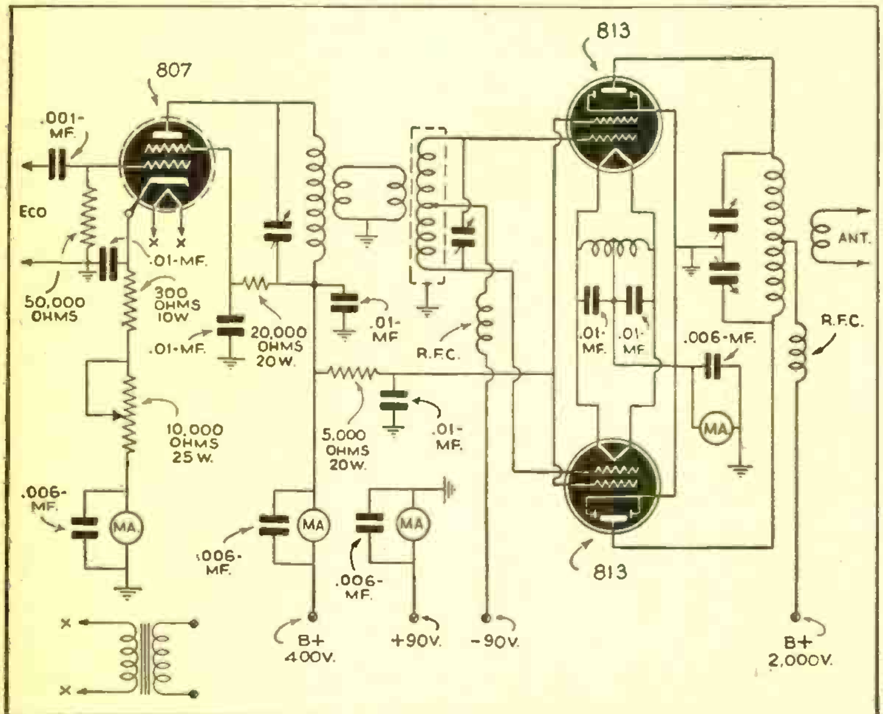
GUARDIAN
1—Model X-100 overload relay—RY1

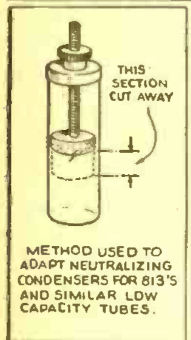
CORNELL-DUBILIER (Condensers)
(All condensers as indicated on circuit) .01 by-pass may be paper
C1—(HV supply) TQ 30020
C2—TLA 6040
C3—TLA 6040

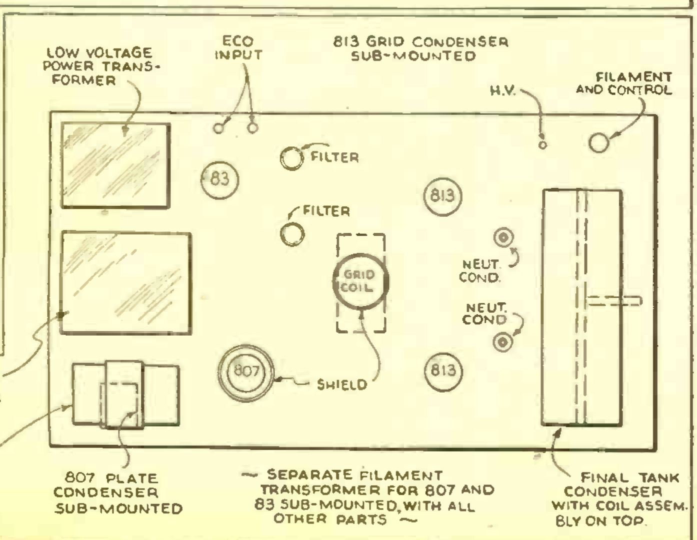
STANCOR (Transformers & Chokes)
THOROBREDS
1—T8005 plate trans., T1
1—C2313 choke, CH1
1—P8023 HV fil., T2
STANDARD LINE
1—P4081 6L6 plate, HV only, T3
1—P6289 fil. windings only, T4
1—C1421 choke, CH2

AMPHENOL
Plugs

Revamped diagram of the transmitter here described, as well as chassis layout.



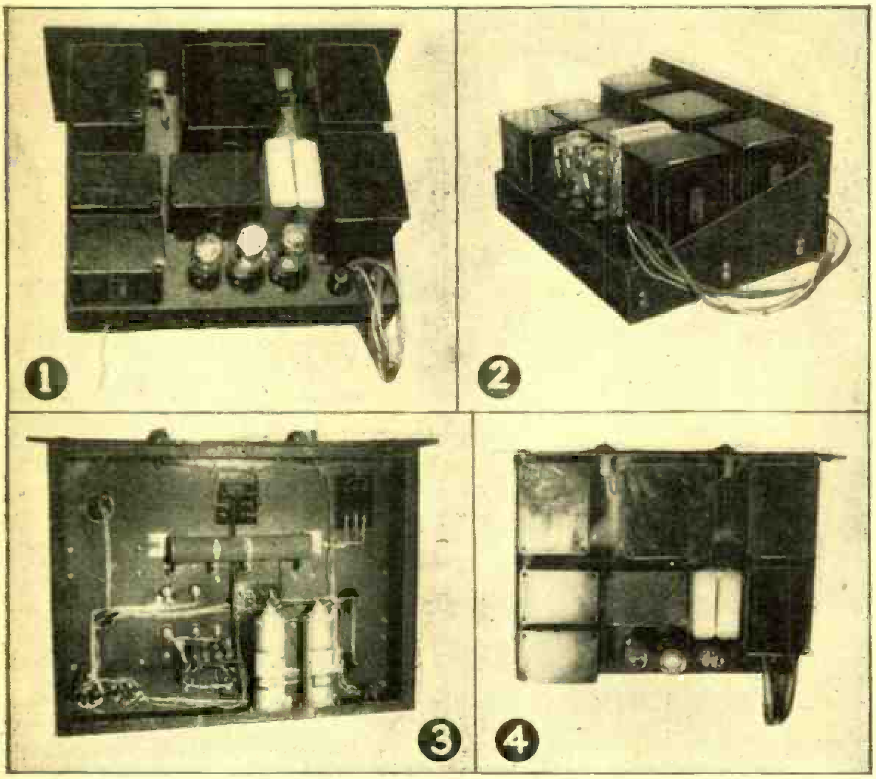




A "Pull-Swing" Frequency Modulation System for the Amateur

Part 3—Power Supplies

Ricardo Muniz*; Donald Oestreicher**; Warren Oestreicher***



1—Top view of power supply, showing tubes and connector plugs. 2—General view of power supply, showing general arrangement. 3—Bottom view of power-supply, illustrating mounting of parts. 4—Top view of power supply, showing tubes and connector plugs.

Power Supplies: In designing a power supply for use with the frequency modulation transmitter the authors considered it advisable not only to make a power supply applicable to this unit, but to make a dependable, sturdy supply which could be used wherever voltages in the order of 200 to 600 are needed.

The evolved unit is a supply which will give 250 volts at 250 ma. and 500 volts at 350 ma. or (by use of the primary taps), 350 volts at 250 ma. and 600 volts at 350 ma. It is readily apparent that these voltages and currents can be used to supply all but the final stages of any medium power transmitter. The oscillator and buffer stages can be run from the 600 volt supply, and all audio equipment from the low voltage section. At the same time this unit completely satisfies the needs of the R.&T.-F.M. transmitter.

Design Factors: In a power supply of this type where heavy currents at high voltages are encountered, there will be found strong fields about all of the transformers and filter chokes. In laying out the chassis, therefore, care must be taken that the power transformers are so placed that their fields will not induce ripple in the windings of the filter chokes. As one can see by referring to the layout diagram, the transformer's axes are at right-angles to the axes of the choke windings (the condition for minimum mutual inductance). The layout used was decided upon only after careful consideration of theoretical and practical (space) factors. It is inadvisable, in a unit designed to supply equipment having a large number of tubes, to incorporate filament voltages on the power-supply chassis. (The heavy filament currents would cause excessive IR drop in long leads to the equipment in use.) Provision has been made for 110 volt A.C. leads in the power cable to supply filament transformers on the equipment chassis. A six-wire cable and male and female six contact plugs (Amphenol) in the low voltage supply, and a four-wire cable and plugs in the high voltage supply, are used to carry all voltages to the equipment chassis. This method was used in order that there should be no exposed high voltage contacts.

Voltages Available for F.M. Unit: To properly operate the F.M. unit, the construction of which was described in last month's article, the following voltages are needed: For the audio system, 350 volts; control oscillator, 100 volts (screen and plate); master oscillator, 200 to 350 volts; limiter, 200 volts. The intermediary voltages are obtained from a 5,000 ohm 100-watt bleeder on the low voltage supply. If modulation causes reaction on the master oscillator amplitude it may be necessary to take the plate voltage for this tube from a tap on the 600 volt supply.

Additional Construction Data for F.M. Unit: It was found that the electron-coupled oscillator is more stable when the following grid coil is used: Eight turns, one inch long, No. 18 bare tinned wire, tap three-quarters of a turn from ground (on Amphenol miniature form). The larger sized wire does not heat as much as the small wire that was previously specified and, therefore, frequency drift during the warm-up period is greatly minimized.

Three toggle switches (S.P.S.T.) have been added, one in each of the plate supply leads of the three oscillators in order to facilitate adjustment. They have been mounted on the back of the chassis since they are only used during initial adjustment.

It was found that better control of balance with less reaction on oscillator frequency was had if the capacitance of each section of the balancing condenser were reduced to about twenty micro-micro-farads. This may be done by removing all but two stator plates on each side of the balancing condenser.

Adjustment for Operation of F.M. Audio System: The audio system differs in no way from a conventional audio amplifier either in adjustment or operation, except for the fact that the amplification is proportional to the audio frequency. This exception, however, need not be rigidly adhered to, so long as the highs (5,000 cycles) are between fifteen and thirty db.; above the lows (100 cycles) with approximate linearity between. A method for obtaining this type of response was described in the preceding article.

Oscillator Adjustments: The control oscillators are tuned with the balancing condenser set for equal capacitance in each section. The control oscillators are left in operation and their signals are found at 14.83 and 14.79 megacycles on an A.M. receiver. The receiver dial is then set to a point midway between these frequencies and the control oscillators are turned off. The master oscillator is then turned on and adjusted by means of the 100 mmf. condenser roughly to the receiver dial setting and exactly centered from the front panel by the 10 mmf. band-spread condenser. The plate circuit is then tuned. Since the "Q" of tuned circuits at 28 megacycles is usually low—therefore, the dip in plate current at resonance may not be noticeable, a tenth-watt neon bulb will prove a valuable tuning indicator. With the band-pass adjustment knob set for low coupling the limiter is tuned, first the grid circuit and then the plate circuit, as a conventional doubler. The signal is then found on an F.M. receiver at

*Radio Instructor, Brooklyn Tech. H. S., Eng. WYNE.
**Student, Electrical Eng., Brooklyn Polytech., W2LOE.
***Student, Electrical Eng., Cooper Union, Night.

59.25 megacycles and the control oscillators are turned on. An oscilloscope is connected to the output of the receiver. An audio oscillator is connected to the input of the F.M. unit and adjusted to about 200 cycles. If the wave-form viewed in the 'scope contains appreciable harmonics, the following adjustments must be made: 1. The balancing condenser should be shifted slightly from the center position. 2. Since this will change the center band frequency, the master oscillator is retuned by means of the band-spread condenser. 3. If the wave-form viewed in the scope is worse than before, the balancing condenser must be adjusted in the opposite direction. If the wave-form is improved, further adjustment should be made in the same direction. If the receiver does not appear to have sufficient output the audio gain of the F.M. unit may be turned up and usually an optimum setting of this control for minimum distortion will be easily found. The next step is the tuning of the band-pass circuit. The M-type curve desired is obtained by over-coupling, therefore, adjust the coupling knob for increased coupling. The introduction of the metal of the movable coil into the field of the fixed coil will detune both slightly. Readjustment should, therefore, be made. The audio oscillator frequency should be increased to 5,000 cycles. The wave-form may now be viewed in the 'scope and if it appears incorrect increase the coupling of band-pass circuit.

A more reliable, although more difficult means of adjusting the band-pass circuit is as follows: The saw-tooth wave-form obtained from the oscilloscope horizontal deflection circuit may be introduced into the F.M. audio system. This will cause a linear frequency swing over the complete band. If a broadly tuned detector (a single tube will do) is then coupled to the limiter output and the detector's output is fed to the vertical deflection terminals of the 'scope, a curve will be traced representing the characteristics of the band-pass circuit. Adjustments may then be made quite easily. (The saw-tooth voltage is obtained through a .1 mfd. condenser tied to the horizontal deflection plate of the cathode ray tube, and the circuit in the 'scope is not broken.) Care must be taken to provide adequate shielding in all external leads since their lengths may be sufficient to introduce appreciable radio frequency voltages to the measuring equipment.

When the above adjustments have been made, and they should not prove difficult, a microphone may be connected to the input and the unit is ready for operation.

In all of the above adjustments the authors used a *Hallicrafters* model S-27 high frequency F.M.-A.M. receiver. It proved to be the most practical receiver we have yet seen for this service since A.M. and F.M. adjustments are made by simply turning a switch, and the quality of reproduction leaves no doubt as to where any distortion may be found. It will certainly not be in the receiver.

Of interest is the fact that the band width of this transmitter may be readily varied. The authors used crystals ground 10 kc. apart, thus halving the band width, and little change was noticed.

In the next article, we expect to describe an amplifier which will give about

(TURN THE PAGE)

BRAZILIAN AMATEURS JOIN HANDS

● BRAZILIAN radio amateurs have now joined hands with those of brother "hams" in thirty-six other countries of the world by their recent election to membership in the International Amateur Radio Union, according to a statement by Kenneth B. Warner, secretary of the Union, in announcing the affiliation of the *Liga de Amadores Brasileiros de Radio Emissao.*

In Brazil there are about 1,000 amateur operators, all of whom belong to the L.A.B.R.E. Due to present international conditions amateurs in that country are not allowed to contact stations in foreign countries actively at war, so the emphasis is on domestic communication. Numerous groups of amateurs form weather-reporting nets and emergency communications reserves, and learn military operating procedure as well, patterned after similar groups in the United States. Brazilian amateurs have an official organ to keep each other posted on radio happenings, called "QTC"; in radio parlance this reads, "I have a message for you," appropriately enough.

50 watts of frequency modulated power in the 112 mc. band (118.5 mc.). The amplifier will be readily adaptable to conventional A.M. service. Subsequently, too, will be described a combination frequency deviation indicator and monitor for this F.M. transmitter.

Acknowledgments: The authors wish to express their gratitude to *Hallicrafters, Inc.*, for their generous cooperation and to all the other companies whose splendid response in the interests of modern research made this series of articles possible.

Parts List for Pull-Swing Set

KENYON TRANSFORMER CORP.

T1—Plate power transformer—pri. tap., 450-350-0 at 250 ma.; T-655
T2—Plate power transformer—750-600-0; 300 ma., T-656
T3—Fil. transformer. See text: 2.5 V., 10 A.; 2.5 V., 7 A; 5 V., 4 A; T-364
L1—Swinging choke (to carry 300 ma.) 6-19 hy.; T-510
L2—Filter choke, 11 hy., 300 ma.; T-166
L3—Filter choke, 10 hy., 250 ma.; T-151
L4—Filter choke, 10 hy., 250 ma.; T-151

INTERNATIONAL RESISTOR CO.

R1, R2, R3, R4—50 ohm, 10 watt (wire-wound); AB
R5—Bleeder resistor, 50,000 ohms, 100 w. fixed; HAA
R6—Bleeder and stabilizer resistor, 5,000 ohms, tapped; HAA

PAR-METAL PRODUCTS CO.

1—8¾" x 19" steel rack panel; 3604
1—13" x 17" x 3" steel chassis and bottom plate; 15281
1—13" type angle-bracket set; SB-713

BUD RADIO, INC.

P1—"Jumbo" type pilot-light, candelabra base; JL1698S
P2—"Jumbo" type pilot-light, candelabra base; JL1698S

AMERICAN PHENOLIC CO. (Amphenol)

2—6-prong bakelite sockets; S-6
3—4-prong bakelite sockets; S-4
2—6-prong "male" cable connectors; PM-6
1—Socket punch; LD-1

NATIONAL-UNION (Tubes)

1—Type 83v.
2—Type 83

KESTER SOLDER

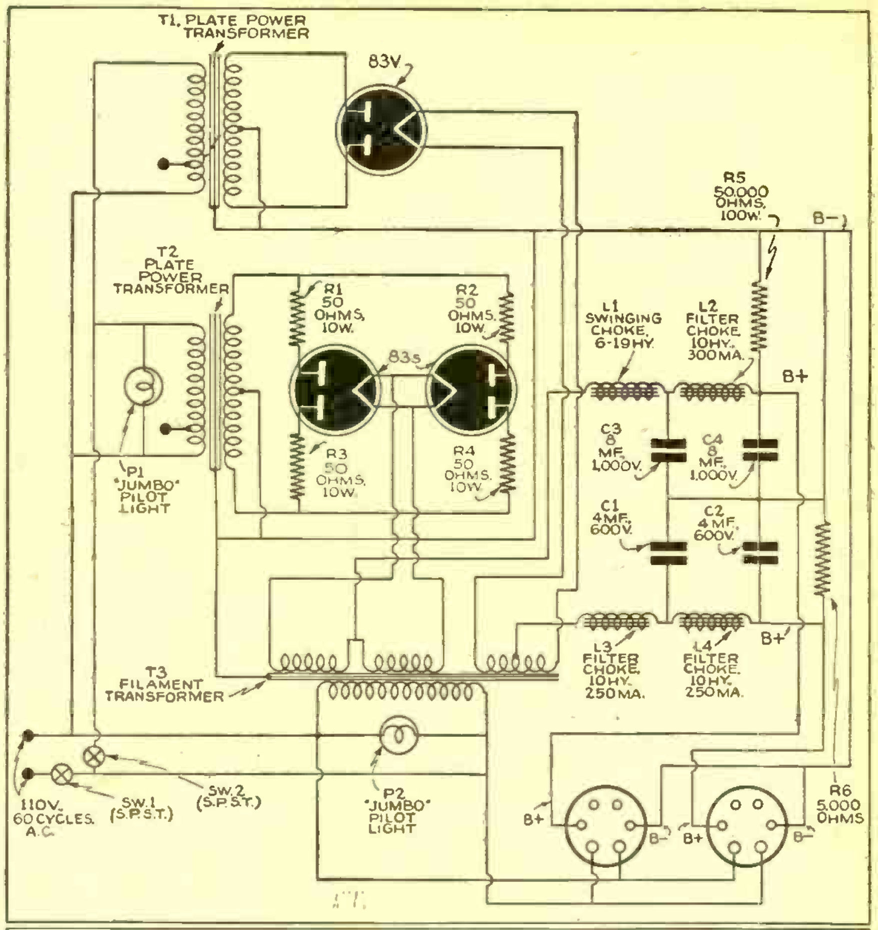
1—Roll "radio type" rosin core solder

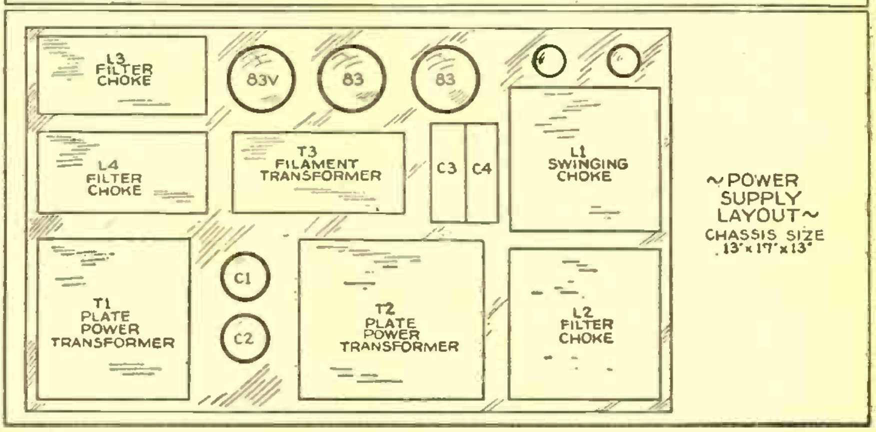
CORNELL-DUBILIER (Condensers)

C1—4 mf., 600 V. Dykonol paper; TLA-6040
C2—4 mf., 600 V., Dykonol paper; TLA-6040
C3—8 mf., 1000 V., paper type; T-10080
C4—8 mf., 1000 V., paper type; T-10080

INSULINE CORP. OF AMERICA

SW1—S.P.S.T. toggle switch; 1281
SW2—S.P.S.T. toggle switch; 1281
Hardware, nut and bolt assortment, etc.; 5252





The drawings above show plan view of the power-supply and also a schematic diagram of this unit.

BOOK REVIEW

OCCUPATIONS IN RADIO by Kenneth G. Bartlett and Douglass W. Miller. Stiff paper covers, size 6 x 9 inches, 48 pages, illustrated. Published by Science Research Associates, Chicago, Ill.

This is one of the most excellent treatises we have seen on the subject of, "What can I do in radio?" The first part of the book deals with the rapid rise of radio, and succeeding sections deal with the organization of radio stations, control work, the radio broadcast station staff and the work they do, including salesmen, script writers, etc. A very interesting chapter discusses the details of radio network organization, both from the business angle, and also details of the program department, including special program features, radio writers, etc.

Other chapters cover employment with radio service organizations, qualifications in training for radio jobs, including writing and producing, special "news events," and the work of the announcer. A very vital chapter deals with "technical" jobs in radio, including operators and engineers. Women in radio have an interesting chapter—they hold many of the important jobs in radio broadcasting today, especially in the program and audition departments.

The final chapter deals with the future of radio broadcasting, including opportunities in television.

PLAYING WITH LIGHTNING, by Dr. K. B. McEachron in collaboration with Kenneth G. Patrick. Cloth covers, size 6 x 8½ inches, 232 pages, illustrated. Published by Random House, New York, N. Y.

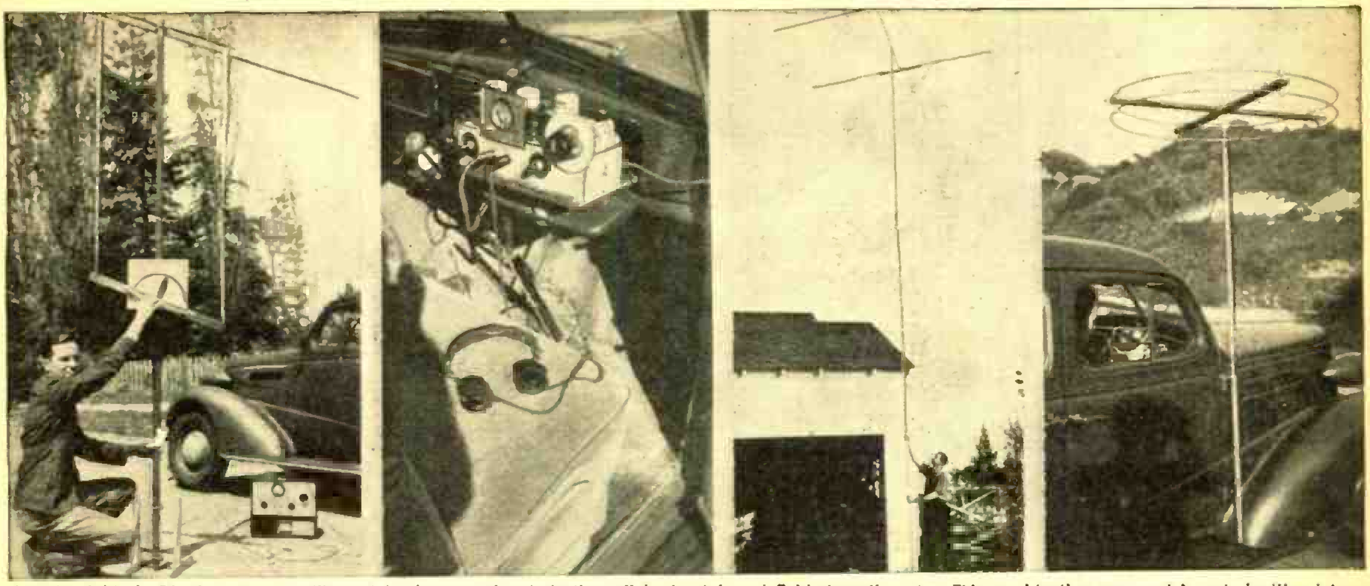
This unusual volume deals with man's experiments with lightning—both natural and artificial. Many years ago electrical engineers decided that they must know more about lightning, for otherwise the high voltage transmission lines would be constantly out of order, due to lightning bolts smashing insulators and causing other disturbances, such as high transient currents or surges which would wreak all kinds of havoc on sub-stations and generating apparatus.

This book is written in popular style, and anyone interested in such questions as—*what is the voltage of an average lightning flash?* and *How long does it exist?*—will find the answers in this book. Some of the chapter titles are—How Much? How Fast? How Long?—Men Make Lightning—How Quick Is a Flash?—The Lightning Stroke—Skyscrapers and Lightning Rods—"Freezing" Lightning on Film—The Thunder Storm—Lightning Rods.

THE RISE OF MODERN PHYSICS, by Henry Crew. Cloth covers, size 5 x 7½ inches, 434 pages, illustrated. Published by Williams & Wilkins Co., Baltimore, Md.

Every radio and electrical student is, by a common token, also interested in physics. This book will prove very interesting as it is written in a smooth, easy style and the origin of the electrical and similar branches of physics is discussed. In the forepart of the book we find a very interesting treatment of the early Greek and Roman science, Arabian physics, and physics in the middle ages. Next the author takes up the birth of American physics and modern optics and then progresses to early discoveries in the field of electricity and magnetism. This is followed by the discovery of the nature of heat and the nature of matter in general. Radio and electrical students will find particularly interesting the sections dealing with Volta, Oersted, Hertz and other well-known scientific investigators.

The origin of modern electrical units forms a fine chapter. This is followed by—The Rise of Modern Spectroscopy, Relativity, etc., followed by a valuable bibliography and a thorough index.



Left to right: 1—Dipole antenna calibrated in degrees of polarization off horizontal, and field strength meter. This combination was used in auto-ignition interference tests and "carrier-wave" polarization measurements. 2—Signal strength meter used in locating diathermy interference, and other mobile explorations of "carrier-wave" propagation. 3—30-foot, telescoping mast supporting dipole reflector antenna. It can be moved about and held by one man. 4—Mobile equipment consisting of Reinartz antenna and signal strength meter, used in locating source of diathermy interference.

Interference Phenomena in

Television Reception

Thornton Chew

This article will be of interest to every student of television—whether he is an experimenter or a service man. Test reports are given with diagrams, showing the effect of placing the television receiving antenna at different angles.

● IT is an obvious truth that the most exact calculations on the part of the design engineer, and the finest work on the part of the production engineer will be lost value unless the television receiver is equally well applied in public use.

Good television reception is unprecedentedly dependent upon the antenna design and installation method. Only by acquaintance with the peculiar relationships between the carrier wave and the several forms of interference, is the television engineer able to so design the antenna system that adequate and "pure" signal input to the receiver is obtained.

The three major types of interference, in the order of the frequency of their appearance, are automobile ignition systems, diathermy, and reflected signals. For the present, at least, auto ignition interference presents the greatest problem.

When, in the course of establishing standards of television transmission, the question of polarization of the carrier wave arose, so little was known of noise propagation characteristics within the ultra-high frequency portion of the radio spectrum that horizontal polarization was decided upon merely because the committee "believed" it had more favorable noise characteristics. The findings of subsequent research have supported this conclusion.

Auto Ignition Noise

In a series of tests recently, the average automobile ignition noise level, using a *vertically* polarized antenna was found to be as much as 25% greater than when using a *horizontally* polarized antenna.

The tests were made under a variety of conditions using a field strength meter and a dipole antenna mechanically arranged to provide an instant change to any angle of polarization.

It was also observed that ignition noise pickup, like other radiations, is sharply reduced from the end directions of a dipole. This again is a point in favor of horizontal carrier polarization, since in the case of the commonly used horizontal dipole antenna the noise pickup will be bi-directional rather than non-directional as with the vertical dipole.

Quantitative tests show that ignition noise has a sharply critical nuisance-value versus distance characteristic.

To the average television viewer streaks of interference passing through the picture are not unbearable since most of the picture information is still conveyed. But interference strong enough to destroy synchronization renders the receiver completely useless throughout its duration. The average auto ignition noise will have sufficient magnitude to destroy synchronization of a visual signal, having a field strength of one millivolt per meter, within a radius of 150 feet from the antenna. With a signal field strength of 100 microvolts per meter, the critical distance moves out to about 400 feet.

Moving Antenna Often Helps

It can readily be seen how important the length of a city lot may be in the placement of a television antenna. Quite often a receiver may be freed of frequent breaks in synchronization by moving the antenna from the front to the back of the lot. The signal strength will, for practical purposes, remain constant, while the increased distance between noise source and antenna will result in a relatively large attenuation of interference. Even a considerable increase of lead-in length, to the point of minimum modulation voltage requirements, may be tolerated since a well-balanced transmission line will discriminate equally against signal and noise, and the rapid rise of signal-to-noise ratio in the antenna will more than offset the loss of surplus picture-tube modulation capabilities.

If this critical distance of separation between ignition noise source and antenna may be accomplished in vertical direction, a still more favorable signal to noise ratio will be obtained since signal voltage developed in the antenna will rise while the noise level is reduced.

A Freak Case

A good example of this is shown by a receiver located about six miles from the Don Lee television transmitter, W6XAO, in a business district congested with automobile traffic. The measured field strength was approximately 500 microvolts per meter. The antenna was roughly 125 feet above street level and 200 feet of low-loss twisted-pair transmission line was brought down through an air shaft. With this installation, a picture *completely free of blemishes* from ignition interference was obtained, although a constant stream of automobiles passed within less than 100 feet of the receiver location.

A more complete knowledge of *auto ignition interference* characteristics would undoubtedly be of great value, but after considerable observation, it is my opinion that the only complete solution of the problem lies in cooperation with automobile manufacturers, with a view to eliminating this type of interference at the source.

Diathermy Apparatus Frequent Offender

Diathermy is probably the most irritating form of interference. Being of sustained magnitude for several minutes at a time, it thoroughly destroys picture information for large portions of the program, and the impulse of the viewer is to turn from the receiver in disgust. It is poor tribute to the rationality of our self-government, that the so completely regulated radio-television communications art should suffer interference from its offspring, completely unregulated by any Federal agency.

Diathermy radiations are not sharply limited as to polarization. However, from nearly one hundred recorded observations, it appears that most of this type of interference approaches *vertical* polarization.

Design characteristics account for the considerable variation in magnitude and form of diathermy interference. Apparatus having poorly filtered plate voltage supplies cause *black-out* of part of the raster. Strong interference causes a shift of vertical synchronization control from the desired synchronization pulse to the negative peak of this A.C. modulation. The same apparatus with well filtered plate voltage supplies would not affect vertical synchronization and much picture information would remain.

Poor or complete lack of line filtering permits radiation through power supply lines acting as long wire, aperiodic radiators. One manufacturer of diathermy equipment stated that only the highest priced of three models incorporated line filtering. When it is remembered that many diathermy machines boast of 500 watt ratings with no more shielding than a wooden cabinet, the extent of interference is not surprising.

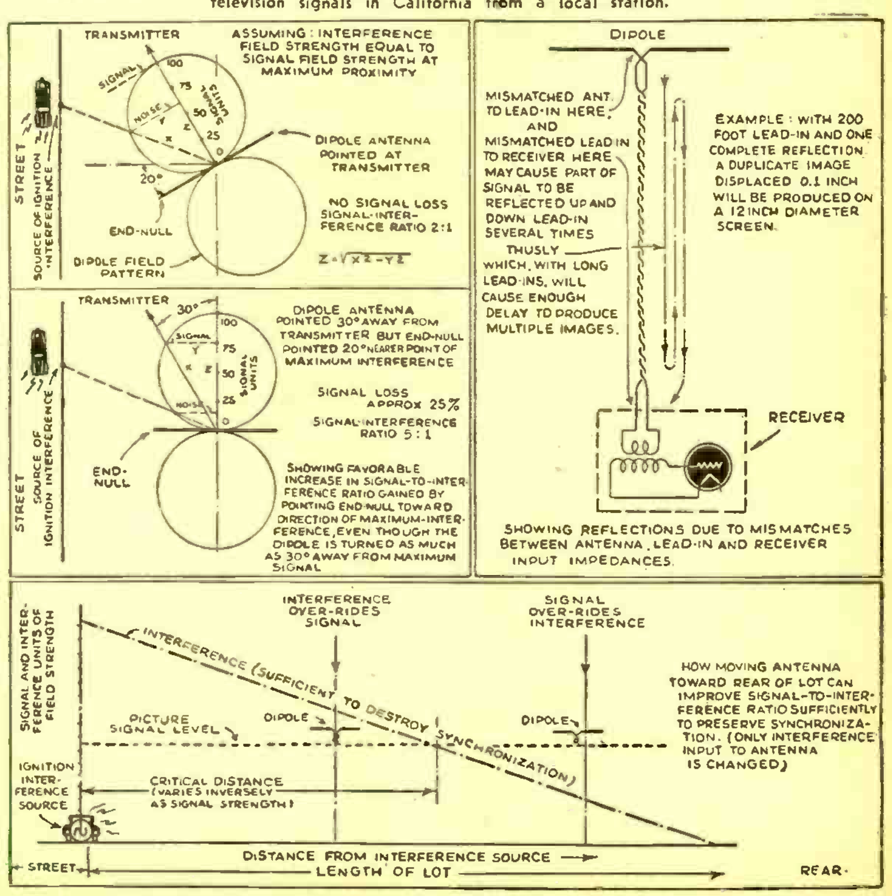
However, these sources of interference are relatively limited in number. Explanation of the problem to the diathermy owner may elicit permission to re-tune, shield and install line filtering in the offending apparatus. When the interference is strong and frequent, the attempt to obtain such permission is well worth while. It remains to locate the apparatus.

In connection with diathermy interference problems of the Don Lee Broadcasting System, a rapid method of locating the point of origin of diathermy interference was developed. The equipment used consisted of an automobile carrying a Reinartz circular antenna, provided with means of rotation, and a portable receiver incorporating a "signal strength" meter. The field pattern of this antenna is characterized by its heart shape, the null point being very narrow and deep.

Locating Interference

The method is to first determine the general direction of the source using the antenna null point. About three readings at spaced intervals are necessary to obviate possibility of error due to reflected signals. The previously used system of taking frequent cross-bearings with the directional antenna, resulted in considerable delay since it was necessary to stop for each

The diagrams here reproduced are the result of actual field tests made by the author, in picking up television signals in California from a local station.



bearing and false clues were obtained from numerous reflected waves. It is therefore advisable to switch the receiver to a non-directional antenna, after the general direction is established and to base subsequent conclusions upon the signal magnitude. This permits of rapid driving with no stops necessary.

A course following the direction indicated is maintained until a rise and fall of signal strength is observed. When a point of maximum signal along this line of travel has been determined, the course is retraced to that point and a new course, 90 degrees from the first, is pursued until a point of maximum signal strength along this line is obtained—thereby providing, in effect, *cross-bearings.*

Standing waves will be observed to cause rapid fluctuation of signal strength until the point of origin is approached within a few hundred feet, at which time the field of electro-magnetic induction establishes control and the standing wave effect disappears.

This method will determine the point of origin to within 100 feet and it then but remains to look for a physician's sign, or make a few inquiries.

Carrier Wave Reflections

The problem of interference from *carrier wave reflections* can only be solved by a receiving antenna installation technique, based upon a thorough knowledge of the behavior of such reflections. In general, reflections can be considered lateral in direction, although occasional reflection interference from aircraft has been observed.

Radio waves travel about 75,000 times faster than the spot on a 12 inch picture tube scanning at the 441 line 30 frame rate. Thus the displacement of the secondary image upon the raster will be 1/75,000th part of the difference between the length of direct and reflected wave travel. Phase differences between the two waves and their side-band components may cause reinforcements or cancellations, which distort half-tone values and frequently produce *negative* images.

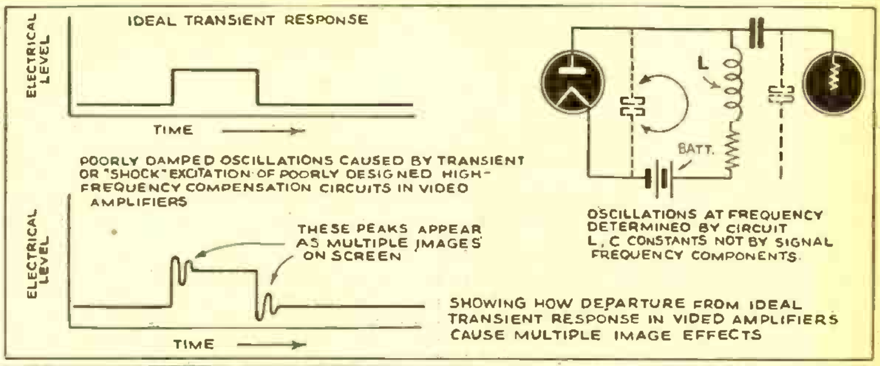
Special care must be taken to determine the presence of short delay reflections. These cause only blurring and loss of vertical picture detail and therefore are likely to be overlooked, while the sub-standard picture is blamed upon poor video frequency band-pass of the receiver.

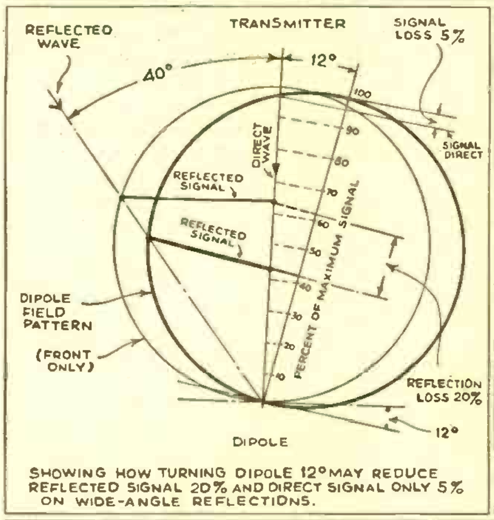
Poor Impedance Matching May Cause Trouble

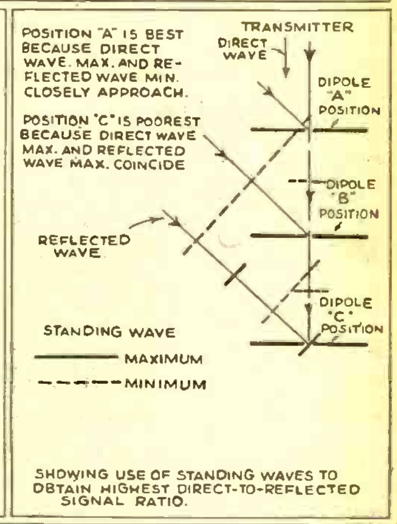
It should be noted here that many multi-image effects are *not* due to *carrier wave reflections.* When the transmission line length is in the order of 100 feet or more, poor *impedance-matching* between receiver, transmission line, and antenna may cause signal reflections from receiver to antenna and back again to the receiver, sufficient to seriously impair the picture quality.

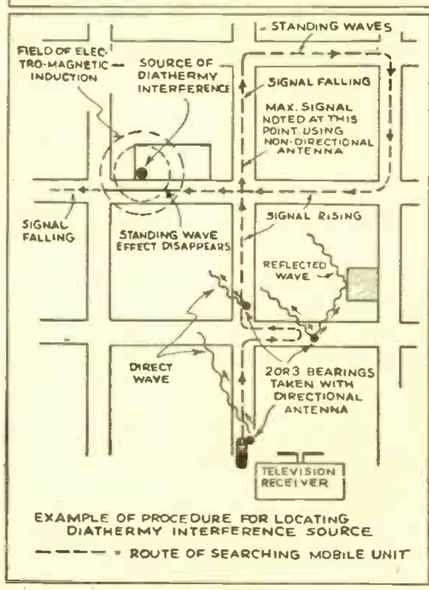
Repetition of vertical lines may result from undamped oscillation, set up in poorly designed or defective high frequency compensation circuits by shock excitation.

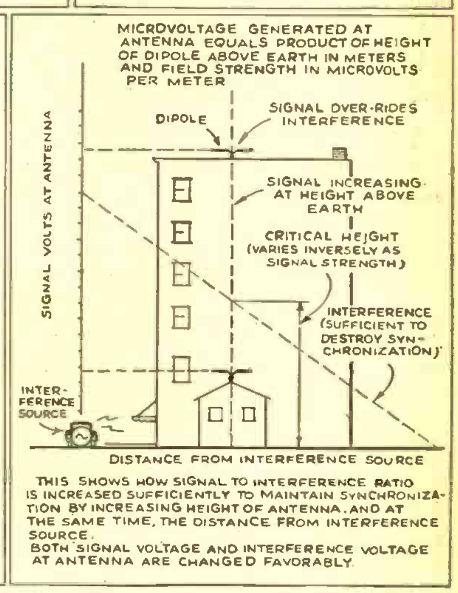
A sharply directional antenna is necessary where the angle of arrival between direct and reflected waves is less than 45 degrees. Orienting this antenna 10 degrees off maximum, away from the reflected











Diagrams herewith show effects of interference with received television signal, and the reason why it is important to choose carefully the final location for the television antenna.

wave, will considerably increase direct to reflected signal ratio, with only slight loss of desired signal.

Standing wave phenomena is very helpful where the angle between direct and reflected signal is greater than 30 degrees. Phase relationship between direct and reflected standing waves varies for each half-wavelength. Thus at a given point, the direct signal may be maximum, while the reflected signal is minimum. At a point several half-wavelengths removed, direct and reflected maximums may coincide. The obvious solution is to locate the antenna position at a point where the direct signal is maximum and the reflected signal is minimum. About a five to four ratio of standing wave maximum to minimum is most frequently encountered.

Evidence points to possible *twists of polarization* of reflected waves, but observations to date are inconclusive. If this be true, antennas polarized accordingly will offer another means of discrimination between direct and reflected signals.

In conclusion, may I urge that those vitally interested in the television art do not permit slipshod use of their art in the field. No invention of science has been measured against more exacting standards of performance, and only an unrelenting insistence upon peak performance can place television in its rightfully high place in public service.

Principles of Frequency Modulation

Part 2—Concluded

F. L. Sprayberry*

● OBVIOUSLY, if we use 1000 cycles instead of 100 cycles, the deviation frequency will become 10 times as great. Similarly if we use 10,000 cycles our deviation will be 100 times as great. Since we desire to have every deviation in frequency of the carrier correspond to an equivalent audio amplitude and have a faithful proportion between the two—this matter of deviation being determined by frequency introduces a serious problem.

In the foregoing, we have chosen 100 cycles as the modulation frequency for the sake of our example, and we have found that this has been involved in finding the corresponding frequency deviation to be 52.3 cycles. For reasons which we are about to study, we desire to have a maximum frequency deviation of 25 cycles. Now, we must find what modulation frequency (audio) will give exactly this deviation if we retain the maximum phase shift of 30°. To find this value for fm, we simply invert the formula—

F = .01745fmθ to solve for fm as follows—

$$fm = \frac{F}{.01745\theta}$$ and substituting 25 for F and 30 for θ we have—

$$fm = \frac{25}{.01745 \times 30}$$

$$fm = \frac{25}{.523}$$

fm = 47.75 cycles

Whereas 100 cycles of A.F. will produce a deviation of 52.3 cycles of the 200 kc. carrier, 47.75 cycles A.F. will produce 25 cycles deviation of the 200 kc. carrier.

This being so, we see that if we desire 25 cycles deviation of the carrier for every audio frequency of the same amplitude, we must supply the balanced modulator screens with 10 volts at 47.75 cycles, 1 volt at 477.5 cycles and .1 volt at 4775 cycles or the audio voltage must vary inversely as the audio frequency. If we did not do this at the transmitter, a 1000 cycle signal would produce 10 times the output of a 100 cycle signal at the receiver. This figure of 10 volts is purely arbitrary and is used only in illustration. The actual voltage must be adjusted so that a peak phase shift does not exceed 30° each side of zero phase.

To correct this undesirable effect, we design the input A.F. amplifier so that it will be continuously frequency selective and will amplify all energy inversely proportional to its frequency. The amplifier circuit is shown in Fig. 11 and its characteristic output response is shown in Fig. 12. The usual flat characteristic is shown in a dash line for comparison.

The amplifier is a 4 stage unit, using a self-balancing phase inverter and the values of parts are chosen to give it the desired characteristic. Note that the output grids are shunted with .1 mfd. condensers and have 200,000 ohm resistors in series with them. This part of the circuit alone will very much reduce the voltage of high frequencies.

The amplifier uses a transformer coupled push-pull type input with an R.F. filter in each lead. The R.F. filter is, of course, typical of any audio amplifier used near a transmitting circuit. A single triode input tube V1 using a cathode loaded circuit also called a "cathode-follower" circuit feeds energy through a resistance network to another triode (V2) grid. The 75,000 ohm series element of this network is shunted by a condenser in series with a switch so that a larger portion of high frequencies may pass this point in the circuit when desired. It is possible in this way to emphasize the high frequencies and the action is called "pre-emphasis" of the high frequencies. The same can be done in amplitude modulation but the transmitters for amplitude modulation are not equipped to make use of additional high frequencies at an equivalent FM transmitter cost and in addition having operating channel limitations placed upon them. Thus, while pre-emphasis is not new, it has importance in this type of transmission.

Tube V3 is simply a monitor for indicating the voice level during operation. Tubes V4 and V5 are amplifier and phase inverter respectively, while V6 and V7 are push-pull output tubes. This type of amplifier having characteristics as given in Fig. 12 must be used with the Armstrong modulation system. The output terminals of this amplifier connect to the input screen terminals of V3 and V4 of Fig. 8.

(End of Part 2)

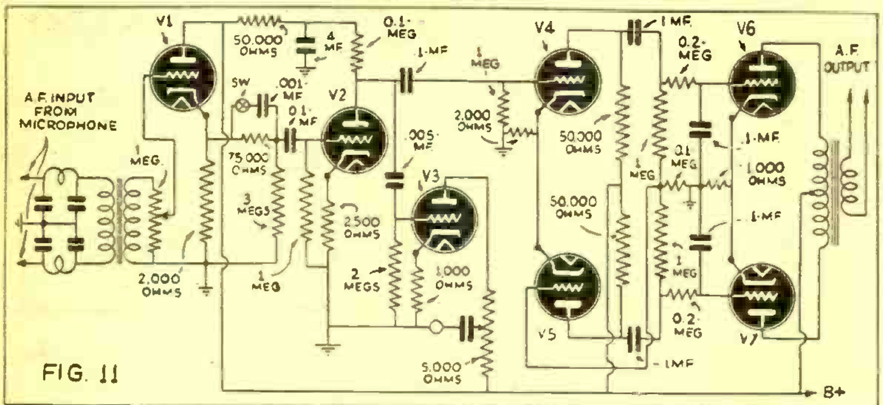


FIG. 11

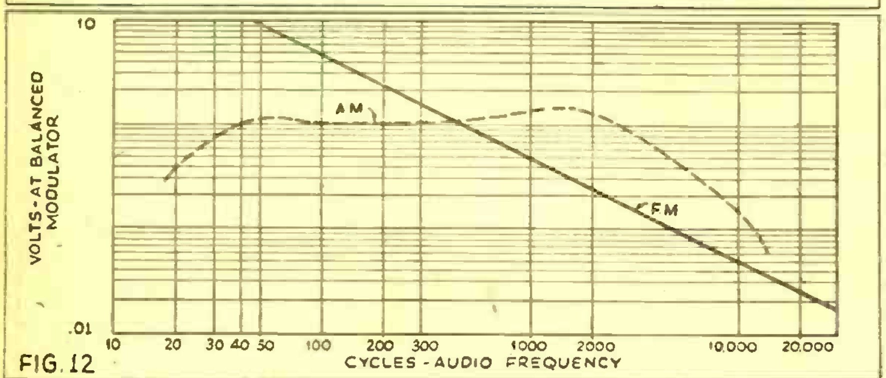


FIG. 12

Circuit of input A.F. amplifier designed to be continuously frequency selective; so as to amplify all energy inversely proportional to its frequency. Response curve of amplifier is also shown.

*President, Sprayberry Academy of Radio.

F-M PRINCIPLES—Part 3

WE have chosen a reference deviation frequency of 25 cycles in the foregoing but in accordance with our earlier studies we know that this must ultimately be expanded by frequency multiplication to around 75 or 100 kc. Since a deviation of the final carrier of 75 kc. is considered satisfactory, let us see what is involved in the multiplier circuits. To multiply 25 cycles until it is 75,000 cycles it must be multiplied 3000 times. Let us look at an actual multiplier circuit as in Fig. 13.

The 200 kc. signal with a maximum deviation of 25 cycles enters tube V1 in Fig. 13 and is simply amplified. It is further amplified by V2 which feeds the grids of V3 and V4 in phase opposition. The plates of V3 and V4, however, are in parallel so that they receive a plate current pulse for each positive grid pulse in each tube. Being biased at cut-off or beyond, these tubes V3 and V4 produce two plate pulses for each grid cycle and in this way the frequency is doubled effectively. The common plate load for V3 and V4 is tuned to 400 kc. Accordingly, the frequency deviation has been doubled, becoming 50 cycles instead of 25. For example, as the 200 kc. carrier momentarily rises to 200,025 cycles on deviation peaks and this frequency is doubled, we have 2 x 200,025 or 400,050 cycles, in which we may observe that the 25 cycle deviation has now reached 50 cycles. Tube V5 then amplifies the 400 kc. signal and feeds it to another frequency doubler of the same type, raising the carrier to 2 x 400 kc. or 800 kc. and the deviation to 2 x 50 or 100 cycles.

Tube V8 is simply an 800 kc. amplifier but V9 is a doubler stage of the bias type. In this stage the grid is biased beyond cut-off so that plate current may flow in the tube only during a small fraction of the R.F. cycle. The plate circuit is then tuned to 1600 kc. and while energy is only supplied to it once every two cycles, its own "energy storage" or pendulum effect makes it produce a cycle in between each one which is forced in it. The carrier is now 1600 kc. while the deviation is 200 cycles.

Stages V10, V11 and V12 are similar types of doubler-amplifier stages raising the carrier frequency to 12,800 kc. and the maximum deviation to 1600 cycles. It should be apparent that we cannot continue this direct multiplication process if we desire a 75 kc. deviation and a carrier of not more than say 50 mc. Two more doublings of 12.8 mc. would produce a carrier of 51.2 mc. with a deviation of only 6400 cycles. We have gone beyond our carrier goal but have not nearly reached our desired frequency deviation.

We, therefore, must resort to heterodyning or beating the 12.8 mc. carrier with another carrier having no frequency deviation so that we may have a relatively low frequency with this same deviation. This particular multiplier circuit makes use of another frequency of 11.9 mc. as in Fig. 13, which is introduced into the mixer grid of a 6L7 tube with the 12.8 mc. fed to its oscillator grid. The tube is identified as V13 and its plate load is tuned to 900 kc. as this would be the "difference-beat" produced by the demodulating action of this tube.

Now as the 12.8 mc. carrier advances to 12,801.6 kc. on maximum positive deviation its beat with 11.9 mc. will be 12,801.6—11,900.0 kc. or 901.6 kc. Thus, we find that the same frequency deviation, namely 1600 cycles, is found in the 900 kc. beat as was originally found on the 12.8 mc. carrier.

Incidentally, the 11.9 mc. signal is obtained by using a 5.95 mc. crystal controlled oscillator (V14) and doubling its output frequency. Continuing from the 900 kc. output of V13, we come to V16—another frequency doubler. The action is often roughly compared to that of a single cylinder 4 cycle engine in which only every other "stroke" is a power stroke while the "fly-wheel action" supplies the additional intake stroke. A radio tank circuit is, therefore, often referred to as having fly-wheel action although it is actually reciprocating as a pendulum rather than a continuous motion as a flywheel.

In the plate of V18, we therefore, have 1800 kc. and for reasons given above we also have 2 x 1600 or 3200 cycles deviation. Following are listed the final frequency considerations.

Tube	*Carrier Output*	*Cycles Deviation*	*Type*
V16	1.8 mc.	3200	doubler
V17	3.6 mc.	6400	doubler
V18	7.2 mc.	12,800	doubler
V19	21.6 mc.	38,400	tripler
V20	43.2 mc.	76,800	doubler

Operation of the tripler stage V19 is similar to that of the doubler except that its plate circuit is tuned to three times the frequency supplied to the grid. Hence, the plate tank circuit produces two additional cycles between each grid pulse by "fly-wheel" or "pendulum" action.

The tubes in Fig. 13 may all be power amplifiers so that we can increase power in addition to multiplying. We may thus start with from 1 to 5 watts at V16 and obtain 1 KW. at V20. From the plate of V20 energy is fed to a vertical dipole antenna.

Note that all of the plate and grid tank circuits are resistance padded so that they will respond to the increasing frequency deviation. They are broadly tuned in the same manner as receiver circuits.

Motor Controlled Reactance Tube Modulator

Among the reactance tube types of frequency modulated oscillators for F-M transmission there is a motor frequency controlled type in present use, which may become important in this field in the future.

Because of our previous detailed study of the reactance control tube and circuit, we can discuss this circuit as presented in Fig. 14 much more freely.

The oscillator circuit is of the push-pull or, as we more commonly say, back-to-back Hartley type. It is identified by the connection to its main tank inductance which is connected to the plates of tubes V1 and V2. The oscillator plates (V1 and V2) are series fed through this coil while the grids are shunt coupled to it by means of the regular grid coupling condensers.

The tank circuit is primarily tuned by means of a relatively large two-section fixed condenser and a relatively small two-section variable condenser (correction condensers) which, as you will notice, is motor driven through a reduction gear train indicated by the dotted line. In parallel with each oscillator plate is a plate of one of the reactance-operated tubes (V3 and V4).

In this study it may have occurred to you that since it is possible to make a tube exhibit certain inductive properties by control of the phase between its plate current and voltage, *it may also be possible to make a tube exhibit capacitive properties by an equivalent means.* This is what the reactance control tubes accomplish in this circuit.

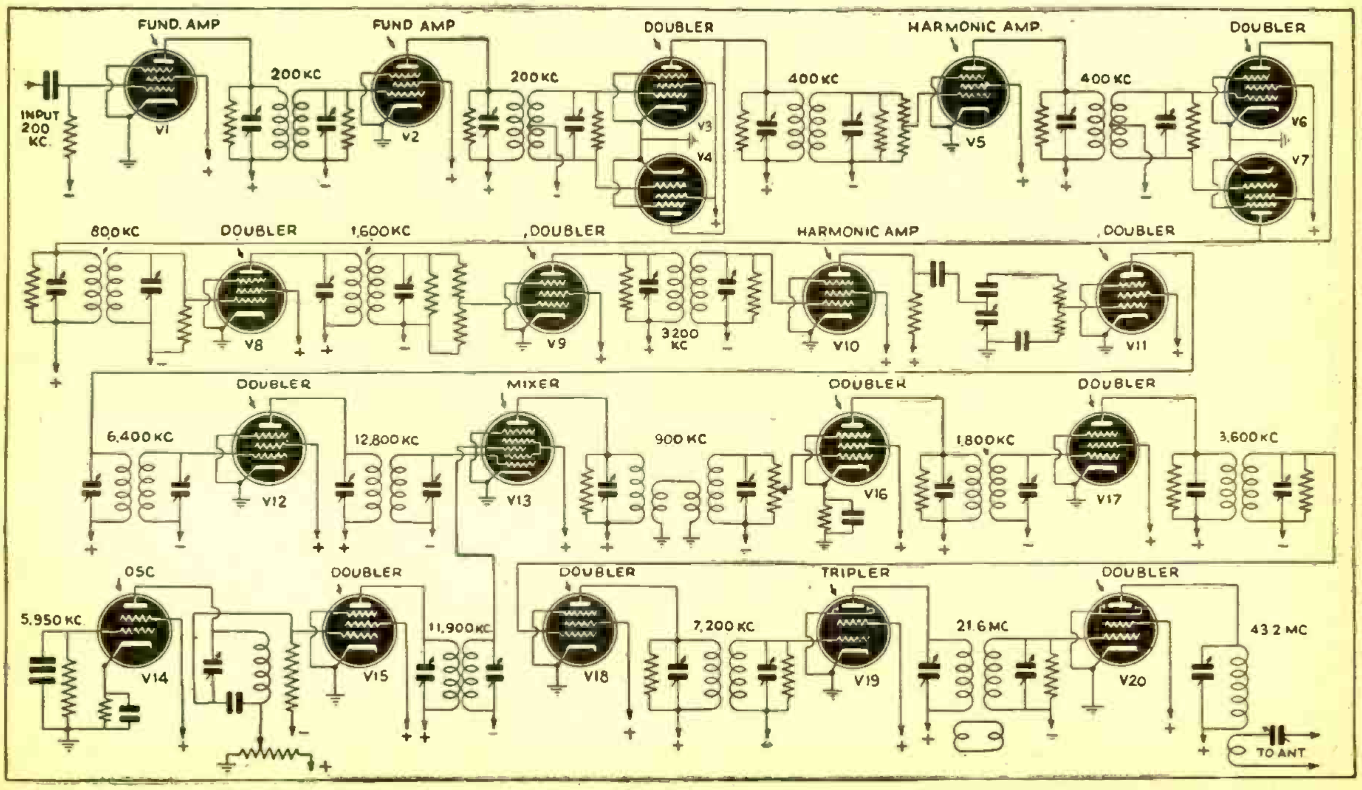
To make a tube exhibit certain capacitive properties it is only necessary to make its A.C. plate voltage lag its A.C. plate current component by as near 90° as possible. As you will recall, the voltage across a perfect condenser lags the current flow through it by 90°.

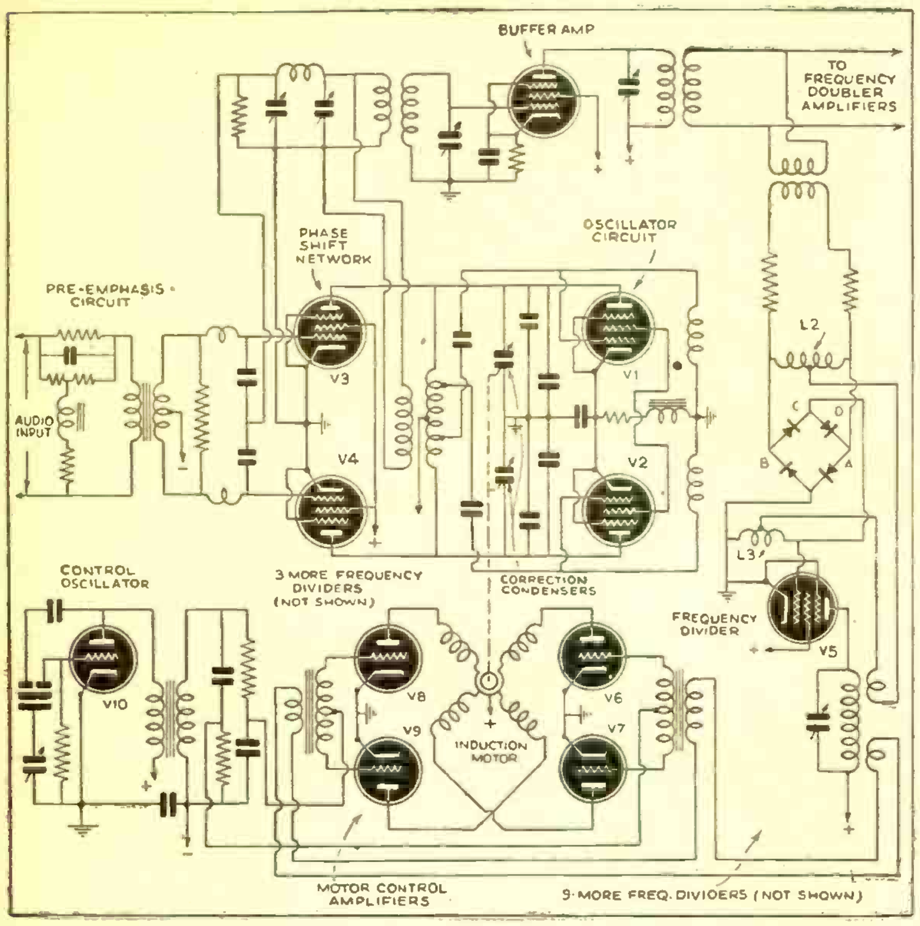
A phase-shifting network shown supplied with R.F. energy through inductive coupling to the oscillator delivers a voltage to one grid (V3) approximately 90° leading the A.C. plate voltage applied by the oscillator. To the other tube V4 (since the grids are supplied in phase), it is a lagging voltage but as the instantaneous R.F. plate voltage is now minimum the current in the other tube is the dominant influence in the circuit. The net A.C. plate-to-plate current therefore leads the A.C. plate voltage by approximately 90° and the effect on the tuned circuit is that of a condenser whose reactance approximates the plate to plate A.C. impedance of the reactance control tubes V3 and V4.

Far from being a low frequency oscillator the circuit of tubes V1 and V2 operates at about 5425 KC. or 5.425 mc. By using such a high frequency we only need to change the capacity reactance of tubes V3 and V4 .46 of 1% in order to change the frequency 12.5 KC. (this is the deviation frequency). Since this is the maximum amount of capacity change caused by tubes V3 and V4, it is obvious that the reactance control tubes form but a very small part of the entire tank capacity.

This fundamental oscillator frequency of 5.425 mc. with a frequency deviation of 12.5 KC needs only to be doubled three times (multiplied by 8 as 2 x 2 x 2 = 8) to bring it to the desired final output carrier frequency of 43.4 mc. on which we have a deviation frequency of 100 kc. (12.5

Fig. 13—Multiplier circuit described in the text.





Note in this circuit, Fig. 14, that from the same source that supplies the phase-shifting network, a buffer amplifier is fed, which isolates the oscillator and its reactance control from the following circuits.

kc. x 8 = 100 kc.) each side of the radiated carrier.

The A.F. as usual entering the grids of the reactance tubes V3 and V4 varies the amount of capacity which these tubes can exhibit, bringing about frequency changes in the carrier proportional to the A.F. voltage impressed. This capacity reactance tube circuit has the advantage that the frequency deviation of the carrier is proportional to the A.F. *voltage* only—the audio frequency not affecting it as in the Armstrong system.

Since the reactive tubes in this circuit also exhibit variable resistance properties tending to vary the load on the oscillator and hence produces a certain amount of amplitude modulation, this, of course, is not wanted. For this reason other provisions of the circuit are needed to overcome this. This action is effectively compensated by the introduction of a cathode load in the oscillator producing degeneration enough to compensate for amplitude modulation to a satisfactory degree. Note the iron core inductance with a series resistance in the common cathode to ground circuit of the oscillator tubes V1 and V2.

The most serious problem with this type of circuit is the one of *frequency control of the carrier*. Note in the circuit Fig. 14, that from the same source that supplies the phase-shifting network, a buffer amplifier is fed. This buffer effectively isolates the oscillator and its reactance control from the following circuits. The output of this buffer feeds the frequency doublers and power amplifiers as well as a frequency control circuit to be described later. As mentioned, there are three doubler stages following the buffer and enough additional fundamental frequency amplification to acquire any output power which may be desired. The one described here has a power output of 1 KW.

The frequency control circuit consists of ten frequency dividers, each dividing its input frequency in half. Thus the ten stages divide the carrier frequency by 1024. One of these ten similar stages is shown in Fig. 14. It consists of an R.F. transformer coupling into a special bridge circuit which is in turn coupled to a tube input (V5). Note that the control circuit rectifier resembles a bridge rectifier and is of the copper oxide type with two of its elements reversed from the conventional bridge rectifier wiring.

The input frequency (5.425 mc. from the buffer) alone causes no output action of the amplifier V5 because the input bridge circuit is balanced. Thus for a half cycle of the basic oscillator frequency (5.425 mc.) introduced into the bridge at point A, it will become more positive than ground and B, equally more negative. Let us say A is at +10 volts while B is at -10 volts. The bridge circuit elements to C being equal, whether current flows through this branch or the ground branch the potential of C will remain fixed or at ground.

A regenerative action of V5 however, with its plate circuit tuned to ½ the input frequency to the bridge feeds this frequency back to the bridge input (taps of L2 and L3). It feeds points A and B of the bridge in-phase—that is, both positive or negative at the same time and this influence varies point C in the same phase as the feedback connections to the taps of coils L2 and L3.

During the other half cycle of the input the potential of A and B are both reversed but since C is midway between them in potential it is unchanged by this process. During ½ of the R.F. input cycle a current through one bridge section due to this R.F. is in phase with the voltage at C, while during the second half cycle, another modulator section is in phase with C which now is completing its first half cycle. In this way the 5.425 mc. carrier has accurate control over the divided frequency at all times. Ten circuits of this kind will divide the 5.425 mc. carrier by 1024, producing approximately 5300 cycles output which is a frequency low enough to act on a motor so as to give mechanical control as explained further on.

A crystal controlled oscillator (with tube V10) operating at approximately 84 kc. is likewise fed into a smaller series of frequency dividers four stages dividing it by 16, and producing also 5300 cycles approximately. This latter frequency is held to better than 1 cycle accuracy due to the crystal action.

The two 5300 cycle frequencies are fed each to a special double push-pull amplifier (tubes V6, V7, V8 and V9) loaded with a frequency correction motor, of the non-synchronous induction type. Note that the control oscillator feeds all four grids of V6, V7, V8 and V9 in phase by reason of the grid return feed, while the reduced carrier component feeds the grids in opposite phase by pairs. For example, V6 and V9 will be in phase while V7 and V8 will be in phase but displaced 180 degrees from V6 and V9.

With the two frequencies exactly in synchronism the field of this motor will simply be one of changing intensity but of fixed direction. However, if one frequency exceeds the other, the motor fields will change phase continuously and a rotating magnetic field will be produced in the motor. This will, of course, rotate the armature. The magnetic field will rotate at the frequency of the *beat between the two 5300 cycle (approx.) frequencies* and this motor will rotate the correction condenser plates of the oscillator through a reduction gear train.

If the component from the transmitter carrier is higher than that of the crystal controlled oscillator V10, the rotating magnetic field will rotate in such a direction as to turn the oscillator tuning condensers more in-mesh *lowering the oscillator frequency*. If the carrier frequency component is too low the reverse rotation will result. Thus the carrier is *automatically kept within 1000 cycles* by this mechanical means. With the frequency corrected the motor field will naturally cease rotation.

Frequency changes due to modulation of the oscillator, of course, produce rapidly, reversing rotating fields up to nearly 200 revolutions per second reversing at A.F. but the mass of the motor armature is far too great to follow these instantaneous fields. It will only follow the cumulative effect of a great number of such instantaneous fields which, of course, would correspond to the carrier.

With this apparatus all conditions of transmission can be well within the Federal Communications Commission requirements. The fidelity and noise level achievements are as usual characteristic of this type of transmission.

F-M Quiz

1. What relationship between audio volts and carrier cycles deviation is most desirable in F-M transmitters?
2. In what essential way must we operate a vacuum tube to make it exhibit inductive properties?
3. What is the chief disadvantage of the resistance component in the "reactance tube" type of modulator?
4. In the Armstrong modulator system, do the two waves which in combination form the ultimate carrier have the same frequency?
5. What two basic factors determine the frequency deviation in the Armstrong modulator?
6. Does the audio output of the voice amplifier for the Armstrong modulator depend in any way upon the audio frequency?
7. For what reason are practically all of the tuned circuits in the frequency multiplier circuits loaded with shunt resistors?
8. How is the frequency which actually drives the motor in Fig. 14 derived?
9. Why can no system of frequency modulation as described in this lesson be crystal-controlled but the Armstrong system?
10. By what factor do we increase a frequency deviation if we multiply the frequency itself by 3000?

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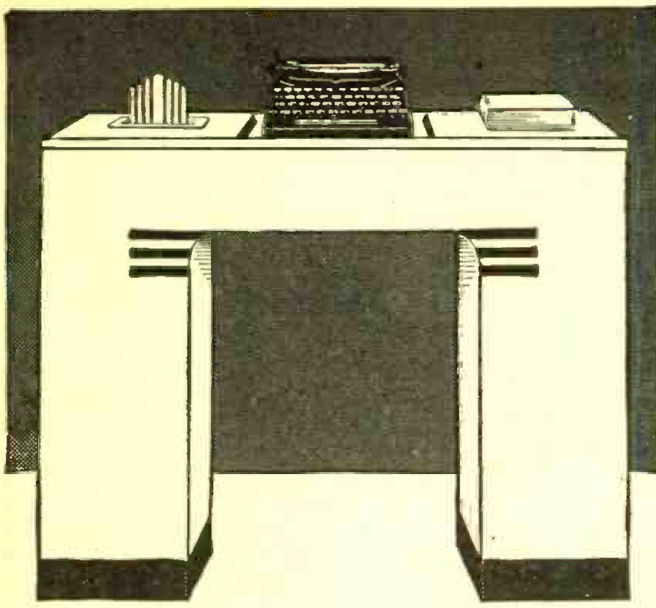

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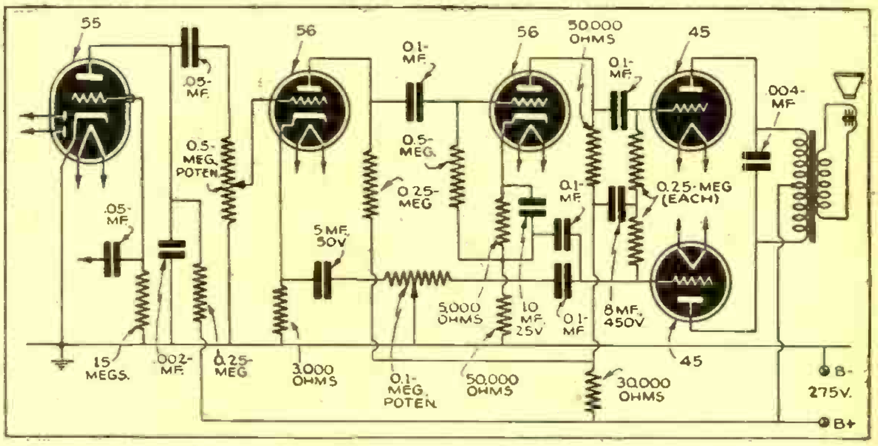
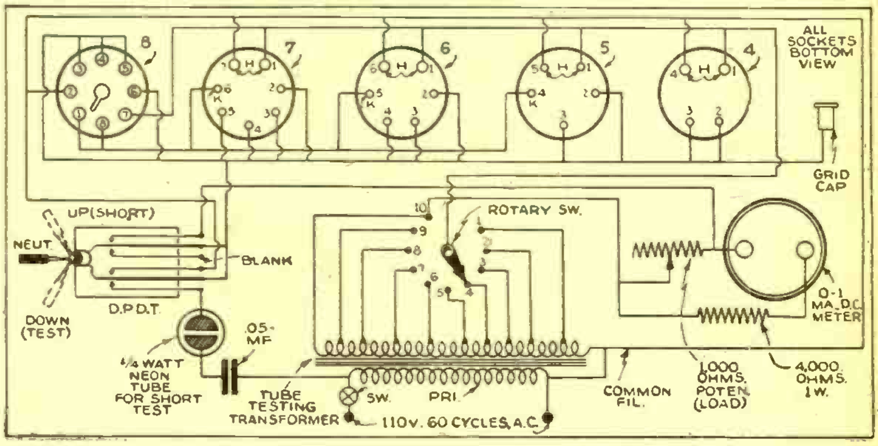
All diagrams and descriptions accepted and published will be paid for at regular space rates. Diagrams may be for receivers, adapters, amplifiers, etc. Send them to Hook-Up Editor, RADIO & TELEVISION, 20 Vesey St., New York City.

10-WATT HIGH FIDELITY AUDIO AMPLIFIER



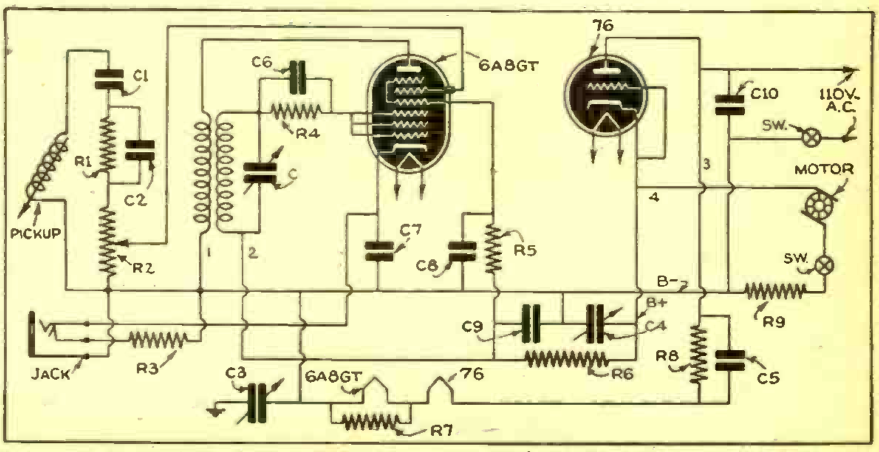
A 15 megohm resistor is used in the grid circuit of the 55 to increase its sensitivity to weak signals. Resistance-capacity coupling is employed and also single tube phase-inverter. All resistors one watt, condensers 600 volt. The "pot." connected to cathode of first 56 tube is a "high-fidelity" control. Circuit contributed by R. T. Stephens, W9CPC, Davenport, Iowa.

EASY-TO-BUILD TUBE TESTER



The sensitive short-tester checks leakage between cathode and filament, where it is most apt to occur. The meter is fitted with a new scale, calibrated to read half BAD-GOOD. The Neon bulb will show a pale color if a tube is "shorted."—Robert Boehler, La Grange, Ill.

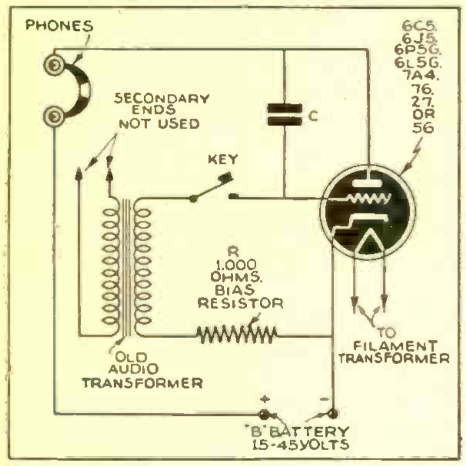
WHAT'S WRONG WITH THIS DIAGRAM?



Study this diagram at least three minutes before turning to the answer on page 768.

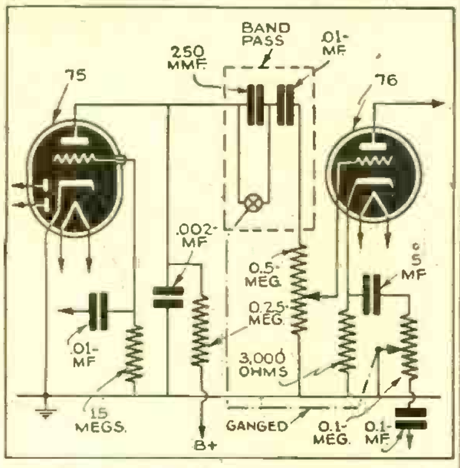
to the Radio Experimenter

CODE-PRACTICE SET



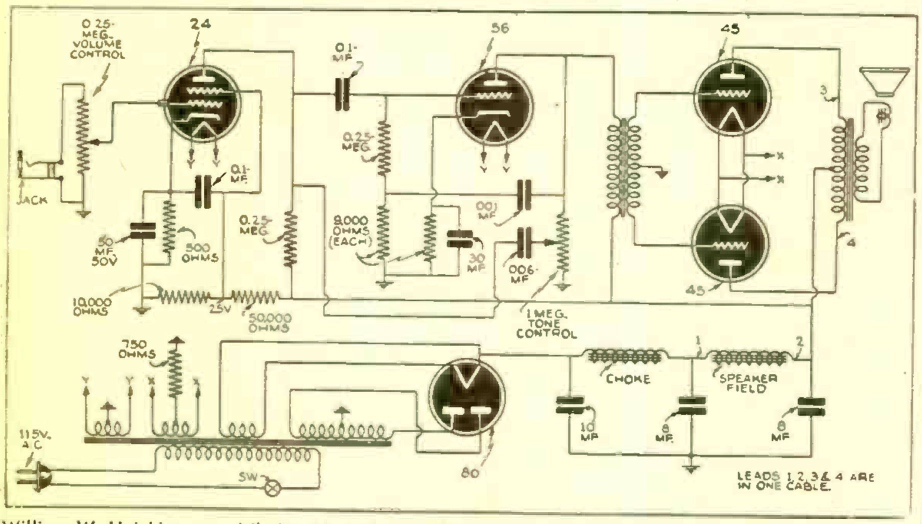
This code-practice circuit oscillates easily. The plate voltage may be as low as 15; tone can be changed by varying capacity of C, using values between .0005 and .002 mf. No key clicks!—John Sasuga, Los Angeles, Calif.

HIGH-PASS AUDIO FILTER



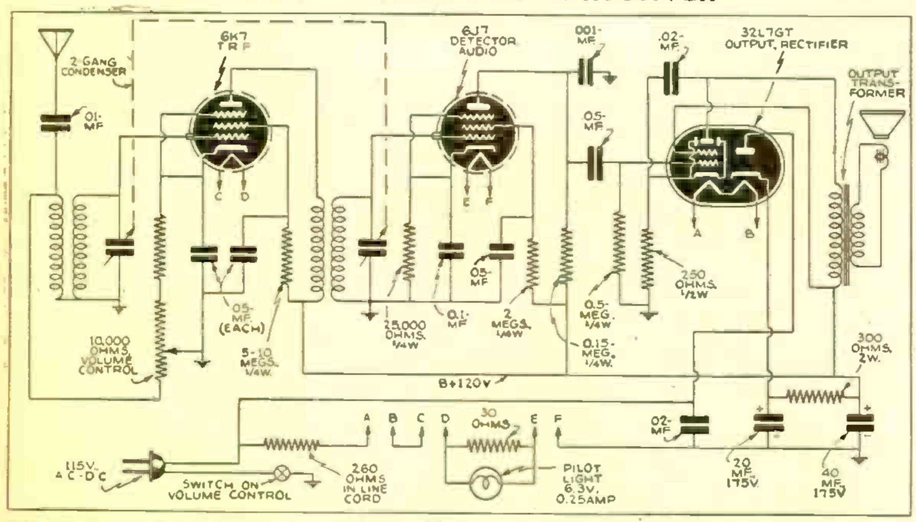
With the switch "on"—normal tone results; with switch "off" only high frequency notes pass. Makes speech easier to understand, with less hum and background noise, especially when QRM is present.—R. T. Stephens, W9CPC, Davenport, Iowa.

PHONO AMPLIFIER



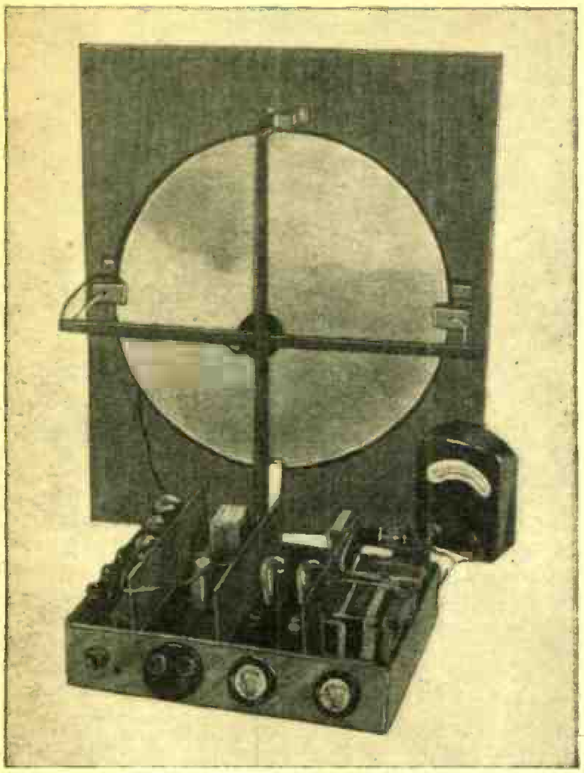
William W. Hutchinson contributes this audio amplifier hook-up, which he has used mostly for phono work. The negative feed-back improves the tone qualities very remarkably; an 8 inch Magnavox speaker was used. Two hundred volts was used on the plates by the contributor, due to the 75 volt drop caused by the speaker field (unusually high resistance in this case).

3-TUBE "T.R.F." A.C.-D.C. RECEIVER



This circuit, contributed by Winslow Williams, 74 So. Elliott Place, Brooklyn, New York, of a 3-tube T.R.F. receiver, makes use of the 32L7-GT tube. A 6K7 is used as an R.F. amplifier and a 6J7 as biased detector, resistance-coupled to the output stage. The author states that he has built this circuit at a very low cost, and that it gives surprisingly fine results. It has good tone, selectivity and sensitivity, the power output being about 1 watt. Use "good" Antenna and R.F. coils, the author stresses.

Please turn to page 757 for full details on another FREE book given with subscriptions.



The complete sound-detecting apparatus, including the parabolic reflector which focuses the sound onto the microphone. The amplifier and A.C. voltmeter are also shown.

Detecting Approach of Airplanes with Sensitive Sound Amplifier

Experimenters everywhere will be interested in this sensitive sound detector, which was designed in England for detecting the approach of aircraft. Not only is the apparatus interesting from this angle, but there are many other applications of such a "super-sensitive" sound detector. A method of laying out the parabolic reflector which focuses the sound on to the microphone, is given in detail.

● ONE of the most urgent needs at the present time is the development of apparatus that will accurately locate hostile aircraft invisible either by reason of darkness or cloud.

Aural methods, of course, are liable to error due to factors over which we have no control, but properly applied it appears that they will render useful service in assisting roof "spotters" to obtain an idea of direction and distance of aircraft more easily and quickly than with the unaided ear.

The following is an account of a number of experiments which were made to assist roof spotters of a large building, and the result has justified the inclusion of the apparatus described as a permanent feature of the warning system.

Various types of directional microphones are available, but the area of pickup is much too wide for accurate sound direction finding. Of the methods tried in order to increase the ratio of desired to undesired sound, the one now to be described provides excellent discrimination and a large magnification. The first experiments carried out made use of a 10 ft. exponential horn with the microphone located at the throat. The angle of coverage appeared to be about 25° which, although it enabled one to ascertain the location of aircraft, was very cumbersome, heavy and inaccurate.

The final apparatus makes use of a parabolic reflector with a microphone at the focus point followed by a high-gain amplifier, telephones and an A.C. rectifier-type voltmeter. Fig. 1 shows a schematic arrangement of the apparatus. The choice of a parabolic reflector was due to experience of its use in film studios, where it is employed to pick up the voices of the leading actors in a crowd scene.

Before describing the apparatus in detail it will be useful to outline the method of projecting a parabolic curve. It can be described by a point which moves in a plane so that its distance from a given point,

Fig. 1 shows schematic diagram of the sound locating device. Fig. 2 illustrates one method of laying out the parabolic reflector curve.

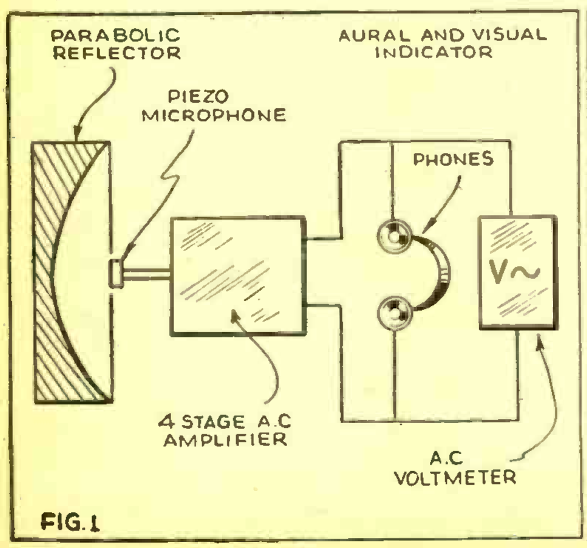


FIG. 1

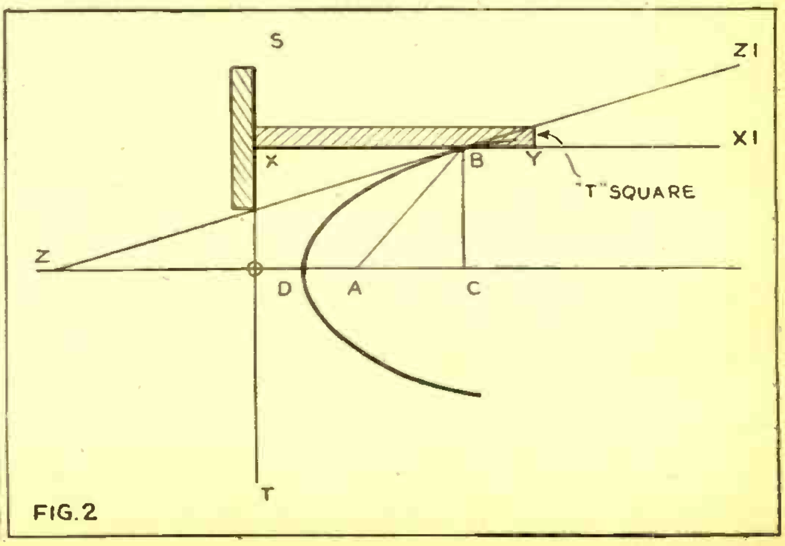


FIG. 2

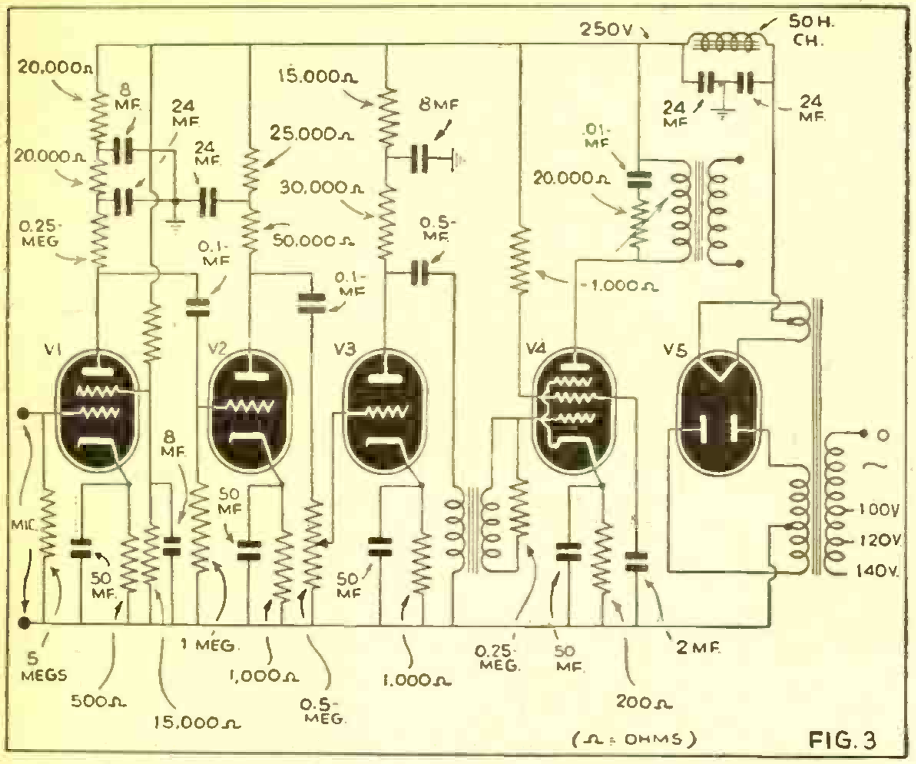


Diagram of the special amplifier used with the airplane sound detector.

which is termed the focus, is the same as its distance from a line termed the directrix.

In order to plot a parabola the following method can be adopted. Pin a sheet of drawing paper to a drawing board and place a pin at any point chosen as the focus A (Fig. 2). With the aid of a "T" square, set it so that the side XY is at right angles to the side of the board S.T. To the pin at A fasten a length of thread and fasten the other end of the thread to the extreme edge of the "T" square at Y, the length of thread being equal to the length of the side XY. By means of a pencil press the thread up against the edge of the "T" square so that it makes contact at B, sliding the "T" square along the edge S.T. and maintaining contact between the pencil and "T" square. Thus one half of the parabola will be drawn, and by inversion the other half can be traced. Thus point A is the focus and the line OX is termed the directrix from which it can be seen that the length $AB = BX = OC$.

The point D is known as the vertex of the parabola and let it be assumed that $OD = DA = a$.

Therefore $(AB)^2 = (AC)^2 + (BC)^2$ – Pythagoras' theorem.
Also $(AC)^2 = (x - a)^2$ and $(BC)^2 = y^2$
Also $BX = OC = (x + a)$
Therefore $(x + a)^2 = (x - a)^2 + y^2$
$y^2 = 4ax$

It will be seen that the lines AB and BX^1 produce equal angles with the tangent ZZ^1. Thus if, for example, a beam of light radiated from the focus A falls on the internal mirrored surface B, it will always be reflected parallel to the axis OC, because the optical reflection of the angle of incidence ZBA is equal to the angle of reflection Z^1BX^1.

It is assumed that the focus point A is of zero size and all the radiated light will, therefore, travel in parallel paths similar to a searchlight beam. The reverse of the above operates in a similar manner, that is all light picked up by the parabolic mirror is reflected and concentrated on the point A.

As light obeys these laws, sound radiations will follow the same laws approximately. Therefore, a 24 in. parabolic mirror was used in the initial experiments, the focus point A being 12 in. from the vertex. At this point a microphone was suspended and held rigidly in position. The degree of magnification obtainable is in proportion to the ratios of the areas of the mirror and the microphone, and, therefore, it is desirable to use the smallest microphone possible, provided that it has a good response in the bass register. For the early experiments various types of Reisz and other carbon microphones were used, but the final instrument is fitted with a small piezo crystal microphone. The one used is rugged and has a silent background.

The output from the microphone is taken via a screened cable to a four-stage high-gain A.C. mains operated amplifier. The requirements here are (a) a very low background noise level, (b) high stage gain, (c) means of measuring output signal level. The amplifier follows conventional lines in design, and no special components are necessary; Fig. 3 gives the circuit, but values of the components can vary considerably without affecting the performance of the apparatus, provided that a good low frequency response is maintained. Very adequate smoothing must be provided so that if an A.C. voltmeter is placed across the headphone's terminals no reading should be obtained with zero input. The intervalve transformer may pick up stray hum voltages, and it may be necessary to orientate it for minimum hum level. The output transformer must have a ratio suitable for use with headphones. In the final amplifier Ericsson 120 ohm phones were used so that the transformer ratio was calculated to be

$$\frac{\sqrt{\text{tube optimum load}}}{\text{Headphone resistance}} = \frac{\sqrt{7000}}{120}$$

= 7 to 1 approximately. As the ear is very insensitive to small sound level changes an A.C. voltmeter is also connected across the output on a suitable range. This shows the slightest change in output level before it can be appreciated by the ear.

It was found on completing the apparatus that although the microphone was accurately located at the focal point of the mirror, the low-frequency response of the mirror-microphone unit using a carbon microphone was inadequate. A piezo (crystal) microphone was obtained, and in the final instrument a 36-in. diameter reflector was used. Not only did the magnification increase considerably, but the angle of discrimination decreased also.

The parabolic reflector can be constructed in various ways, but it was found that one made from plaster of Paris was the easiest to make. A rectangular box, 36 in. square with a depth of 10 in. was made from 1 in. deal. A full-scale drawing of a parabolic curve was produced, from which a section of wood 1 in. thick, having the same contour was made. The box was partly filled with plaster of Paris, and then slowly rotated on a turntable. The parabolic contour board was carefully lowered into the box and the plaster was moulded into shape as it was rotated. After it had set, it was sand-papered smooth and finally sprayed with a cellulose paint. This gives a very hard and weatherproof surface. The center of gravity of the box was then found, and it was then mounted on a rigid tripod in a U-shaped arm (Fig. 4) with swinging adjustments so that it could be rotated and elevated at any desirable angle. The microphone is attached to two brass rods, which are mounted diagonally across the cabinet; by means of 2BA studding it can be accurately set to the focal point (Fig. 5). The screened lead from the microphone is taken along one of the arms and led to the amplifier, which can be located in the vicinity.

The microphone unit was placed as high as possible, and clear of any obstacles that would reflect sound waves. A map of London was located below the tripod so that the location of enemy aircraft can be noted, and by means of a pointer attached to the rotating turret the direction of flight can also be ascertained. In addition a protractor was mounted on the side of the cabinet so that the angle of elevation can be read off.

The method of operation is relatively simple, and can be readily mastered by an inexperienced operator. The microphone unit, having been mounted at a suitable location, can be checked by pointing it at a source of sound, for instance, a clock some 10 to 15 feet away, and the unit rotated until the tick can be heard in the 'phones. Then by referring to the A.C. voltmeter, more accurate positioning of the microphone can be made. Speech conversations can be picked up from up to 100 feet away, suitable adjustment of the volume control being made.—Courtesy of *Electronics and Television & Short-Wave World.*

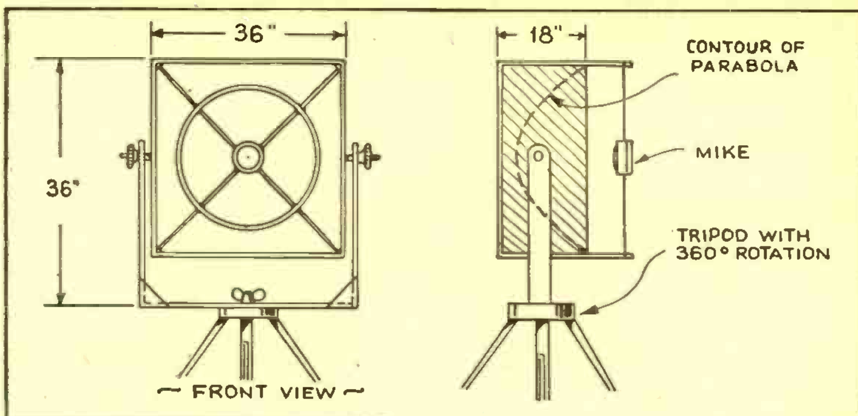


FIG. 4

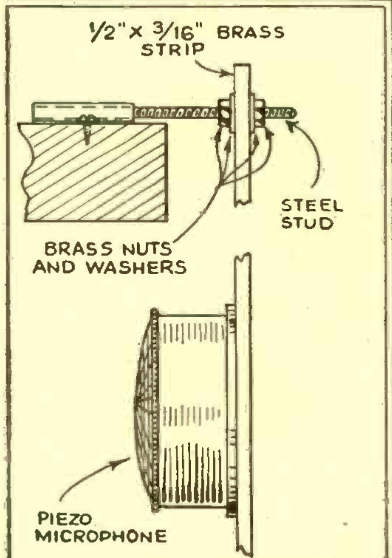
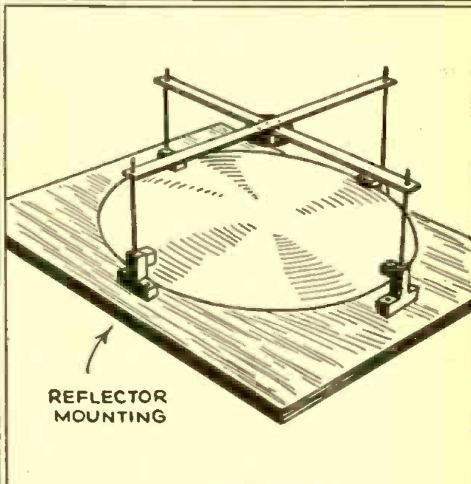


FIG. 5



SKETCH - B

Fig. 4 shows front and side views of the parabolic reflector and its mount. Fig. 5—one method of mounting the mike. Another sketch shows the mike adjustably mounted over the parabolic reflector.

Edited by Herman Yellin, W2AJL

6 Volt Amplifier

? *I would like to build the small 6 volt amplifier shown on page 393 of the November issue, but wish to use a crystal mike instead of a carbon microphone as shown.—J. Godin, La Sarre, Canada.*

A. Shown herewith is a 6J7 preamplifier for use with the amplifier mentioned. The 500,000 ohm volume control feeds into the grid of the tube lettered "55" on the diagram, but which should have been an "85"; the microphone transformer shown on the original diagram is not used. The bias cell is the tiny 1½ volt type, made especially for this purpose by Mallory. It must not be *shorted*, as it is not designed for any current drain.

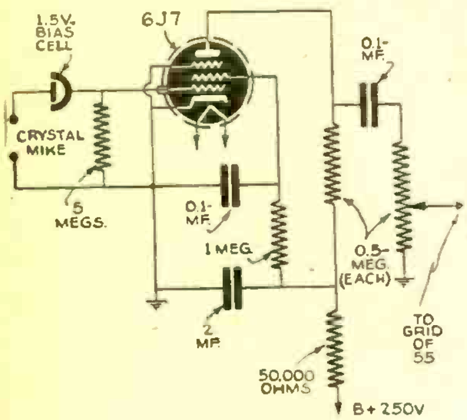


Diagram at left shows 6-volt pre-amplifier for use with crystal mike, utilizing a 6J7 tube. No. 1250.

Set Howls on One Band

? *What causes squeals and howls to appear when tuning in stations on the 5.3 to 15.7 mc. band on my receiver?—J. J. Meier, Bethlehem, Pa.*

A. Since the squeals occur on one band only, the receiver is obviously oscillating in the R.F. section. If changing the R.F. tube and realigning the set does not help, try re-dressing the leads. Insertion of RC filters, consisting of a 2000 ohm resistor in series with the B plus lead to the R.F. stage, by-passed by a 0.1 mf. condenser, may help. In extreme cases it may be necessary to lower the gain of the stage, by cutting down on the screen-grid voltage or increasing the amount of bias.

Judging Signal Strength

? *I was greatly interested in your answer in the November issue, dealing with information anent Verification Cards. I would like to know how to judge* signal strength.*—G. Boycoman, Brooklyn, N. Y.*

A. It is not necessary, in reporting to a station on its signal strength, to give the absolute signal strength, since this would necessitate the use of accurate and expensive measuring instruments. Comparative and approximate strengths are sufficient and can be estimated in several ways. If a magic eye or cathode-ray tuning indicator is used, the amount of closing of the shadow angle is indicative of the signal strength. If an R.F. gain control is used, this control should always be in the same position when making measurements. An excellent device is the so-called "R" meter, used on the better short-wave communications type receivers. Lacking either of these two methods, you can always give the strength of the signals relative to some other station, or employ the system used by amateurs and other communications services for reporting on signal strength.

The scale used to express strength or legibility of signals as adopted at the last International Telecommunication Convention follows:—

Strength	*Legibility*
QSA 1—scarcely perceptible.	QRK 2—readable now and then
QSA 2—weak	QRK 3—readable, but with difficulty
QSA 3—fairly good	QRK 4—readable
QSA 4—good	QRK 5—perfectly readable
QSA 5—very good	
QRK 1—unreadable	

Push-Pull Amplifier

? *How many watts of audio can be obtained from the push-pull 2A3 amplifier, shown on page 303 of the September issue?—K. L. Francis, Kansas City, Mo.*

A. This amplifier will deliver 10 watts without any distortion and employs the newly developed *self-balancing* type of phase inverter, for procuring the two out-of-phase voltages necessary for feeding the push-pull output stage. In building this amplifier, keep the 6J7 input tubes as far as possible from the power-supply and output tubes. Keep all leads in the input circuit as *short* as possible, using shielded wire for any grid leads over one inch long.

Audio Frequency Hook-Up Query

? *Referring to the diagram shown on page 239 of the August issue, a 1H5-GT is coupled by means of a center-tapped audio choke to two 1Q5-GT tubes. Is this conducive to good tone quality and where can the choke be obtained?—R. H. Trimble, San Bernardino, Calif.*

A. The center-tapped choke is used to obtain two out-of-phase voltages to apply to the push-pull audio stage. This is employed in preference to using an additional tube as a phase-inverter, or else using a heavy audio transformer. The tapped choke will give quite good tone quality and can be obtained from any of the various transformer manufacturers or your local dealer.

Adding Audio Stage to 1-Tube Set

? *I have built the 1-tube "Pigmy" receiver described in the June issue, and would like to build a small additional unit to amplify the signal to operate a speaker. Please show such a diagram.—J. Schoenhaut, Brooklyn, N. Y.*

A. A single stage 117L7GT amplifier is shown above. This can be connected to the original Pigmy receiver through a 4-prong plug and cable, or if desired it can be built into a somewhat larger container, with the detector shown previously. Use shielded wire for the lead from the upper phone jack to the 25,000 ohm resistor and .05 mf. condenser. Note that the rectifier section of the 117L7 is not used, the rectifier section of the detector tube furnishing sufficient power to operate the audio tube. The 10,000 ohm resistor R-3 should be replaced with a 5000 ohm unit, and an 8 mf. 250 volt filter condenser is added to the rectifier cathode. As mentioned in the original article, the tuning condenser is a midget 140 mmf. unit, used in conjunction with two winding plug-in coils, thus affording "all-wave" coverage.

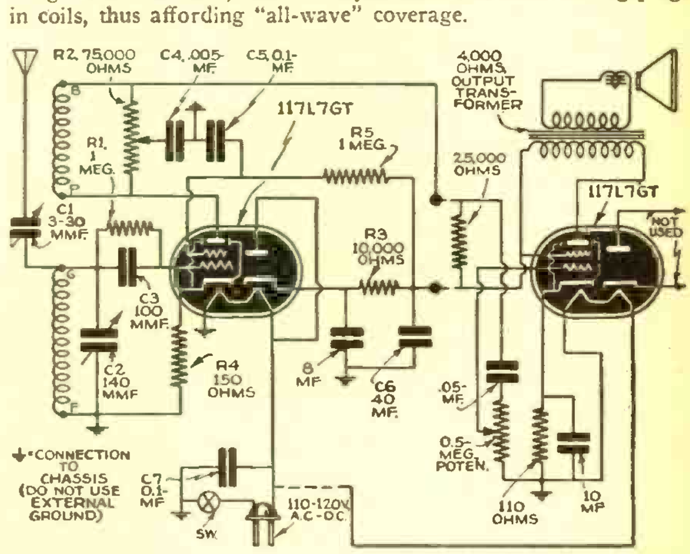


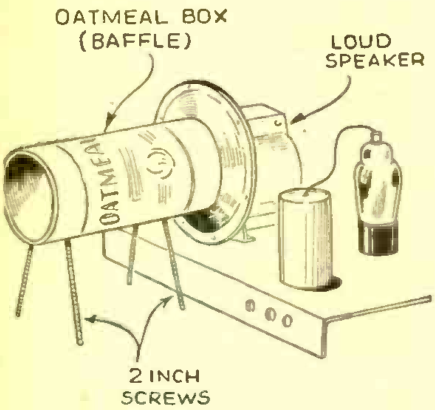
Diagram above shows how to add an audio stage to the one-tube Pigmy receiver. No. 1251.

Queries to be answered by mail (not on this page) should be accompanied by fee of 25c (stamps, coin or money order). Where schematic diagram is necessary, our fee is 50c up to 5 tubes; for 5 to 8 tubes fee is 75c; over 8 tubes, fee is $1.00. *No picture diagrams can be supplied.*

The Cover Kink
First Prize Winner

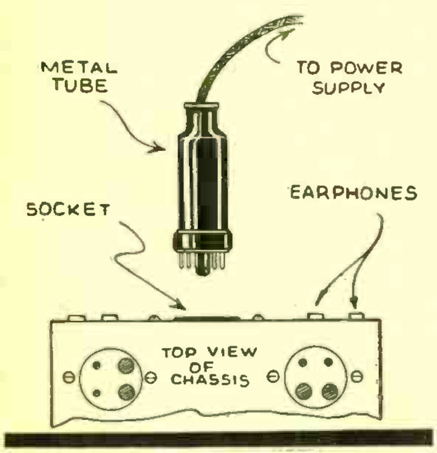
Improvised Baffle

When testing a radio set outside of its cabinet, an empty twenty-ounce oatmeal box, with both ends removed, makes a very effective baffle for four or five inch speakers. Four two-inch screws may be used as legs. It is important that the end of the container next to the speaker does not quite touch it. The tone and quality of the set is reproduced as though it were in its cabinet.—*David Spencer.*



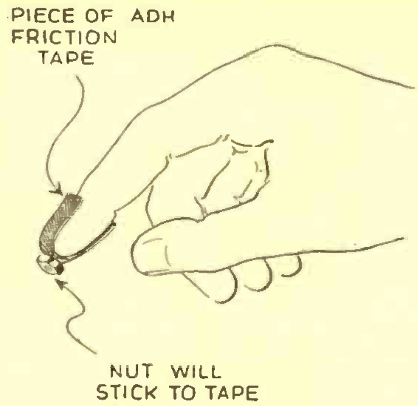
Power Plugs

Here is my idea for a power supply plug which I arranged for use with my short wave receiver. I took an old burnt out metal tube, a 6K7 for example, removed the grid cap and enlarged the hole for the wire leads or cable. I pried open the 4 clamps holding the base on the tube and cleaned up the inside. The metal shell and base remained. I then put the leads through the hole in the top of the tube and soldered them to the prongs. I put the base back on and poured wax in the top hole to secure the wires in place. The plug may be painted if desired.—*Bob Murphy.*



Nut Locator

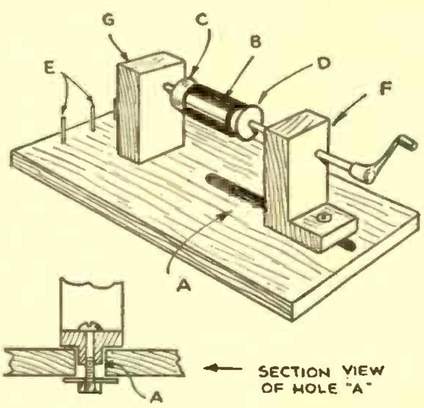
The accompanying sketch shows a simple trick which I have often found useful in placing a nut or washer on a screw in an awkward corner of a radio cabinet. A piece of adhesive or other tape is placed over the end of one finger and the washer



or nut pressed against the tape. In this way you can readily place a nut in many locations, where it would be impossible otherwise.—*Russell Minks.*

Coil Winder

I have found this coil winder very useful in my radio laboratory. The base is a piece of wood of medium size. Part G is not movable and one of the wooden or metal cones C is mounted on a rod fitted in a hole in the block G. The upright F is movable and is held tight to the base with a screw and nut. A slot A in the base



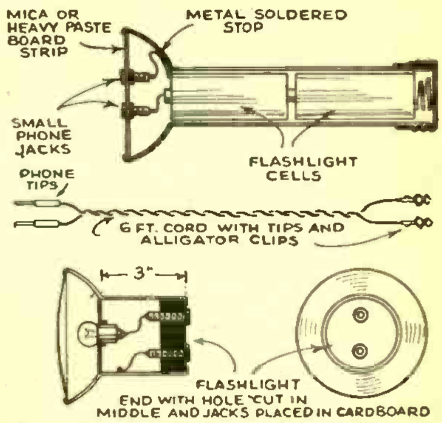
permits F to be moved back and forth to accommodate different size coil forms B. A second cone D clamps the coil form rigidly. The hole in G for the shaft supporting C, should not be drilled all the way through, and in this way and with little grease on the shaft the coil and the two cones will rotate when the handle is turned. The nails E prove handy to hold spools of wire when winding coils.—*Isaac Stempnitzky.*

Circuit Tester

Here's a handy unit for making continuity tests where current is not available. I took a flashlight and placed the bulb at one end of the wires and the battery at the other, and on this principle I constructed this small test set.

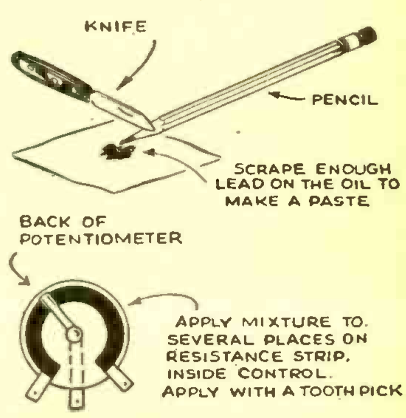
I found two old flashlight cases and using a few radio phone tips, I made this device as shown. With this device continuity tests can be made where current is not available, for tracing out wires in switch boxes, etc. It also can be used on "trouble" calls.

In operating it, one fellow can take a unit to one end, as on a three-way switch circuit, and the other person one unit on the other end. If the person is alone he can plug in phone tip cords and clip on alligator clips to the circuit to be traced, then proceed to the other end of the circuit; by placing the wires into phone tip jacks or by touching them, the bulb will light if on right wires.—*Homer L. Davidson.*



Volume Control Repairs

Like many experimenters I have "hundreds" of bad volume controls laying around. These may be repaired by using a mixture of lubricating oil and some graphite scraped from a lead pencil with a knife. This is applied to the carbon resistance strip inside the control. The resistance of the control may be made nearly anything you wish, by applying the mixture in different variations. After the control has been turned back and forth a number of times to spread and pack the mixture evenly, the control may be put back together. This will come in handy when building sets or repairing sets with bad volume controls.—*Wayne Furnell.*



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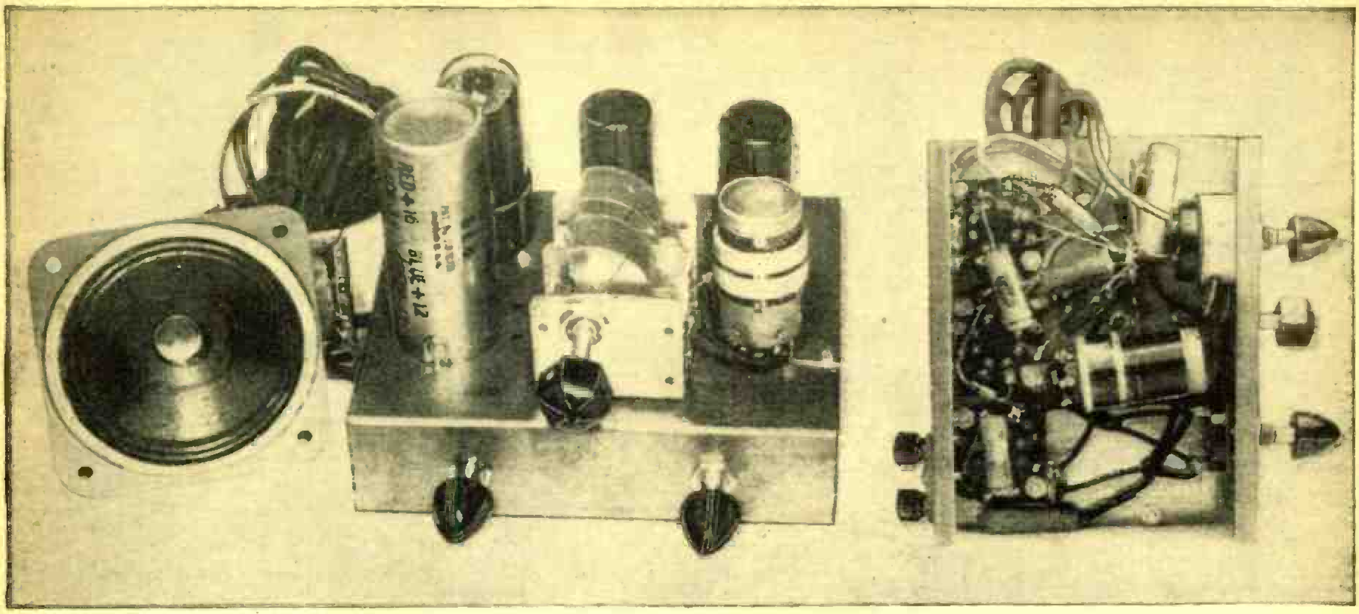


Two views of the T.R.F. receiver are shown above.

The "Bandswitch 3" TRF

L. M. Dezettel, W9SFW*

The beginner in radio set-building will find this article a very interesting one, as it describes a very effective receiver built on the T.R.F. principle. No aligning of I.F. stages is necessary and the whole construction is a simple, straight-forward job. Loudspeaker operation is obtained with but three tubes.

● FOR the experimenter who wants to build an inexpensive TRF set to listen to the local hams on 160 meters as well as the broadcast band, the "Bandswitch 3" is an ideal construction project. It makes use of three of the latest type tubes and is easily built.

The design of this kit is based on the simple *tuned - radio - frequency* circuit. Tapped antenna and R.F. coils are used with a double-pole, single-throw switch for changing bands. With the switch open the entire broadcast band is covered, and with the switch closed the frequency coverage is about 1400 kc. to 3500 kc., where many police, amateur and airport stations can be heard.

The sensitivity on the broadcast band is so great that the volume control could not be set at maximum volume without overloading the speaker, except on the low power stations. Although the *short-wave* band section does not have the sensitivity of a good superhet—police, amateur and airport stations were heard up to 200 miles distant.

An attempt was made to build the set onto as small a chassis as practical. This, together with the 3½ inch speaker, makes it possible for those of you who are a little adept at cabinet making, to build a compact modern receiver for the home.

For the sake of economy and versatility, operation is on 110-125 volts A.C. or D.C. The use of 150 ma. heater tubes keeps total power consumption down to about 25 watts.

A little about the circuit: A 12SK7 tube serves as R.F. amplifier. Volume control is accomplished by a combination of varying the bias and shunting the antenna in the R.F. stage. A 12SJ7 tube functions as a power type detector. These two tubes are of the new single-ended type and have higher gain, as well as doing a better job of shielding, than their older counterparts with the grid cap at the top. The antenna and R.F. coils are tuned simultaneously with a two-gang 365 mmf. variable condenser. The condenser has trimmers on both sides of it for easy accessibility.

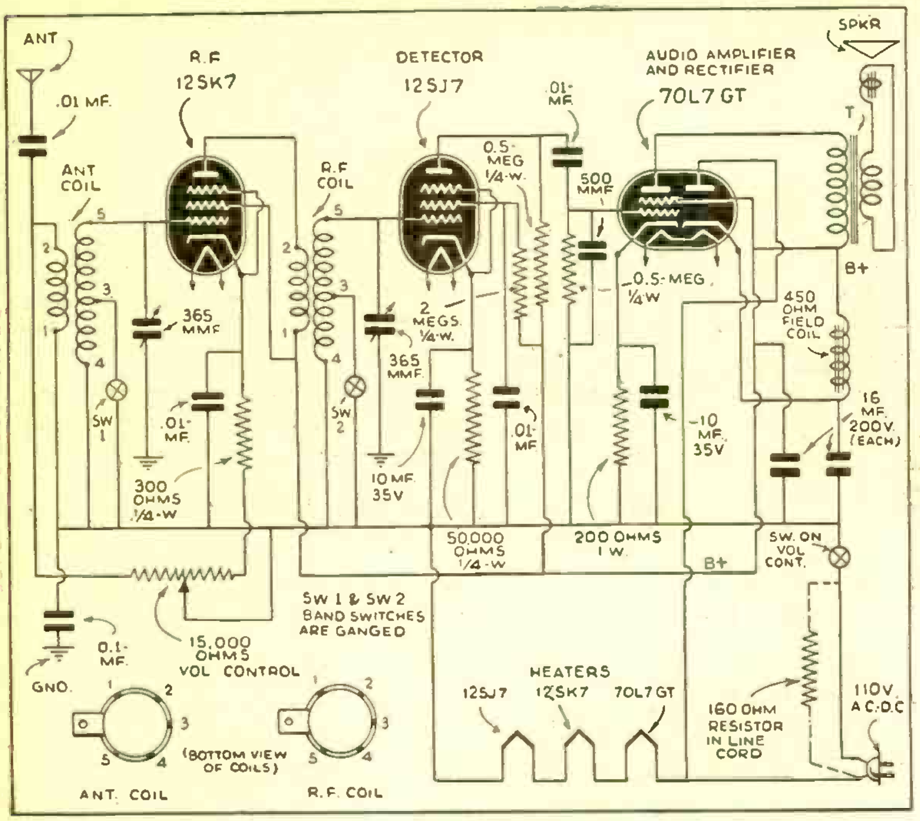
A 70L7GT tube combines the functions of power amplifier and power-supply rectifier. This tube is capable of nearly two watts of audio output. A four-section filter condenser takes care of by-passing the 12SJ7 and 70L7GT tube cathodes and filtering the D.C.

Now, what do you say we build one of these sets: The chassis measures 6" x 4¾" x 1½". This chassis can be obtained already formed and punched, ready for mounting. If you prefer you can make your own chassis from electralloy, aluminum or cold rolled steel. The pictures show the general layout, which should be followed closely when mounting the parts. The *antenna* coil is mounted above the chassis and the R.F. coil below it. The mounting bracket on the R.F. coil was intended for vertical mounting, so it will be necessary to put a squared "S" shaped crimp in it to mount it horizontal to the chassis. Be careful when mounting the speaker plug, that the terminals do not touch those of the 70L7GT tube socket.

Wiring should be done slowly and *carefully*. There is really very little to it, but a reasonable amount of care is necessary to prevent excessive regeneration. Keep all leads as *short* as possible and close to the chassis. This applies particularly to those connections which are made to the grid and plate contacts on the sockets. Notice that there is only one connection to the chassis itself—one side of a .1 mf. 200 volt condenser, which acts as an isolating condenser so that the chassis does *not* become part of the power circuit. The other side of the condenser is connected to the common negative in the circuit. This arrangement permits you to use an *external* ground connected directly to the chassis, although an external ground is not necessary. Isolating the chassis eliminates the hazards of accidental shock or blowing of house fuses. An isolating condenser is also used in the antenna circuit to prevent "fireworks" in case your antenna should come free and accidentally touch the ground or a pipe that is grounded.

No special equipment is required for adjustment. The primaries of the antenna and R.F. coils are adjustable by sliding them up and down on the secondaries. The positioning of the primaries and the adjusting of the trimmers on the condensers are the only adjustments necessary.

*Engineer, Allied Radio Corp.



Wiring diagram of the T.R.F. receiver.

1—Antenna coil and R.F. coil, tapped for S.W., Miller #20-T
4—.01 mfd. 400 volt condensers, Knight
1—.1 mfd. 200 volt condenser, Knight
1—4 section filter condenser, Knight
1—15,000 ohm potentiometer, Utah-Carter
1—Switch for potentiometer
1—Dual tuning condenser, 365 mmfd. per section, Knight
1—300 ohm, ¼ watt resistor, Knight
1—50,000 ohm, ¼ watt resistor, Knight
1—2 megohm, ¼ watt resistor, Knight
2—½ megohm, ¼ watt resistors, Knight
1—200 ohm, 1 watt resistor, Knight
1—160 ohm line cord, c or d ohm
1—Bandswitch D.P.S.T., Centralab #144
2—Small knobs
1—Large knob
1—4-prong plug
1—Ant.-Gnd. connector, Eby
1—Chassis, Knight
1—.0005 mfd. mica condenser, Knight
2—2 terminal wiring tie-points
Miscellaneous wire and hardware
(Knight—trade name of Allied parts.)

Accessories

1—Tube, type 12SK7
1—Tube, type 12SJ7
1—Tube, type 70LGT
(RCA or other good make)
1—Speaker
1—Transformer

We begin by plugging the line plug into a 110 volt A.C. or D.C. outlet. Turning the volume control to the right turns on the set, as the "on-off" switch is on the volume control. Connect an antenna and allow a minute for the tubes to warm up. With the band-switch in the *broadcast* position, you should hear stations immediately. Some oscillation, indicated by squealing sounds, will occur with the volume control on full. Slide the primary of the R.F. coil to the other end of the secondary—the end on which the terminals are located. This will eliminate or substantially reduce the oscillation. A perfectly built and adjusted job *should not oscillate at all.* However, a little oscillation occurring when the volume control is full on, will not hurt and will disappear when the volume control is turned down slightly. Even at slightly reduced volume, the signal strength is much too great for comfort.

With the receiver switched to *receive* on the *short-wave* band, local 160 meter amateur phone stations will come in at about one-half scale. Tune in the highest frequency station you can hear. Now turn each of the trimmers on the sides of the gang condenser for loudest signal. This adjustment can also be made with the switch in the broadcast band position. Next slide the antenna coil primary down on the secondary. There will be a place about half-way down, where a happy compromise between signal strength and selectivity is obtained. The exact position is a matter of antenna length used and your personal preference. Loudest signal response is heard with the antenna primary at the top. Best selectivity, with the primary at the bottom.

Even if a cabinet is not used, a speaker baffle cut from an 8" square piece of plywood will improve the tone considerably. You will be surprised at the fine reproduction quality and sensitivity of the set.

"Bandswitch 3" Parts List

1—4 prong socket, wafer
3—Octal sockets, wafer

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Relays and Magnetic Controllers for Radio Experimenters

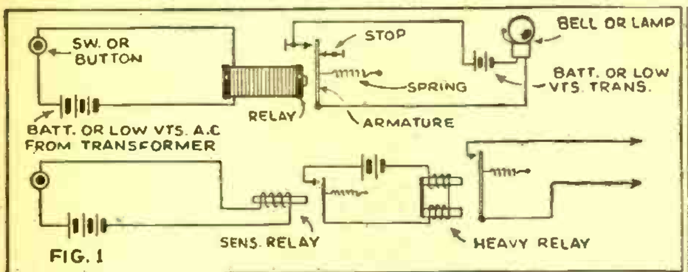


FIG. 1

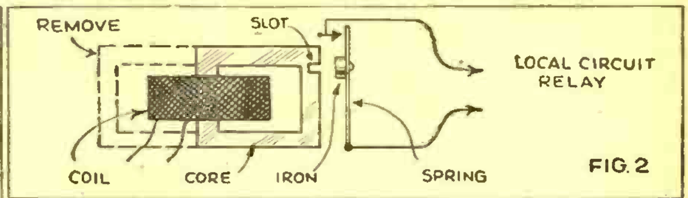


FIG. 2

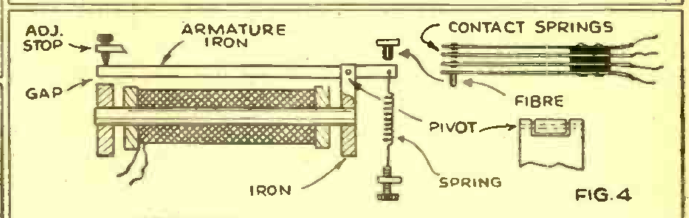


FIG. 4

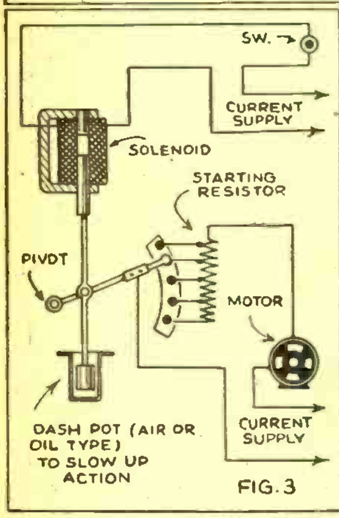


FIG. 3

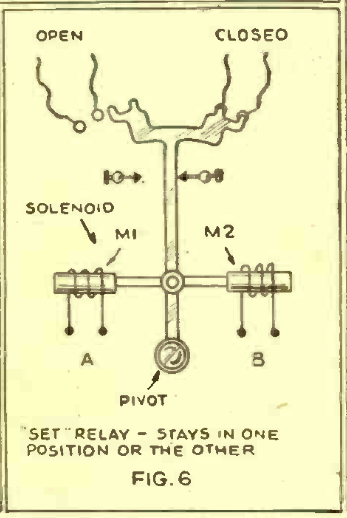


FIG. 6

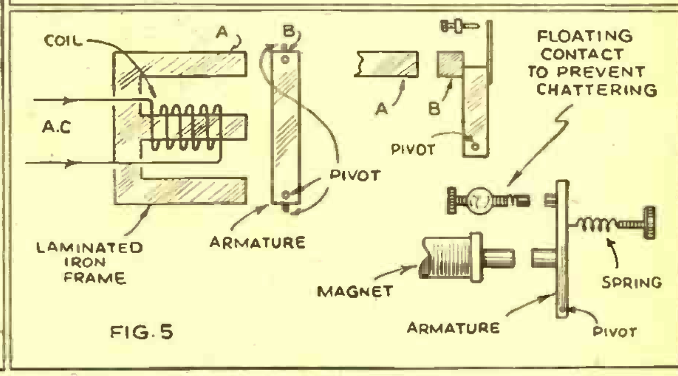


FIG. 5

The radio and electrical experimenter will find the designs suggested useful about the shop and laboratory. Very good relays can be constructed from old electric bells and telegraph apparatus. Old audio-frequency transformers can be revamped to make surprisingly good relays.

THE radio and electrical experimenter frequently finds it necessary to use a relay of some type, whether it be for controlling a distant motor, or performing some other important function about the station or laboratory.

In Fig. 1 the use of a relay for controlling a signal bell or lamp is shown: also how a sensitive relay may be used to close the circuit of a secondary heavy-current relay. The sensitive relay usually has a high resistance, which means that the magnets are wound with fine insulated copper wire, the current requirement being a fraction of an ampere. In consequence a few batteries will operate such a sensitive relay over a circuit several hundred feet long or more. A common resistance value for such relays is 300 ohms.

Where a heavy current, such as that for controlling a motor or other apparatus, is to be switched on and off—then a more sturdy relay with heavier (silver) contacts is used. Such a relay may be constructed from an old electric bell or a telegraph sounder. Where relays are to be operated on A.C. the iron core should be laminated or built up of sheet iron strips.

The relay may be caused to *close* a circuit when a current is passed through the coils, or in some cases the reverse action may be desired—i.e., when the armature is attracted by the magnets, it *breaks* the local circuit.

A sensitive relay that may be made from an old audio frequency transformer is shown in Fig. 2. Here half of the iron core is cut away as shown, and either the primary or secondary coil of the transformer is used as the relay winding. The armature spring, of steel or brass, has a soft iron button riveted on to it as shown; this button is mounted so as to come opposite a slot cut almost—but not quite—through the iron core with a hacksaw. The slot should be about 3/32 inch wide and may be cut easily by putting two or three blades on the hacksaw frame, and cutting the slot at one operation with the compound blade.

This relay will be found very sensitive and with proper adjustment screws on the armature, it can be regulated so as to have a high degree of sensitivity. It may be used in connection with photo cells and for other purposes.

A *solenoid* or suction type magnet, shown in Fig. 3, is very useful for radio and electrical experimenters, the one shown at Fig. 3 being used to pull up the arm of a motor-starting rheostat. In order that the arm shall not be jerked up instantly but moved slowly, a *dashpot* is attached to the arm. This delays the upward motion so that the motor is started slowly, as it should be. These dashpots may be of the oil or air type, and consist of a close-fitting piston, in a brass or other metal cylinder, closed at the lower end. The degree of delay caused by the dashpot may be varied by drilling a hole through the piston, and fitting a screw near this hole, so as to cut off more or less of the opening as the screw is adjusted. For *direct* current, the solenoid magnet may be made with a wrought iron or mild steel core or yoke; for *alternating* current the core and yoke should be laminated, or made up of soft iron (or transformer steel) strips.

For battery operation (6 to 8 volts) the solenoid may be wound with fairly heavy wire, about No. 16 to 18, depending upon the size of the coil. For 110 volt D.C. operation, the coil will have to be wound with much finer wire, or about No. 28 to 30, depending upon the size of the coil. If the magnet coil should heat up a little too much, some extra resistance such as a 110 volt lamp, of suitable size, may be connected in series with the magnet. For 110 volt, 60-cycle A.C. operation, the coil can be wound with heavier wire, or about No. 24, for average size coils.

In Fig. 4 a very good design of relay is shown; here the armature has a powerful action and the short end of the armature closes the contact springs in the manner apparent from the drawing. A relay of this type can easily be made by the experimenter, and as indicated there is an iron piece at each end, secured to the core, with a slot cut in one of these end strips. The armature is pivoted by means of a nail in this slot, as per drawing. An adjustment nut and a spring permit of varying tension on the armature, the back motion of which is controlled by an adjustable stop-screw. Any number of contact springs can be mounted in a position like that illustrated and operated by the armature. The coil winding may have fine wire on it, if it is to be used on a fairly long circuit, but if a strong pull is desired, and a fair amount of current is available to operate the relay, it may be wound with heavier wire, say about No. 18 or 20.

One method of constructing an A.C. relay is shown in Fig. 5. To make this an old audio frequency transformer core may be utilized. A section of the iron core may be employed as the armature, arranging it on pivots so that it can move.

For A.C. operation, where the armature is liable to vibrate or chatter, a very good idea is shown in the drawing, whereby a "floating" contact may be mounted on the end of the stationary contact screw (or it may be mounted on the armature). In some cases experience has shown that an ordinary telegraph relay will work very well when operated on low voltage A.C. from a step-down transformer. The trick in this case is to adjust the magnets so as to leave an extra large air gap between the poles of the magnets and the armature. In any event, for A.C. operation, the floating contact will be found a life-saver and is very desirable.

A "set" relay, see Fig. 6, is one in which the armature *stays where it is moved* by one magnet or the other; for many cases such as radio control of model boats, etc., such a relay will find many applications. By means of solenoids or ordinary tractive magnets, the arm A is moved to one side or the other and the contact shoe or spring caused to open and close the respective circuits in the manner apparent from the diagram. The contact springs carried on the arm A, may be of any intricate pattern worked out by the experimenter for such cases, and instead of these springs closing the circuits, the end of the arm A may simply push against a fiber block on a set of contact springs, like those found on jack type switches. In the case of a model boat, such a relay switch is very desirable, in order that one radio impulse may excite solenoid M1, for instance, and cause a solenoid-operated device to pull the boat's rudder, let us say to port. The second impulse transmitted from shore would operate the arm A, in the opposite direction, and energize the magnet or solenoid pulling the rudder in the opposite direction—or to starboard.—*H. W. S.*

ELECTRICAL ARTICLES WANTED!

● **IF you enjoy this department be sure to send us a description of your favorite piece of electrical apparatus. We want articles on simple electric motors and methods of using them, electric meter test set-ups, high frequency furnaces, home-made battery chargers, home-made measuring instruments and bridges, etc. All articles accepted and published will be paid for at regular space rates. Be sure the photos are sharp and clear.—*The Editors***

(Cover Feature)

TELEVISION APPARATUS

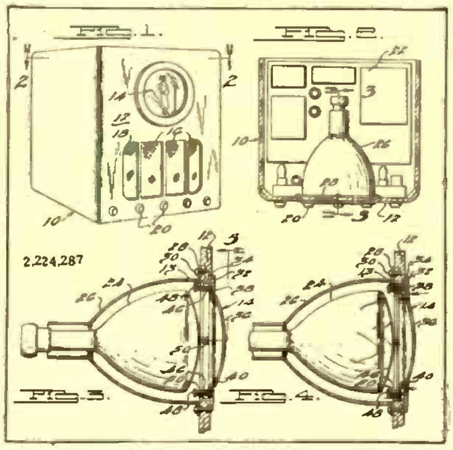
2,224,287—issued to Vern W. Busch, Rushton, Michigan.

● THIS invention includes the provision of television apparatus having non-shatterable means, through which the audience may view the pictures on the end of the cathode ray tube; pleasing in appearance and readily adaptable to changes in design, enabling it to be readily blended into various design features of a television cabinet.

This invention also provides a protective transparency for the large end of the cathode ray tube, so constructed as to impart to it a maximum degree of inherent rigidity.

This apparatus introduces air directly to the cathode tube upon implosion thereof, to thereby neutralize the effects of the implosion, with a minimum disadvantage to both the audience and the television apparatus contained within the cabinet.

The transparency is mounted for movement toward and away from the cathode



Non-shattering transparent "safety" screen for use with television tubes.

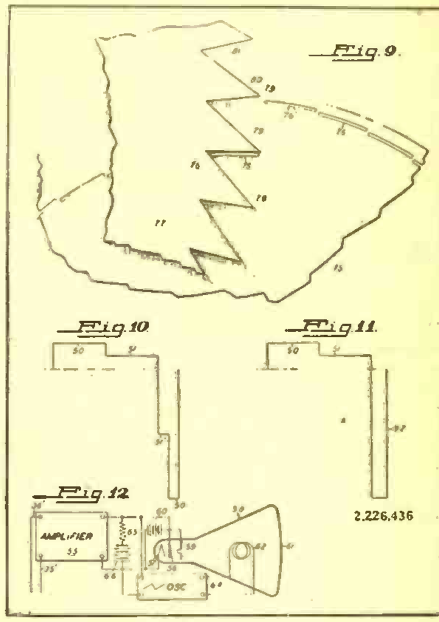
tube by resilient means. The transparency through which the audience views the large end of the cathode tube is of a lens-like character and partially corrects any distortion of the image on the end of the cathode tube.

PICTURE TRANSMISSION

2,226,436—Issued to Donald K. Lippincott, Larkspur, Calif.

● AMONG the other objects of my invention are: to provide a scanning system which may be applied with any type of scanning mechanism, whether cathode ray, oscillating mirror, or scanning disk, and with either beam scanning (the so-called flying spot) or image scanning. Further: to provide a scanning system wherein synchronizing pulses are automatically generated without the use of additional equipment; to provide a system wherein the entire picture transmission is accomplished on a single wave, the positive portions of the wave carrying the picture, while the negative portions accomplish the synchronizing. And to provide a scanning system wherein variations in scanning speed, over the various portions of the picture field, do not result in departures from the true illumination level as long as the transmitting and receiving scanning apparatus travel at the same velocity.

An additional object of the invention is to provide a scanning system, whereby either square front waves or waves resulting from the removal of certain definite frequencies from such square-front waves, may be generated without the use of filters or other auxiliary apparatus.



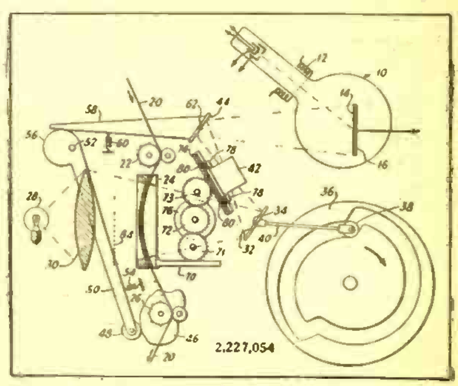
A scanning method applicable to cathode ray, oscillating mirror or scanning disc television systems.

FILM PROJECTOR FOR TELEVISION

2,227,054—Issued to Alda V. Bedford, Collingswood, N. J.

● IN the present invention provision is made whereby intermittent movement of the film is entirely unnecessary, and the film may be moved through the television scanning device in a *continuous* and uniform manner. In order that an image of the separate frames of the continuously moving film may be projected upon the mosaic or light responsive electrode of the television transmitting tube, some means must be provided for creating a stationary image. In the present invention a mirror is used, the mirror being oscillated in synchronism with the operation of the scanning device and in accordance with the movement of the film.

A still further purpose is the provision of means for the operation and optical adjustments of the scanning device and compensating for changes in the physical dimensions of the film.



Intermittent movement of the film in television is not necessary with this device.

New Radio Apparatus

New Deluxe Victrola Home-Recorder and Table Model Set

• A DELUXE Victrola, incorporating *home-recording* facilities, housed in an 18th century design cabinet in Chippendale style, has been announced by RCA. Also introduced was a powerful, but compact, table model RCA Victrola.

The deluxe instrument, Mr. Mills said, is substantially the DeLuxe Victrola V-301, with the addition of *home recording* facilities. It has the same handsome cabinet and the same operating features.

The new instrument provides a deluxe home recording instrument at reasonable cost. In addition to conventional home recording, this model also provides for re-recording, for mixing music or speech with either radio programs or recorded music, or it may be used as a public address system. The new instrument is identified as Model VHR-307 and may be had in either mahogany or walnut.

The new "table model," V-101, is a 5-tube (plus rectifier tube and ballast) instrument delivering 5 watts of power through an audio system especially designed for record reproduction. Its distinctive cabinet allows for playing 10- and 12-inch records with the lid closed.

It has the newest type of molded tone arm and an efficient crystal pickup. Two-point tone control and a highly efficient 6-inch loudspeaker are among its many features. Convenient radio reception is provided by a built-in loop antenna, while provision is made for connecting an outside antenna for distant reception. Its selective superheterodyne circuit has magnetite core I-F transformer for increased sensitivity.

New Victrola Home-Recorder

RCA Table Model Phono-Radio Set

Company Changes Name

• GOAT RADIO TUBE PARTS, INC., recently announced a change in their corporate name to Goat Metal Stampings, Inc. This company has recently reorganized their plant in expanded quarters; they will continue to supply their well-known line of tube shields, etc.

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Instructograph Company	Code Machine	Information		Free	737
Lafayette Radio Corp.	Mail Order	196-Page Catalog		Free	717, 727
Lancaster, Allwine & Rommel	Patent Attorneys	Booklet		Free	762
Mass. Radio School	Radio School	60-Page Catalog		Free	707
Midget Radio Co.	Set Mfr.	Information		Free	730
Midwest Radio Corp.	Set Mfr.	1941 Catalog		Free	747
Millen, J., Mfg. Co., Inc.	Parts Mfr.	Catalog		Free	739
National Company, Inc.	Set & Parts Mfr.	Literature		Free	I.F.C.
National Radio Institute	Radio School	64-Page Book		Free	705
National Recording Supply Co.	Parts Mfr.	1941 Catalog		Free	730
National Schools	Radio School	Catalog		Free	707
Nelson Co.	Used Courses	72-Page Catalog		Free	735
N. Y. Institute of Photography	Photography School	Booklet		Free	739
Par-Metal Products Corp.	Parts Mfr.	Catalog	40	Free	734
Radio & Technical Publ. Co.	Radio Textbooks	Circulars on each book		Free	737
Radolek Company	Mail Order	Radio Profit Guide		Free	767
Rapid Electroplating Process, Inc.	Electroplating Kits	Catalog Folder		Free	748
RCA Institutes, Inc.	Radio School	Catalog		Free	707
Remington Rand, Inc.	Typewriter Mfr.	Catalog		Free	749
Sprayberry Acad. of Radio	Radio School	52-Page Book		Free	I.B.C.
Supreme Publications	Publisher	Information		Free	729
Teleplex Co.	Code Machines	Booklet	S-4	Free	732
Thordarson Electric Mfg. Co.	Parts Mfr.	Bulletin	SD-464	Free	739
Triplett Electrical Inst. Co.	Parts Mfr.	Catalog		Free	735
Tri-State College	Radio School	Catalog		Free	707
Vibroplex Co., Inc.	Radio Keys	Catalog		Free	735

If you wish to buy, sell or exchange anything in Radio or allied fields, RADIO & TELEVISION'S classified ads will bring results. See Page 763.

Allied Introduces New Tube Line

● A NEW line of Knight radio tubes is currently being featured by Allied Radio Corporation. Built to exacting standards and specifications, these new tubes have created a stir. First, because of the adherence to strict standards in the manufacture of these tubes, engineers have been able to develop high quality, superior performance, and long-life dependability. Each tube carries a replacement guarantee covering any electrical or mechanical defect for a period of *six months* from the date of purchase. In addition, all tubes are

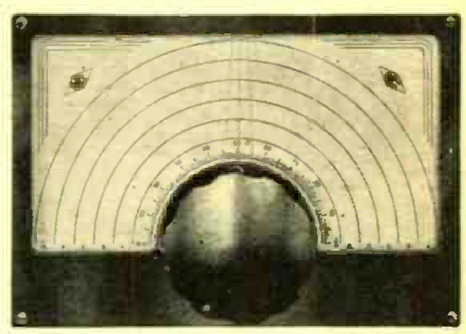
R.C.A. licensed and incorporate the latest developments in vacuum tube design and characteristics. The line of radio tubes offers a wide selection of the latest type tubes in all-glass, all-metal, octal base glass, miniature, and GT octal base types. All tubes are supplied in factory-sealed cartons.

New 5-Scale Dial

● THE type ACN dial illustrated is a new National item. Here, for the first time, is a dial that will fill a long-felt need of individuals in constructing home-built units such as electron-coupled oscillators, UHF Receivers, etc.—its five-range scale can be calibrated by hand. To facilitate accurate calibration and reading, a 0 to 100 division linear range is provided and the transparent lucite pointer has a black etched hairline.

A bezel holds the dial scale and its transparent lucite window in place. Two extra dial scales are supplied with each ACN Dial for use in case calibration is changed or original scale is spoiled.

The same 5 to 1 ratio Velvet Vernier Drive that has been famous for many years in Type A and N dials is employed in this new item. The large black HRK knob is similar to that used on the NC-200 Receiver.



An insulated coupling permits the assembly to be used in conjunction with a 180-degree rotation capacitor having a ¼ inch diameter rotor shaft. The dial frame measures 5 by 7¼ inches.

New Line of Relays

● A NUMBER of relays interesting to Hams and radio experimenters in general have been developed by the Standard Electrical Products Co. These relays include break-in and change-over types, as well as radio frequency relays, etc. One of the new relays featured by this company is of the miniature type, and the A.C. models of these relays are said to be free from hum and A.C. chatter.

The break-in relays are of the type commonly known as push-to-talk type, the operator merely pressing a push-button while transmitting and releasing it when receiving. The armatures have ball bearing pivots and large silver contacts are fitted on the relay. The radio frequency relays of the RB series are especially insulated for frequencies up to 15 megacycles, while the RM series are specially insulated for frequencies up to 60 megacycles. The A.C. coils on the R.F. relays consume 4 watts and the D.C. coils 2 watts. In the group of miniature relays it is interesting to note that one type has a coil of 5,000 ohms resistance, and it will pick up at 2 ma. and drop out at 1 ma. These relays are designed for vacuum tube plate circuits and general control applications.

(Continued on page 766)

W47P GETS LAST MINUTE CHECK

The new 3 kilowatt frequency modulation transmitter for Pittsburgh's F-M station, W47P, is seen here receiving a last minute inspection at the G.E. Laboratories from C. A. Priest (left) of the radio transmitter engineering department and W. R. David of the transmitter sales department. The transmitter will be shipped to WWSW.

The complete unit comprises a 250 watt exciter (the left rack) and a 3 kilowatt amplifier (right). Priest's hand is on the antennuator which controls audio input. The station will broadcast on 44.7 mc. to cover an area of 8400 square miles with a potential audience of 2,100,000 persons.

NEW INTERNATIONAL STATION ON COAST

Station KGEI is being converted from 20 kw. to 50 kw. to carry non-commercial American programs from the heart of San Francisco to Latin America, Asia, the Antipodes and South Africa. The station broadcasts from 4 to 9:15 A.M., and from 10 P.M. to 12:15 A.M., P.S.T. daily on 9.67 mc. or 31.02 meters. Its programs are beamed to Alaska, Hawaii, Philippines, China, Japan, Netherlands East Indies, French Indo-China, Australia, New Zealand and South Africa, and it is the only United States station heard in the Orient, according to a statement from G.E.

INTERNATIONAL LISTENING

A report from the BBC says that now more than 400 persons are engaged in its headquarters listening to and transcribing what the Axis powers say of themselves and the rest of the world over the air. In view of the increased German and Italian comment on the American attitude toward the war, summaries of such broadcasts are transmitted nightly from BBC at 7:45 P.M. E.S.T. The British stations are also broadcasting programs dealing with the Empire's war progress. These broadcasts give radio listeners the opportunity of getting the best information "direct from the feed box."

DON LEE MAKES IMPROVEMENTS

Station KHJ, which recently moved to new half-million dollar quarters in Hollywood, has one of the most elaborate studio plants in the United States. The layout includes a central plant comprising lobby, three luxurious auditorium studios, one production studio, and executive sales offices. There is also a two-story annex, housing production, news, publicity, merchandising, and engineering offices. On the second floor of this building are six one-man studios for commentators, etc. A third building contains the $100,000 Don Lee music library.

The Don Lee network, incidentally, comprises 33 stations and is the largest regional network in the United States. Nearly 200 persons are employed in the technical and production departments of KHJ, which was founded April 13, 1922, and came under Don Lee management some five years later. The network is still completing its new $100,000 television station, and the 300 foot steel tower is already up.

In Next Issue

•

Portable Receiver A.C.-D.C. and Battery

The TRF 7, with lots of zip!

A Receiver for the Set Constructor

by STANLEY WEBER

New Microphone Has "Paracoustic" Reflector Baffle

● A NEW aeropressure microphone whose directional characteristics may be changed at will by the use of a new "paracoustic" reflector baffle attachment, has been announced by the RCA Manufacturing Company. The microphone is ideal for all types of public address applications, as well as for amateur radio-telephone transmitters.

Characterized by outstanding modern design and unusual ruggedness of construction, the microphone is designed primarily to withstand the wind and weather conditions found in outdoor applications. It is equally well suited for indoor use, especially under conditions demanding low cost and ability to withstand rough usage. Frequency response covers the full usable range—60 to 10,000 cycles, with exceptionally high sensitivity.

The microphone is of the bullet-shaped type, with the "live" end protected by a grill. Housed in an attractive black and chrome plastic case, the unit is supplied with an adjustable mounting and adaptor for any type microphone stand.

The "paracoustic" baffle changes the directional characteristics of the microphone. With the concave face of the circular, dish-shaped baffle toward the grille, the directional characteristics become sharpened, and feedback is reduced. When the baffle is reversed, so that the convex face is toward the grille, the opposite directional effect is obtained. Without the baffle, the microphone becomes a normal pressure microphone.

The "paracoustic" reflector fits over the "live" end of the microphone and is held in place by an inconspicuous thumb-screw.

The microphone is available in both low impedance (250 ohms) and high impedance (40,000 ohms) models. It employs a new type of plastic diaphragm to assure maximum ruggedness and is equipped with a 30-foot cable.

CORRECTION

In the article on Television Receiver appearing on page 550 of January issue note following corrections: There should be one each .25 mf., 600 volt condensers from R80 to R81 to ground. In sweep circuit diagrams the Cathode Resistor R69 in the 6N7 tube circuit and R51, where connected together, should go to ground.

NEW RADIO CATALOGS

New Howard Catalog

● HOWARD announces three new free catalogs. Illustrated is the 490 Technical Manual. In addition to full charts and schematics on the Howard 14-Tube Professional Receiver, several pages are devoted to the art of receiver measurements. A good technical book for amateurs, servicemen and sound engineers. The other catalogs are Folder 103, containing recording discs and needles; and Folder 104, complete line of Communication Receivers and Accessories.

Recording Catalog

● THE National Recording Supply Company of Hollywood, Cal., has just issued its annual catalog of recording accessories. Newest single item is a small coated blank made especially for amateurs in the form of a patented National QSL disc. Recent developments indicate that many amateurs now possess recording equipment and, instead of the old-time postcard, now use a disc to record other amateurs' voices and send them through the mails.

The Hollywood company, the staff of which represents many years of recording sales and service, has specialized in grouping complete recording accessory lines under one roof at a single source. Its items also include recording albums, crystal pickups, marking inks, mailing envelopes and the like.

New Chart Presents RCA Tube Characteristics

●COMPLETE information on the characteristics, classification, and socket connections of RCA receiving tubes is included in the new edition of the RCA Receiving Tube Characteristics Chart now being supplied through RCA tube distributors.

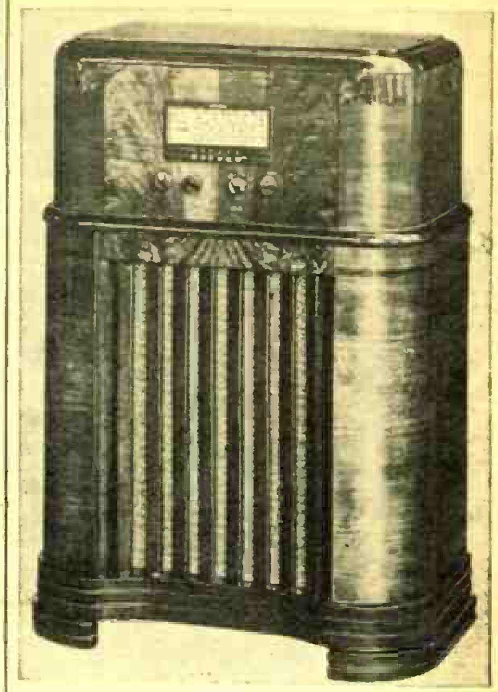
The chart, published in 14-page booklet form, is invaluable for jobbers, servicemen, engineers, radio amateurs, and others in constant need of complete information on radio tubes. The chart is printed in easily legible, large-size type.

The first two pages are given over to classifying RCA tubes according to their cathode voltages and their functions. It assists the tube user in identifying type numbers and choosing the proper tube type for a given application.

The following nine pages make up the characteristics chart. Complete information is given as to dimensions, socket connections, cathode type and rating, use, plate supply, grid bias, screen supply, screen current, plate current, A-C plate resistance, transconductance, amplification factor, load and power output.

On the last two pages are shown bottom views of socket connections for 116 types of tubes. Ask for booklet No. 1275-B.

(Continued from page 764)



New Howard 12-Tube Receiver

• HERE'S the new Howard 12-tube console, tuned 3 band from 540 kc. to 22 mc. (555 to 13 meters). Model 718-C has six push-buttons. 12" Jensen speaker and 10 watts beam power output.

Exceptional distance on both the broadcast and short wave bands are made possible by two iron core I.F. stages and a stage of tuned radio frequency on the broadcast band. The built-in loop antenna can be used for all ordinary reception, but there are connections for an outside antenna when exceptional distance is desired.

A unique tone control system permits the user to have the exact response desired. One tone control brings out the bass, and a separate tone control amplifies the treble tones. These can be mixed until the exact tonal response is achieved to suit the program. Set is housed in an attractive modernistic walnut cabinet, with butt walnut center panel and trim.

New Television Receiver

• THE new Gilfillan Bros. Model G12 television receiver has the following characteristics:

The receiver utilizes a total of twenty-eight tubes plus the picture tube, which is an R.C.A. 12AP4. The "mask opening" for this picture tube is 8 by 10 2/3 inches. The receiver incorporates the broadcast band, manually tuned, and also the selection of four broadcast stations by push-button. Provision is made for the selection of any one of four television channels, which is the total number presently anticipated in any one area. Volume and tone controls are provided for the sound side and their equivalent contrast and brilliance controls are also available on the panel for the adjustment of the picture.

Nine other controls which may need adjustment at the time the television receiver is installed are accessible through a cut-out at the bottom of the protective screen in the rear of the cabinet.

The G12 television receiver is Underwriters' approved and has special magnetic shielding and electrical filtering of the power supply—this latter requirement due to the fact that some areas on the West Coast are supplied with fifty cycles as against the more commonly available sixty.

New Hallicrafters FM-AM Tuner

• THE Hallicrafters Model S-31 FM-AM Tuner offers special advantages to those who already possess high-fidelity audio equipment, providing full facilities for FM, and for broadcast reception of unusual quality, without the necessity for duplication of audio equipment. Its undistorted output of 130 milliwatts is ample for any standard amplifier, including those in existing broadcast receivers.

The S-31 provides a dual I.F. system, the 4.3 mc. FM channel utilizing 1852 and 1853 tubes in its two 4.3 mc. stages, a 6SJ7 limiter and 6H6 discriminator. The 455 kc. AM channel includes a single 6SK7 with special band-pass input circuit, and a 6SR7 which serves as detector and A.V.C. and its triode section as the output stage for both AM and FM channels and also for phono. A

6SK7 T.R.F. stage and 6SA7 converter provide the R.F. input to both channels.

The two tuning ranges are 540 to 1650 kc. and 40 to 51 mc. These are selected by a panel switch which also automatically selects the appropriate I.F. channel. Terminals are provided for standard and doublet antennas, and for phono input. The two scales on the "slide-rule" dial are fully calibrated in kc. and mc. Other controls include a radio-phono switch, A.F. gain, tone control, and "S"-meter adjustment. This meter, mounted on the panel beside the tuning dial, serves as a conventional tuning and signal strength meter for AM reception and as a carrier-centering indicator for FM tuning.

Outputs of 500 and 5000 ohms are provided, plus a headphone jack for monitoring purposes. The panel is the standard rack-mounting type, 19" x 8¾" and suitable for rack or cabinet mounting.

Newest rack mounting model S-31 Hallicrafter FM-AM receiver.

What Do YOU Think?

(Continued from page 707)

He Wants SWL Magazine

Editor:

There are so many short wave listeners in the United States that are enjoying their hobby, while studying to become an amateur, that I think they would like a national organization such as the amateur's A.R.R.L. and have their own magazine like Q.S.T. Why doesn't some radio magazine editor try this out and see how it goes over? I would suggest that it contain articles on sets and operating of receivers and other helpful data that would be valuable for them. Also have some award for the best looking SWL shack. How about it, you SWL's out there, write in and maybe we might succeed.

CHARLES GRETEN,
755 Moxahala Ave.,
Zanesville, Ohio.

SWL Reports Should Be Answered

Editor:

I have heard much about the QSL cards and SWL reports, and I would like to say something.

First of all, my name is Juan R. Saborio, T.I.5.J.R.S., Alajuela, Costa Rica. (I am now studying electrical engineering at Clemson College, S. C.)

In Costa Rica I used to read your magazine which one of my friends received. I am now a regular reader of RADIO & TELEVISION.

I think (and so do most of my friends of the air in Central and South America) that an SWL report is always to be answered. Most of the radio amateurs I know used to send their QSL card, but there are radio amateurs that never send a card. I think that all these problems will be solved if a radio Ham answers the reports; they are always useful and bring the satisfaction that the set has been working well.

I have some QSL cards that I'll be glad to exchange.

JUAN R. SABORIO,
P.O. Box 1404,
Clemson College, S. C.

Constructive Criticism

Editor:

My criticisms start at the front with the cover. The covers used to be paintings and were so good that I framed some of them and hung them in my listening post; they are, in my opinion, "works of art." They would be a lot better than a page of small photographs.

Your monthly "editorials" are still good and hope they continue so.

The receiver diagrams you print are all right, but 7 tube "super-bloopers" are out of the average experimenter's class. So why not print a few 2, 3, 4 tube TRF and Super. jobs? Let's have less high-fidelity amplifiers for F-M and more 3 and 4 tubers.

The "Kink" department could stand a little shakeup. Everybody who submits a kink that is published should receive a 6 mo. subscription to R.&T. The best kink should be worth $10 and second best $5, while the third ranking one should be a year's subscription.

I would also like to see a diagram for a code practice oscillator employing a 4½ volt "C" battery and a tone control.

GLENWOOD HALL,
P.O. Box 285,
Desloge, Missouri.

Index to Advertisers

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

What the Amateurs Can Do
(EDITORIALS)

(*Continued from page* 709)

contacts out of the air, the *short-wave experimenter* is not seen by them. He is not known by the company he keeps, the church he attends nor by the clothes he wears, but by the signals he sends out and the honest reports he sends in. He is in a *new* world, whose qualifications for success are entirely within his own grasp. A good home-made transmitter or receiver, carefully built from the data given in the pages of RADIO & TELEVISION gives him more prestige than a commercially manufactured one.

The nations on earth may well take a lesson—many lessons—from the *short-wave* listener and amateur radio operator—lessons in WORLDWIDE FRIENDSHIP. I like to see these idealistic men and boys, and yes, women too, working toward international peace and friendship—and they are doing it, too. You know, it's rather bewildering to find that the fellow your home-town propaganda expert is trying to teach you to *hate*, is a "brother radio experimenter," faced with the same problems of life as yourself and that HIS kids just had chickenpox too!

DR. PHILIP WEINTRAUB,
W9SZW-W9TMQ,
3860 Harrison St.,
Chicago, Illinois.

TELEVISION TUBE OF THE FUTURE

● IN the future, television pictures will be obtained with a tube having a screen only one inch in diameter, or smaller.

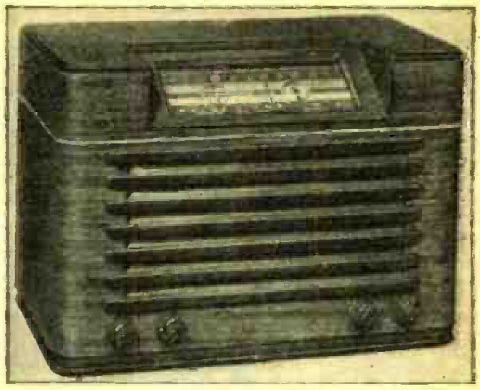
The tube's screen will be coated with a chemical, which instead of fluorescing, will vary in opacity as the strength of the electron beam varies.

The tube will have receptacles for lights, which will shine through behind the chemical screen, and as the screen varies in opacity, will shine through. In this way pictures will be obtained which will compare favorably with the present system of home movies.

The projecting system will use a set of lenses, such as are used in the present-day home movie projectors.

The low voltages necessary to operate it will mean smaller sets, and smaller sets mean portability.

We, more than any other country, have



Prize—The Pilot Clipper—Model T-122 receiver, covering the "broadcast" band and also the 15 to 53 meter short-wave band.

the necessary engineering ability and ingenuity to develop this; so Television Industry, why not get busy and develop the chemical screen, one that varies in opacity as the electron beam varies in strength, instead of using the present fluorescent screen?

LEE GARRISON,
Radio Service,
Falls City, Oregon.

(The Editor's reason for selecting Mr. Anthony Guide's guest editorial this month as the prize winner, is that Mr. Guide pointed out one of the most important angles that should be carefully checked in every case where radio transmissions are to be investigated. In other words, Mr. Guide points out a very important job which our radio amateurs can and should do; undoubtedly the F.C.C. or other government agency, will sooner or later take advantage of this suggestion.)

ANSWERS TO PUZZLE DIAGRAM ON PAGE 750

The diagram shows a phono oscillator and the following errors occur in the hook-up as shown:

1. There should be no condenser C1 in series with pick-up.
2. Bypass condenser C2 is superfluous.
3. Leads 1 and 2 are transposed, so that no plate voltage is applied to the plate of the 6A8GT.
4. Condenser C3 and C4 are ordinary fixed bypass condensers and not variable, as indicated by the arrows.
5. Bypass condenser C5 is superfluous.
6. Resistor R9 is not needed.
7. The motor lead wire 4 should connect to the 110 volt wire 3, and not to the cathode of the 76 tube, as it would not derive sufficient current to operate it.
8. Resistor R7 is not required.
9. The grid of the 76 tube should be connected to the plate and not to the cathode.
10. One grid too many is shown in the 6A8GT.

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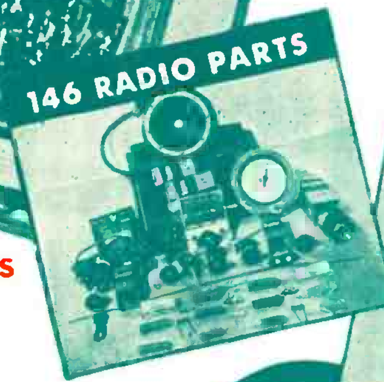

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