RCA Continues to Build America's Radio Audience!

Better programs—which increase the demand for better radios—are constantly being fostered by NBC's own unsponsored programs...they constitute 70% of NBC's time on the air!

During 1937 the National Broadcasting Company, a service of RCA, broadcast more than 50,000 unsponsored programs. Such service accounted for 70% of all NBC time on the air. The variety offered was as wide as human interests.

Through the miracle of radio such programs bring to millions entertainment, information and help which they could not receive otherwise. Through NBC, living rooms become boxes at the Metropolitan Opera. Or they are filled with the sonorous cadences of great symphonies, played by the NBC Symphony Orchestra, conducted by Arturo Toscanini, or some other famous conductor.

Again, it may be current prices of eggs, or pork, or a discussion of books and plays. But whatever the subject, if it is of interest to any considerable part of the public, NBC provides programs which deal with it.

Programs such as these, together with the fine programs sponsored by NBC advertisers, have been largely responsible for the increased sale of radios. And in offering listeners better radios RCA further stimulates America's interest in fine radio programs.

RCA presents the Magic Key every Sunday, 2 to 3 P. M., E. D. S. T., on the NBC Blue Network.

Radio Corporation of America
RADIO CITY, N. Y.
RCA MANUFACTURING CO., INC. RCA INSTITUTES, INC. RCA COMMUNICATIONS, INC.
RADIOMARINE CORPORATION OF AMERICA NATIONAL BROADCASTING COMPANY
I can't find out what's wrong—
guess I'll make a pool of myself with Mary.

Hello, Bill—got a tough one to fix?
Let me help you.

I've been studying radio at home. Bill,
with the National Radio Institute. You
could take their course. I got a good radio job now. Let's make a
Circuit disturbance test—starting with
the audio output stage,
and testing every stage right back to the
antenna. Listen for the clicks when I
tap the grid leads.

Hello Joe—where've you been lately—
and where did you learn anything about
radio?

I've seen their ads but I never thought
I could learn radio at home—I'll mail
their coupon right away.

I've learned now that this
course is practical and complete, I'll enroll now.

And then I can make
real money servicing radio sets.

Or get a job with a radio
broadcasting or transmitting
station.

Aviation radio, police
radio, television, electronic controls—
radio is surely going
places. And the
National Radio Institute has trained
hundreds of men for jobs in radio.

Say—where did you learn
that test? It's a good one.

I'll try, Mary. I'll take it home tonight.

J. E. SMITH, President
National Radio Institute
Established 1914

The man who has directed
his home study training
Radio Institute makes more
men in America.

Thanks! It certainly is
easy to learn radio the
right way. I started only
a few months ago, and I'm
already making good money.
This spare time work is great fun
and pretty soon I'll be ready
for a full time job.

Our worries are over.
I'm making good money
now, and there's a
big future ahead for us in radio.

Rich Rewards in Radio

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

Dear Mr. Smith: Without obligation, send me a sample lesson
and your free book which points out spare time and full time radio
opportunities, and shows how I can train for them at home in spare time—about the J.B.I.
Set Servicing Instrument you give. (Please write plainly.)

Name 
Age 

Address 

City State 

I'LL TRY, MARY. I'LL TAKE IT HOME TONIGHT.

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

Dear Mr. Smith: Without obligation, send me a sample lesson and
your free book which points out spare time and full time radio
opportunities, and shows how I can train for them at home in spare time—about the J.B.I.
Set Servicing Instrument you give. (Please write plainly.)

Name 
Age 

Address 

City State 

Please Say That You Saw It In Radio-Craft.
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FLASH

Here is news that is news! In addition to the regular articles and departments, September Radio-
Craft and all following issues will contain a new section called "Radio Trade Digest." Here, in condensed, readable form, will be presented authentic information as to what's new in the radio industry; new products, choice gossip, personals, trade-building campaigns, convention news, commentaries, and all vital items that make a successful "newspaper" for the trade. Whether you be Dealer, Serviceman, Experimenter or merely casually interested in radio you will definitely find in this department considerable material of interest to you.

RADIO-CRAFT is published monthly, on the first of the month preceding that of date; subscription price is $2.50 per year in U. S. and Canada. (In foreign countries, $3.00 a year to cover additional postage.) Entered at the post office at Springfield as second-class matter under the act of March 3, 1879.

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Are You Ready for a Better Job—More Pay?

Don’t be an untrained man. Let me show you how to get your start in Radio—a fast growing, live money-making industry. Prepare for jobs as Assembler, Inspector and Tester—Radio Sales or Service and Installation Work—Broadcasting Station Operator—Wireless Operator on a Ship or Airplane or Sound Work—HUNDREDS OF OPPORTUNITIES for a real future in radio!

12 Weeks of Shop Training

We don’t teach by book study. We train you on a great outlay of Radio, Television and Sound equipment—on scores of modern Radio Receivers, actual Broadcasting equipment, Television apparatus and Sound Reproduction equipment, Code and Telegraph equipment, etc. You don’t need advanced education or previous experience. We give you—RIGHT HERE IN THE COYNE SHOPS—the actual practice and experience you’ll need for your start in this great field. And because we cut out all useless theory and only give that which is necessary you get a practical training in 12 weeks. Mail coupon for all facts about my school and training methods.

TELEVISION and PUBLIC ADDRESS

Television is sure to come as a commercial industry. Rapid progress is now being made in developing this new field. It will offer opportunities to the man who is trained in Radio. Here at Coyne you learn Television principles, and work on actual Television equipment. Public Address Systems offer opportunities to the Trained Radio Man. Here is a great new Radio field which is rapidly expanding. Prepare NOW for these wonderful opportunities! Learn Radio Sound Work at COYNE on actual Sound Reproduction equipment. Not a home study course.

SEND FOR DETAILS OF MY “PAY AFTER GRADUATION” PLAN

Mail the Coupon below and I’ll tell you about my “Pay After Graduation” Plan which has enabled hundreds of others to get Coyne training with very little money. On this plan you can get your training first, then take 18 months to complete your small monthly tuition payments starting 5 months after you begin training. Not a home study course. Mail the coupon for all details of this “Tuition Payment Plan.”

PRACTICAL WORK at COYNE in Chicago

ACTUAL PRACTICAL WORK. You build and service radio sets. You get training on real Broadcasting equipment. You construct Television Receiving Sets and actually transmit your own Television images over our Television equipment. You work on real Sound equipment. You learn Wireless Operating on Actual Code Practice apparatus. We don’t waste time on useless theory. We give you the practical training you’ll need for your start in Radio—in 12 short weeks. If you desire code, this requires additional time for which there is no extra charge.

Mail Coupon Today for All the Facts

H. C. LEWIS, Pres.
Radio Division, Coyne Electrical School
500 S. Paulina St., Dept. CS-8H, Chicago, Ill.

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A New Policy!

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You can buy any Gernsback Manual on Three Days' Approval

Perhaps you're new in Radio—or probably, in previous years you missed one of the Gernsback OFFICIAL RADIO SERVICE MANUALS. This is your opportunity to buy any edition you might need—get it in a way differently than ever before offered. Under a new policy—FREE INSPECTION PLAN—you can buy any Gernsback Manual on Three Days' Approval. There are thirteen Manuals and books from which to choose—every man in Radio should take advantage of this privilege.

Here Is How It's Done!

Order any GERNBSACK MANUAL illustrated and described on this page—the publishers will ship it to you immediately POSTPAID. When it reaches you, inspect its contents. If, after three days' inspection, you decide to keep the Manual, mail your remittance to the publishers. If the volume proves unsuitable, return it postpaid.

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Latest Volume 7 Manual Included

Volume 7 of the OFFICIAL RADIO SERVICE MANUAL—the edition which stamped the Radio industry this past year because it was published in a new way—in twelve monthly installments, is included under this new policy. This volume is now complete—twelve installments, totaling 1,600 pages, are bound in a Hardcover binder and just packed with information you need today—and in the years to come. The coupon below gives you the privilege of inspecting this Manual also before you buy it.

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How To Get Any Manual You Need!

After you have definitely decided which Manual you want, fill in completely the coupon at the right. Clip it to your letterhead or paste on a penny post card and mail to the publishers. In a few days your Manual will reach you—Don't lose time—send coupon, TODAY, to

RADCRAFT PUBLICATIONS, Inc.
99 Hudson Street
New York, N. Y.

This only applies to Manuals with over 2,000 illustrations, containing page after page of schematic diagrams—each page an important section of the Manual—enabling you to know exactly what radio element you are looking at. In this Manual you will find:

**Volume 7**

This valuable volume contains over 2,000 illustrations in all—representing every type of receiver ever manufactured or in production today. This Manual answers your question about Radio: *What do I do with this part?* It will show you over 1,000 pages of complete details of all types of Repairs and Service of Auto-Radio and Specialized Receivers, including new Waves, Troubleshooting, Amplifiers, Specialized Receivers, and many more.

**Volume 6**

This volume contains over 1,000 illustrations in all, representing every type of receiver ever manufactured or in production today. It will show you all types of Repairs and Service of Auto-Radio and Specialized Receivers, including new Waves, Troubleshooting, Amplifiers, Specialized Receivers, and many more.

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This volume contains over 800 illustrations in all, representing every type of receiver ever manufactured or in production today. It will show you all types of Repairs and Service of Auto-Radio and Specialized Receivers, including new Waves, Troubleshooting, Amplifiers, Specialized Receivers, and many more.

**Volume 4**

This volume contains over 600 illustrations in all, representing every type of receiver ever manufactured or in production today. It will show you all types of Repairs and Service of Auto-Radio and Specialized Receivers, including new Waves, Troubleshooting, Amplifiers, Specialized Receivers, and many more.

**Volume 3**

This volume contains over 400 illustrations in all, representing every type of receiver ever manufactured or in production today. It will show you all types of Repairs and Service of Auto-Radio and Specialized Receivers, including new Waves, Troubleshooting, Amplifiers, Specialized Receivers, and many more.

**Volume 2**

This volume contains over 200 illustrations in all, representing every type of receiver ever manufactured or in production today. It will show you all types of Repairs and Service of Auto-Radio and Specialized Receivers, including new Waves, Troubleshooting, Amplifiers, Specialized Receivers, and many more.

**Volume 1**

This volume contains over 100 illustrations in all, representing every type of receiver ever manufactured or in production today. It will show you all types of Repairs and Service of Auto-Radio and Specialized Receivers, including new Waves, Troubleshooting, Amplifiers, Specialized Receivers, and many more.

Please Say That You Saw It in Radio-Craft
THE TELEVISION AGE

By the Editor — HUGO GERNSBACH

The curious thing about all modern inventions is that they have a habit of changing our every-day lives to such a tremendous extent that it is sometimes difficult to visualize how much certain inventions have really changed not only our lives, our habits, but much of our civilization as well.

The Railroad can be cited as a good example. It has not only enriched the entire world tremendously but has changed the face of the world to boot. It opened up entirely new countries and did away with untold drudgery as well. The Telephone again changed much of our mode of living. Instead of transporting ourselves from office to office or from house to house we do our communicating, our business and our social friendly chats over the telephone thereby gaining time which may be used for other purposes than the walking or riding necessitated by personal calls.

The Motion Picture, and lately Radio, have had similar profound changes on humanity. The motion picture has taken the place of the theatre in many respects while Radio has brought the poor man his entertainment. It is no longer necessary to go to a concert or to a show when he can stay at home and get much better amusement than he possibly could at most small town theatres.

What will Television do when it finally penetrates into our homes as far as we ourselves are concerned? Adding Sight to present-day receivers, Radio—up to now blind—will again take a leap forward that cannot fail to change much of our mode of living in the future.

Of course, television is usually thought of as merely an instrument of entertainment. This, of course, is wrong, because television has other functions besides entertainment. Thus, for instance, television, when it first was thought of was usually pictured as a means of communication whereby sight was added to sound on our telephones. When television will finally come about it is almost certain that our telephones will have Sight as well. The telephone, while admittedly a valuable means of communication, cannot be used in many instances. For instance, if I wish to buy a certain article I will in most cases have to transport myself to the store; unless of course, I am intimately acquainted with the article. But suppose I wish to buy a lady’s hand bag at a department store. I cannot do so over the telephone today because I cannot see a selection of bags over the telephone.

In the future this will be changed entirely because I will be able to shop not only by sound but by sight as well. The large department stores will have special departments whereby articles will be shown to customers over the television-equipped telephone so that we can make our purchases without leaving our homes or our offices. Salesmen will be able to sell their prospects in a like manner. The bank clerk who is hesitant in cashing a check for an unknown person can call up the maker of the check and show him the check over the wire and so get an OK. There are thousands of other uses that can be easily pictured and from this it will be seen how tremendously our lives will again be changed when Television-equipped telephones are an accomplished fact.

Television in the home, for entertainment purposes, will also change our lives profoundly if present-day Radio is any barometer. It is almost a certainty that television will prove to be a powerful rival to the motion pictures. Indeed the motion picture interests have a case of the “jitters” every time television is mentioned. While I do not believe that television will ever displace the motion pictures it certainly will have an effect upon the magnitude of the motion picture theatre attendance, and while it is not likely that complete motion pictures such as “Snow White and the Seven Dwarfs” will ever be shown from start to finish over a home television set, yet it will probably pay the motion picture interests to show pre-views of coming pictures as a good piece of business. Television will encroach upon motion pictures, only in its capacity as a powerful magnet to keep people home where they can enjoy television programs, which as I said before, have no connection whatsoever with the motion pictures at all. The reason is a fundamental one rather, and that is that people who go to motion pictures maybe 2 or 3 times a week now-a-days, may then not wish to go more than once a week or maybe not even that frequently, feeling that the television shows which they can get at home for practically nothing will be every bit as enjoyable as going to a motion picture theatre and seeing perhaps a poor picture.

One thing television when it comes will probably do, is that it will help to make motion pictures a great deal better. Today there is much dissatisfaction on account of the poor entertainment value of many motion pictures. The coming of television, therefore, will be a powerful stimulant to “clean house” as far as the motion picture industry is concerned. They will then be forced to make the pictures so good and so entertaining that people will wish to see motion pictures rather than television.

From a purely educational standpoint television will do much to increase not only our knowledge but I do believe a higher education will be obtained via the television screen. We will be transported to every nook and corner not only in our own country but we will travel abroad as well and see scenes which most of us probably would never have been able to actually see without television. This will be a forceful stimulant not only to the imagination of the young but to the old as well. Just as Radio has opened up new worlds in music to the average man who, in distant corners of the country never was able to hear good music in a lifetime, so television will bring sight to the most humble as well as to the rich and we will be enabled to tour the entire world at a pace never believed possible before.

These are only a few of the television uses. There are of course, hundreds of others, impossible to enumerate in a short article of this type, but whatever it will do, television will open up an entirely new world to all of us. A world that even the most daring imagination of today can hardly encompass.

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VIDEO BELLWETHERS

Newest in cathode-ray television pick-up cameras is this new type, which is raised and lowered electrically. To speed its operation, a single handle rotates, tilts and focuses it. A special optical system enables the cameraman to focus the image on the signal plate of the "camera tube."

By heck! Here's a "dummy" which isn't! He answers questions (concealed microphone, amplifier and loud-speaker set-up, remote monitored by head phone), "smokes" (suction device), and moves eyes, lips, arm, hand, foot, head (all around), says G.E.

"Television Tillie, like "Hill Billy", is a dummy—but less articulate. As a "stand-in" for testing B.B.C.'s costuming and lighting she's tops.

THE RADIO MONTH

N.B.C./RCA went to town, last month, and gave 1,000 representatives of newspapers, and 200 students of New York University, optical and auditory treats via their 441-line all-electronic television system.

Said David Sarnoff, RCA proxy, cautiously, "Our experiments with television in the past 18 months have improved the system by increasing its capabilities and efficiency, thus enabling it to move closer to the inauguration of a television service for the American home."

Radio-Craft representatives at the press demonstration were of the opinion that (1) reproduction was flickerless, (2) eye fatigue was no greater than for movies, and (3) detail was excellent even to seeing whites of eyes on close-ups. Although 2 of the 15 receivers in use on the 62nd floor of Radio City, reproducing images transmitted by radio from Empire State Building 3½ miles away, acted up, the show with this exception was flawless. Image after reflection from the end of the cathode-ray receiving tube (the Kinescope, says RCA) measured about 7½ x 10 ins. wide; color, black/white and black/green, both being demonstrated. Feature of the show was the clever use of both natural (studio) and artificial (film) staging, in which performers seemingly left the studio, journeyed to foreign lands, and returned to the studio; critical observers were unable to detect this transition from spot-up to film-televison, and reverse!

A feature of the demonstration to the N.Y.U. students was the use of a talk-back circuit. Professor Clark, on the 3rd floor of the RCA building, after delivering an illustrated lecture on the uses and principles of photoelectricity invited students, before the mirrors of 15 television receivers on the 62nd floor, to comment. Student Lillian Chase offered a query, and in response the professor beckoned to her, via the television set-up, to come down to the 3rd floor. The young lady was seen by the remaining students, 5 minutes later, alongside their teacher and talking to him. Told that she was being televised she slumped into a chair but soon regained her composure. This demonstration has inaugurated schoolroom use of television.

DIM "TOWER" VIEWS

Experimenters who saw only dim images from W2XBS, last month, can blame this on broadcasting from an experimental antenna array, on the North side of the Empire State Tower, directive North. Tall Northern buildings reflected some signals South, but this resulted in multiple images at the receiver. Station's normal service radius is about 50 miles; max., about 70 miles.

CAIRO CONFERENCE

Radio broadcasters, set makers, and others in the radio field, have been experiencing sleepless nights, wondering what would happen to frequency allocations, etc., at the International Telecommunications Conference in Cairo, Egypt, which completed its current deliberations last month. The following brief outline by Sir Noel Ashbridge (B.B.C.'s Chief Engineer and U.I.R. Delegate to the Conference) regarding outstanding developments, therefore, will prove interesting.

The International Telecommunications Conference is normally held once every 5 years. It is composed of official delegations representing the Governments of almost every country in the world, and, in addition, there are delegations representing organizations operating radio-telegraph, telephone, or broadcasting services. There are also a few delegations representing international unions catering to various types of service, such as broadcasting and air services, and there were several delegates representing the interests of amateurs in various parts of the world.

(Continued on page 128)
IN REVIEW

STATISTICS;
POWER BY RADIO

A TRI-PART article in May Fortune adds much to their increasing bibliophile on "The Art" (Radio). Story title and blurs are: "Radio I: A $140,000,000 Art (On the shoulders of U. S. broadcasting the entertainment of a nation; under its feet quicksand and uncertainty; in its pockets plenty of cash.); Radio II: A $45,000,000 Talent Bill ( . . . which grows higher and higher as more and more advertisers compete for bigger and bigger Names on costlier programs to get better audiences.); and, Radio III: A $37,000,000 Set Business (Twenty-six million U. S. homes have radios, which means a market saturation of 87%—which sounds worse than it is)."

Discussing superpower, the article describes how, within a given radius of 500 kw., WLW broadcast programs light household lamps (power by radio!), and a "singing arc" acts as a tubeless set to receive them.

Having assimilated what are virtually 3 complete, full-course literary dinners, the reader is offered a chaser, which tends to show how radio's very existence hangs by a thread, the Damascus sword being the "sufferance of a government bureau"; this agency is analyzed in the article, "Federal Communications Commission (Its job is to make broadcasters supply you with clear signals; its yeaning is to make you a better citizen thereby. Results confusion.). The Commission, states this article, has outstanding 55,000 U. S. station licenses for all services; the figure includes 728 broadcasters, every one of which continue on the air only in the event that the F.C.C. renews their licenses every 6 months.

FRENCH TELEVISION

FRANCE has gone high-power television! Headlining the foreign television news, Radio Press Service, one of Radio-Craft's foreign correspondents, reported last month that P.T.T. (French equivalent to our Federal Communications Commission) had OK'd the operation by Eiffel Tower of a station claimed as "the most powerful television transmitter in the world." Starting in 1935 as a low-power, and later 10 kw., station transmitting 180-line images, the power will soon be boosted to 30 kw. and 441-line fidelity. French manufacturers cooperated with functionaries of the Broadcasting Service, who visited the several countries in which television was most fully developed, in reorganizing France's television program.

ANENT B.B.C. VIDEO

LEXANDRA PALACE's past, present and future television programs discussed last month in Television and Short-Wave World (London) may intrigue not only general readers of Radio-Craft but also American television interests.

For instance, more than 30 cars, vintage of 1896 to 1904, will be televised at Hurlingham Polo Grounds; races and games, using these museum-pieces, will enliven the affair for lookers-in. Hot item of the recent boat-race transmissions was the interruption of communication to Alexandra Palace when a workman accidentally cut a telephone cable; "dead" to audio pick-up from outside, the Palace was able to air its comments, however, by reading televised messages scribbled on paper and held up in front of the remote (Continued on page 118)

Showed above is a view of the final model of the harp of Franklin, which was unveiled last month, in Franklin Hall, The Franklin Institute, Philadelphia. Pa. Pedestaled, it stands 18 ft. from the floor.

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TELEVISION PICTORIAL

F. J. Bingley and B. E. Schnitzer, Philco television engineers, at the controls of a television transmitter. Mr. Bingley points to the small cathode-ray tube on which appears the modulated waveform of the high-fidelity picture. Below is the cathode-ray image-monitoring tube which is watched by the control engineer.

For spot broadcast pick-ups of television programs the British Broadcasting Corporation utilizes a fleet of 3 trucks. One contains the complete power supply unit, the second the control and monitoring room, and the third the 3/2 kw. ultra-shortwave transmitter which relays the program to Alexandra Palace for retransmission. At the upper-left is an interior view of the control truck with arrows pointing to the monitoring screens; and below an interior view of one of the other trucks; the sideboards open for maximum accessibility to apparatus.

This is a typical English combination broadcast and television receiver. The illustration above is an unretouched photo of His Highness, the Emir Saud, crown prince of Saudi Arabia, taken directly from the screen of a Cossor (English) television receiver located 50 miles from the transmitter. His Highness was a distinguished visitor at the Coronation. The British are using 405-line screens with 25 pictures-per-second, interlaced scanning. The average price of something like 10,000 sets already sold in England is under $200, claims one writer.

Cathode-ray tubes are not new! According to a display at the recent television show in the Technical Museum of Munich (Germany), a scientist named Dieckman published in 1909 a description of the television system illustrated above in which the reproducer consisted of a cathode-ray tube! The pick-up system included a Nipkow disc equipped with tiny contact brushes instead of the usual slits.

(Photos—Allen B. Du Mont)

RADIO-CRAFT for AUGUST, 1938
MODERN BROADCASTING

WMCA. "at the top of the dial," recently opened its 3,000 square feet of modern "ear-tuned" (acoustically treated) studios in New York City. Note (above) the design on the floor, each studio being enhanced by different symbols of broadcasting. WMCA broadcasts on a frequency of 570 kc., delivering 1,000 W., to its twin 350-ft. tower radiators.

KNX, the new C.B.S. $1,750,000 station in Hollywood, Calif. Above, one of the smaller studios in the ultra-modern broadcasting building. Particularly noticeable are the sloping walls which eliminate reflections. Station frequency is 1,900 kc., with 50,000 watts. Loudspeaker (left of clock) is also a microphone.

Nerve center of C.B.S.'s new Hollywood station KNX. It's the main control desk through which all KNX and C.B.S. network programs clear.

WHAS, 650-ft. vertical radiator fed by a 50-kw W.E. transmitter. Note the nitrogen-filled coaxial transmission lines.

KYW is Philly's new $600,000 Radio Center, located at the terminal of N.B.C.'s television coaxial cable from New York. 2 full floors have been appropriately reserved for television! KYW uses Westinghouse-designed equipment throughout and broadcasts on 1,200 kc., at 10,000 W., although application has been filed with F.C.C. for use of 50,000 W.
$125 TELEVISION RECEIVER
NOW ON THE MARKET?

Service Men are now installing television-image receivers such as here described; television-sound receivers, though, are supplementary units. As tabulated elsewhere in this issue, only a limited number of experimental programs are on the air.

ROBERT EICHBERG

The initial impetus which television needs to emerge from the laboratory and go into the home may be given by a new, moderately-priced receiver developed by Chief Engineer Louis W. Parker of Communicating Systems, Inc. As Radio-Craft went to press, executives of the company were announcing plans to have the apparatus on the market within 10 days, at prices of $125 and $175. It is illustrated in Figs. A and B.

The chassis used in the cheaper model is to be identical with that employed in the more costly one. In each set, it is an 11-tube T.R.F. job. Mr. Parker explained this, saying, "The reason for not using a superheterodyne circuit is primarily that a band width of 5 megacycles is very difficult to obtain with an intermediate frequency of 10 megacycles which is the usual intermediate frequency in television superheterodynes. The problem is comparatively easy at 46 megacycles and up, since 5 megacycles are only a small percentage of the original radio frequency if that radio frequency is high."

THE CIRCUIT AND ITS CONTROLS

The circuit consists of 2 stages of T.R.F., detector, and two stages of V.F. (video frequency) amplification. In addition there is a synchronism separator, an H.F. sweep circuit and an L.F. sweep circuit, the latter making use of the 60-cycle impulse from the power line. The power packs for the receiver and the C.-R. tube are separate units, though included in the price of the sets.

The sets have 7 controls (see Fig. C), one of which is left permanently set. This, located at the rear of the chassis, changes the aspect ratio of the image appearing on the screen of the C.-R. tube; that is, it changes the proportion of the picture's width to height. Once set so that the ratio is 3 high to 4 wide, the control may be left alone.

The others include 3 R.F. tuning controls, frequency controls for the high-frequency and low-frequency sweep circuits, and a control to regulate the degree of contrast between the light and dark parts of the image.

The $125 set is a table model, using a 3-inch, C.-R. tube, and it is in this set that the greatest degree of public interest has been shown, according to S. M. Saltzman and C. H. Sterenfeld, President and Vice-President of the company, respectively. Mr. Sterenfeld states that about 40 to 50 orders have already been received, principally for this model.

The more costly set is a console, using a 5-inch tube. It is interesting to note that the tube is a type 905 oscilloscope tube, which is cheaper than the C.-R. tubes generally employed in television receivers, although it affords a slightly larger spot (hence, less fine detail) and shows a more markedly green image.

No sound reproducer is included in the receiver, this being explained as a way of keeping cost down. Mr. Sterenfeld states that users will be able to buy the necessary sound reproducers for about $10 to $15, or that they may use less expensive "converters" in conjunction with their broadcast receivers.

DEMONSTRATION REPORT

A demonstration witnessed by this reporter was highly satisfactory, though not sensational. While the size of the largest image shown (on the 5-inch C.-R. tube) was only a little over 3 by 4 inches, the pictures did have definite entertainment value for those who sat within 3 or 4 feet of the receiver, and although brilliance was not great, it was more than ample in the darkened room.

Company executives stated that their set did not conflict with RCA patents, and claimed that it was made under their own patents, though they were unwilling to disclose how many such patents there were, nor what they covered. It was definitely stated during the interview that the company is not selling and does not plan to sell stock; therefore, Radio-Craft readers are advised not to listen to any salesmen who (Continued on page 119)
ANY TELEVISION ANTENNA FOR GOOD RECEPTION?

The proper installation of television receivers will be an outstanding factor in keeping these instruments sold. Service Men will do well to read the following article which discusses a type of interference, not present in broadcast receiver installations, which a proper receiving antenna will mitigate.

STUART WM. SEELEY

In broadcast-receiver practice a simple wire of from a few feet to one hundred or more in length will suffice as a receiving antenna, and its operation is completely satisfactory if the received signal is sufficiently above the local and extraneous noise level. A television receiving antenna will have to be erected with much more care and must conform to more complete specifications.

This is true because of the introduction of an additional factor in visual reception not present in sound broadcasting. This factor is the necessity for preventing reflected waves, which have travelled a few hundred feet or more further than the direct wave, from entering the receiver. Fortunately this can be done in all cases, and quite easily in most cases. It is the object of this article to point out that the problem exists in visual reception, and to describe certain methods of meeting it which have been found effective.

SPACE WAVE REFLECTIONS

When reproducing a 441-line, 30-field per second picture, the cathode-ray spot travels across the screen of a 12-inch Kinescope at a speed of about 2½ miles per second. This is 1/76,000 times the speed of light or radio waves in free space. In other words the spot will move about 0.060-inch while a radio wave is traveling 400 feet. Therefore, if both a direct and a reflected wave arrive with comparable magnitude at the input terminals of a television receiver, and one has travelled 400 feet further than the other, a double image will result.

The displacement of the two images in such event will be about 1/16 of an inch and will cause blurring of all vertical lines in the picture. Actually such a condition results in even more complication than is immediately apparent from the above example. The reflected wave may have any phase with respect to the direct wave. Furthermore, each has its own side components, and those of the direct and reflected wave may be entirely different. Thus interference in the form of cancellation or reinforcement frequently causes a black line to be repeated as a white line or vice-versa. If the reflected wave travels 1,000 feet or more further than the direct wave a distinct double image will result.

Thus it is readily apparent that the antenna must supply a television receiver with one signal only from a desired transmission. In metropolitan areas, reflections from large buildings may give rise to several images and the problem of proper construction, location and orientation of the receiving antenna becomes extremely important. However, at any location an improperly-constructed antenna or antenna network and feed

(Continued on page 114)
Many Radio-Craft readers, including Service Men and others actively engaged in the field, have only a hazy idea of what takes place at a broadcast station in the preparation of a studio program. By courtesy of Modern Advertising magazine, therefore, we take you on a photographic tour through the whole story of “Girl Alone,” an actual air program. First tested on the air, “Girl Alone” subsequently became the now 2-year-old, 5-a-week program, over the N.B.C. Red network via WMAQ, currently sponsored by Kellogg. See how it was created.
Finally the cast goes into action before the mike. Not yet over the air, however, for this microphone is merely piped to a loudspeaker...

... in a conference room, where N.B.C.'s planning board sits around a large table...

... lists, argues, and finally OK's "Girl Alone" for a station sustaining program.

Simultaneous with the planning board's OK, N.B.C.'s publicity department becomes active. First by taking news shots of the cast...

... then arty, theatrical shots of Betty Winkler...

All this activity means that "Girl Alone" is on the air. Joan Winters and Ruth Bailey (right), who plays Virginia, read their lines.

And the news stories flow constantly from the publicity department to the nation's press.

... and Joan Winters, who plays the part of Alice Ames...

... and later, Betty again with the award for acting which she won at the 1937 Radio Ball...

... and Betty again with writer Fayette Krum doing research for a coal mine episode.

And here John Walsh, who plays character bits, joins the ladies.

(Continued on following page)
And all the while production director Howard Keegan directs the action from the studio control room behind a glass partition...

... while at his left engineer Berne Mills manipulates the tone and volume controls.

For sound effects, a sound box in the studio can play 3 discs— in succession or all at once.

Or more primitive methods are sometimes better — for example, the crackle of twisted cellophane sounds like fire...

... wooden pegs dropped on a table are a marching army...

... socking a rubber sponge is a sock in the jaw...

... 2 cocoanut half-shells make a horse on a hard road...

... 2 plumber's suction cups thumped on the chest make a horse on turf...

... twisting a bundle of straw means "something is astir in the underbrush"...

... thrusting a knife into a potato sounds like a stabbing...

... crushing a packing case sounds like smashing in a door...

... squeezing water-filled ear syringes into a bucket sounds like a cow being milked...

... and mixing a cake batter sounds like — mixing a cake batter!

After each broadcast the studio is silent for a while, and the cast uses it to go over the script for the following day's stint...
A RADIO SCRIPT SHOW GOES ON THE AIR

... argue about their lines ...

... and try out effects. Left to right in these 3 pictures: Eileen Palmer (as "Red"), Raymond Johnson (as Ty Deyoe), Betty Winkler, John Walsh, Pat Murphy (as "Scoop" Curtis), and Joan Winters.

Symbol of the audience to the studio is the mail room. Here a staff of girls sorts the mail according to programs ...

... codes according to state and county ...

... tabulates listener response ...

... and files the letters for forwarding to the clients.

News from the mail room tells that "Girl Alone" is a success. So a sales portfolio is planned by the sales promotion department, and Gil Thrall of the art staff goes to work on page 1.

By the time Thrall assembles the last page in the leather portfolio binders ...

... and Ken Carpenter, sales manager, and E. C. Carlson, sales promotion manager, give it a final once-over ...

... and John Sample of the sales promotion staff assembles station coverage data ...

... Ed Boroff, salesman, is all hopped up for the interview.

He presents the story ...

(Continued on page 122)
**U. S. TELEVISION STATIONS**

(Experimental Broadcasters)

The following listing of United States Experimental Television Broadcast Stations has been corrected by the Federal Communications Commission (as to columns 1, 2 and 3) as of May 15, 1938. Remaining data is printed as supplied by courtesy of the respective organizations in response to a RADIO-CRAFT questionnaire. All U. S. A. television stations are listed.

<table>
<thead>
<tr>
<th>Call Letters</th>
<th>Licensee and Location</th>
<th>Power (Watts)</th>
<th>Channel (Audio-Vide)</th>
<th>Number of Lines-Frames</th>
<th>Scanning Sequence</th>
<th>Type of Scanning Equipment</th>
<th>Transmitter-Receiver</th>
<th>Miles Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>W9XAK</td>
<td>Kansas State Coll., Manhattan, Kans.</td>
<td>1,500</td>
<td>2,000 to 2,100 kc.</td>
<td>60, 20 (Note 7)</td>
<td>non-interlaced</td>
<td>Iconoscope</td>
<td>Kinescope</td>
<td>50 to 400</td>
</tr>
<tr>
<td>W9XG</td>
<td>Purdue University, Lafayette, Ind.</td>
<td>1,500</td>
<td>2,000 to 2,100 kc.</td>
<td>60</td>
<td>20</td>
<td>scanning sequence progressive (non-interlaced)</td>
<td>disc electronic</td>
<td>600</td>
</tr>
<tr>
<td>W9XX</td>
<td>University of Iowa, Iowa City, Iowa</td>
<td>100</td>
<td>2,050 kc. band 30 kc.</td>
<td>45, 15</td>
<td>1</td>
<td>interlaced 3-spiral disc</td>
<td>(Note 13)</td>
<td></td>
</tr>
<tr>
<td>W9XAX</td>
<td>Columbia Broadcasting System, Inc., New York, N. Y.</td>
<td>50</td>
<td>55-75 mc.</td>
<td>50-55 mc.</td>
<td>441</td>
<td>30</td>
<td>interlaced odd number</td>
<td>(Note 9)</td>
</tr>
<tr>
<td>W9XAO</td>
<td>Don Lee Broadcasting System, Los Angeles, Calif.</td>
<td>1,500</td>
<td>40-10,000 cycles</td>
<td>20-5,000,000 cycles</td>
<td>200, 24 (Note 10)</td>
<td>electronic</td>
<td>(Note 11)</td>
<td>20 to 40</td>
</tr>
<tr>
<td>W3XPF</td>
<td>Farmsworth Television, Inc., Springfield, Pa.</td>
<td>100</td>
<td>2,500 kc.</td>
<td>26-50 mc.</td>
<td>441</td>
<td>30</td>
<td>interlaced odd line</td>
<td>electronic camera</td>
</tr>
<tr>
<td>W9XAL</td>
<td>First Nat'l Television, Inc., Kansas City, Mo.</td>
<td>300</td>
<td>147.5-47.5 mc.</td>
<td>441</td>
<td>30, 31</td>
<td>interlaced 2-1</td>
<td>electronic</td>
<td>30 to 50</td>
</tr>
<tr>
<td>W9XG</td>
<td>General Television Corp., Boston, Mass.</td>
<td>500</td>
<td>none at present</td>
<td>2,500,000 cycles</td>
<td>441</td>
<td>30</td>
<td>interlaced odd line</td>
<td>Kinescope</td>
</tr>
<tr>
<td>W9XBS</td>
<td>National Broadcasting Co., Inc., New York, N. Y.</td>
<td>15 kw.</td>
<td>441</td>
<td>(See Note 3)</td>
<td>electronic</td>
<td>(Note 4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3XE</td>
<td>Philco Radio &amp; Television Corp., Philadelphia, Pa.</td>
<td>10 kw.</td>
<td>20-60 mc.</td>
<td>10,000 cycles</td>
<td>0 to 4.2 mc.</td>
<td>10</td>
<td>30</td>
<td>interlaced</td>
</tr>
<tr>
<td>W2XDR</td>
<td>Radio Pictures, Inc., Long Island City, N. Y.</td>
<td>1 k.</td>
<td>500</td>
<td>10,000 cycles</td>
<td>2 mc.</td>
<td>variable 24 &amp; 30</td>
<td>progressive (non-interlaced)</td>
<td>(mechanical and electronic)</td>
</tr>
<tr>
<td>W3XEP</td>
<td>RCA Mfg. Co., Camden, N. J.</td>
<td>30 kw.</td>
<td>30 kw.</td>
<td>(See Note 6)</td>
<td>(Note 6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W9XX</td>
<td>RCA Mfg. Co., Camden, N. J.</td>
<td>50</td>
<td>50</td>
<td>(See Note 6)</td>
<td>(Note 6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W8XAN</td>
<td>The Sparks-Withington Co., Jackson, Mich.</td>
<td>100</td>
<td>42-46 mc.</td>
<td>441</td>
<td>30</td>
<td>double interlaced</td>
<td>Iconoscope</td>
<td>Kinescope</td>
</tr>
<tr>
<td>W9XUI</td>
<td>University of Iowa, Iowa City, Iowa</td>
<td>100</td>
<td>150</td>
<td>3,000 mc.</td>
<td>15, 24 &amp; 34 spiral multiple</td>
<td>mechanical disc</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>W9XAT</td>
<td>Dr. George W. Young, Minneapolis, Minn.</td>
<td>500</td>
<td>WDGY 15-17,800,300,000 kc.</td>
<td>45 &amp; 125</td>
<td>15</td>
<td>(Note 2) 92 and 175 to 180 mc.</td>
<td>(Note 4)</td>
<td></td>
</tr>
<tr>
<td>W9XBT</td>
<td>National Broadcasting Co., Inc., Portable (Camden N. J., &amp; New York, N. Y.)</td>
<td>100</td>
<td>R.M.A. R.M.A. (Note 3)</td>
<td>441</td>
<td>30</td>
<td>(complete); 60 half-frames interlaced</td>
<td>electronic</td>
<td>45</td>
</tr>
<tr>
<td>W2XP</td>
<td>Philco Radio &amp; Television Corp., Philadelphia, Pa.</td>
<td>15</td>
<td>60 to 4.2 mc.</td>
<td>441</td>
<td>30</td>
<td>complete; 60 half-frames interlaced</td>
<td>Philco camera tube</td>
<td>10</td>
</tr>
<tr>
<td>W3XAD</td>
<td>RCA Mfg. Co., Inc., Portable (Bldg. No. 8 of Camden plant)</td>
<td>500</td>
<td>500</td>
<td>(Note 2) 124 to 130 kc.</td>
<td>(Note 6)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES**

1. "C.P." is Construction Permit.
2. "Group D" operation: any 6,000 kc. frequency band above 118 mc. exclusive of 400 to 501 mc.
3. High-fidelity, according to R.M.A. proposed standards.
5. Video frequency only: not multi-sideband.
6. System in use subject to change; information describes the basic field used for transmission if given.
7. "Experimental Television System".
8. Studio and transmitting equipment is destined to operate at 441 lines, 20 frame, either non-interlaced, or interlaced 2 to 1, or may be operated at 60 lines, 20 frames. However, only the 60-line pictures can be broadcast on the assigned channel of 2,000-2,100 kc. The 44-line picture is used in (1) Fifty miles (primary). 400 miles (secondary) under good conditions.
9. Approximately 500,000 persons on 50-cycle power and 800,000 persons on 60-cycle power within 50 miles of the station.
10. Interlaced scanning not possible of this transmitter.
11. Expiratory: single cathode-ray tube for direct pick-up, special equipment. Synchronizing signals sent at end of each line and at the end of each frame. Voice (Continued on page 111)

**REMARKS**

W9XAK—Approx. schedules, Monday and Wednesday, 7:00 to 8:00 P.M. C.S.T., also at odd hours. Synchronizing signals sent at end of each line and at the end of each frame. Voice.

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**RADIO-CRAFT** for AUGUST, 1938
TOMORROW'S
TELEVISION SERVICING

Servicemen and Servicewomen who early become proficient in locating and overcoming the faults in television receiving and transmitting equipment will soon find themselves in the high-pay brackets of the art.

YOU see on the cover of this month's annual Television Number of Radio-Craft a composite view of students hard at work learning how to service the intricate equipment of a modern television set-up. Note that not only Service Men but also Service Women are looking toward television as a career.

And servicing is not the only phase of television's varied activities which will soon cause thousands of foresighted young folk to flock to this field of business like moths to a candle; as Dr. Alfred N. Goldsmith pointed out last month (see "Looking Ahead in Television Occupations," July, 1938, Radio-Craft), numerous opportunities for lucrative employment will be found in the manufacturing field, in transmitting stations, as cameramen, in servicing, in supervisory capacities, as writers, and as directors, actors and musicians. His concluding remark is especially significant: "Remember that television success will come rather as the result of a prolonged marathon of effort than from a brief gold-rush of enthusiasm."

Incidentally, it is especially significant that First National Television Inc., in making available to Radio-Craft, specially posed photographs to aid in making the cover illustration, called attention to the prominence of floodlights in one of the views. "To indicate the

(Continued on page 107)

$500,000 TELEVISION SYSTEM!

Radio-Craft here presents what is believed to be the first published account of General Electric's plans for a 4-station semi-network; a "television relay station" is part of the system.

DOMESTIC and foreign television systems are being investigated by engineers of one of the biggest radio and electrical manufacturing interests in the United States, preparatory to instituting (at the outset) a 4-station television system second to none; cash outlay—$500,000! The application is now in hearing in Washington (D.C.) before the Federal Communications Commission.

In filing its application, the company stated that it contemplated a 4-fold plan of development to "investigate on a broad developmental scale the type of apparatus, method of transmission and propagation characteristics" that will be necessary to properly broadcast television programs. One station will be located near Albany (N.Y.), 2 in Schenectady (N.Y.) and 1 in Bridgeport (Conn.). The Bureau of Air Commerce has already approved plans for erection of 150-ft. aerial towers at all stations.

In more detail, the plan is as follows: Erection of a 10 kw. television broadcast station in the Helderbergs, 12.5 miles west of Albany and 13.5 miles from Schenectady. It will operate on frequencies of 44 and 50 mc. (believed to have been since amended to 66 and 72 mc.—Editor), with 10 kw. on the video channel and 3 kw. on the audio channel, for an unlimited period, day and night. Cost of transmitter, $70,000; of the studio, $50,000; voice transmitting apparatus, $20,000; antenna, $40,000; and land and buildings, $15,000. It is expected that the Helderbergs station will serve the cities of Albany (capital of New York), Schenectady, Rensselaer, Cohoes and Troy, with a combined population of about 400,000.

Erection of a second, 1st-class 10 kw. television broadcaster is planned for Bridgeport. Operation will be on 66 to 72 mc., with 10 kw. on the video channel and 3 kw. on the audio channel, for an unlimited period, day or night. This station, like the one in the Helderbergs, will involve an expenditure of $70,000 for the transmitter; studio, $50,000; voice transmitting apparatus, $20,000; antenna, $40,000; land and buildings, $15,000. Bridgeport's television station will serve about 1,000,000 persons.

Third station in the system is a 50-watt television relay station in Schenectady, to investigate the possibility of relaying programs from the studios of WGY to the big station in the Helderbergs. (Thus obviating the necessity for inter-station coaxial-type cable)—Editor) Concluding this semi-net-work is a 40-watt station in a building of the G.E. Co's Schenectady plant, to be used temporarily for transmission of television and synchronized sound broadcasts to nearby experimental receiving points.

Note that these are only tentative plans and hence, subject to change to conform with F.C.C. recommendations, etc.—Editor
### COMMERCIAL CATHODE-RAY TUBES

Ralph R. Batchor, radio engineer and electronic specialist, and Instruments magazine have kindly made available to RADIO-CRAFT the listing of commercial cathode-ray tubes we here reproduce. Except for revises as of May 15, 1938, as indicated, this listing carries only the original correction date as of October 1, 1937. Here listed are nearly all the available cathode-ray industrial and television tubes.

#### CHARACTERISTICS OF CATHODE-RAY TUBES

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Screen</th>
<th>Diam. &amp; Color</th>
<th>No. of Leads</th>
<th>Leads Pairs</th>
<th>Control No. 1</th>
<th>Control No. 2</th>
<th>Control No. 3</th>
<th>Control No. 4</th>
<th>Control No. 5</th>
<th>Control No. 6</th>
<th>Control No. 7</th>
<th>Control No. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP 57</td>
<td>8</td>
<td>23.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### ALLEN B. DU MONT LABORATORIES

**General Notes:**
- The Hard diam. refers to the anode.
- The following figures are based on spot readings and are nearly correct focusing.
- These values refer to the deflection voltages required to give one inch deflection at the maximum rated anode potential.
- The number of pairs, in the diagram, refer to the respective sketch designations in the diagram herewith.

**HYGRADE Sylvania Corp.:**

- The figures in next to last column are based on the signal-deflecting-plate value, or the most sensitive one.

#### GENERAL ELECTRIC CO.

- NOTE 2: These values refer to the deflection voltages required to give one inch deflection at the maximum rated anode potential.
- The number of pairs, in the diagram, refer to the respective sketch designations in the diagram herewith.

#### GENERAL RADIO CO.

- The Hard diam. refers to the anode.
- These values refer to the deflection voltages required to give one inch deflection at the maximum rated anode potential.
- The number of pairs, in the diagram, refer to the respective sketch designations in the diagram herewith.

#### NATIONAL UNION RADIO CORP.

- The Hard diam. refers to the anode.
- These values refer to the deflection voltages required to give one inch deflection at the maximum rated anode potential.
- The number of pairs, in the diagram, refer to the respective sketch designations in the diagram herewith.


- The Hard diam. refers to the anode.
- These values refer to the deflection voltages required to give one inch deflection at the maximum rated anode potential.
- The number of pairs, in the diagram, refer to the respective sketch designations in the diagram herewith.

#### WESTERN ELECTRIC CO.

- The Hard diam. refers to the anode.
- These values refer to the deflection voltages required to give one inch deflection at the maximum rated anode potential.
- The number of pairs, in the diagram, refer to the respective sketch designations in the diagram herewith.

#### WESTINGHOUSE Elec. & Mfg. Co.

- The Hard diam. refers to the anode.
- These values refer to the deflection voltages required to give one inch deflection at the maximum rated anode potential.
- The number of pairs, in the diagram, refer to the respective sketch designations in the diagram herewith.
LATEST CONTINUOUS-FILM TELEVISION

The New York Times, in reporting a demonstration, at Chestnut Hill, Pa., of this new Farnsworth telecine camera development, stated that "pictures with unusually good contrast and definition" were obtained on a 6 x 7 inch screen.

We are thoroughly convinced that the transmission of motion pictures by means of film will always, and particularly in the beginning, constitute a substantial part of any television program.

This, of course, does not necessarily mean the transmission of motion pictures as they are now produced, but motion pictures made up of subjects—especially adapted to television—which will bring to the home a type of entertainment and education not otherwise available.

Such films can be readily transported from station to station, and transmitted without awaiting the time when suitable radio or wireline connections are available between stations for the relaying of television programs. We have, therefore, devoted a considerable amount of effort in the development of suitable apparatus for this purpose. This effort has been appreciated by the excellent adaptability of the Farnsworth High-Fidelity Dissector Tube for this phase of the art.

The development of a new model motion picture projector for telecine operation, including many novel features, has just been completed. (See Fig. A.)

CONTINUOUS-FILM PROJECTION

This projector is of the so-called "continuous," rather than "intermittent" type, and the film, therefore, passes through it at a constant rate of speed without interruption. (Continuous-film television has been described in past issues of Radio-Craft.—Editor) The projector focuses its picture upon the cathode area of a High-Fidelity Dissector Tube.

Continuous projection is accomplished fundamentally by 2 lens discs, each carrying a total of 24 lenses (see Fig. B) and rotating in opposite directions, but overlapping sufficiently so that at any instant 2 lenses are acting in conjunction with each other. These lens discs act both as an optical compensator and as a projection lens.

A shutter is provided which masks all lenses except the 2 functioning at a given moment.

The projector is synchronized with the scanning system of the Dissector Tube, so that alternative frames are scanned 2 and 3 times respectively, providing an interlaced picture at a rate of 30 frames per second.

The transition period, i.e., the time required to change from frame to frame, occurs coincident with and during the "flyback" of the scanning system, during which no television signal is transmitted, so that this does not detract in any way from the excellence of the transmitted picture. The transition is accomplished in less than 1/600th of a second, as compared to approximately 1/120th of a second for the most rapid intermittent-type projector.

During transition, the image of the leading frame is momentarily superimposed upon the image of the trailing frame, which condition maintains for the small fraction of a second indicated.

Since the picture projected on the cathode surface is stationary and continuous, this projector can be adapted to camera tubes operating on the storage principle, as well as the dissector-type tube. However, the projector provides sufficient illumination, so that the storage-type tube is not essential, and more than ample illumination is obtained from a concentrated-filament incandescent lamp.

(Continued on page 112)
Radio men who live within the service area of 441-line television broadcast stations are here given the first really inexpensive set-up for experimenting with cathode-ray television reception. An ordinary service oscilloscope plus a simple 3-tube Vertical Oscillator and Synchronizing Pulse Separator are the "heart" of the system, which employs standard, manufactured instruments now on the market.

Ricardo Muniz, E.E.

Many important facts concerning television can be learned using the servicing 'scope you have right in your own shop or laboratory! (Ripley, please note.) With commercial television practically here, it behooves the Service Man who really wants to stay "on top" to learn what makes the electrons go 'round in a modern, high-definition television receiving set-up.

We can reduce the complexity of construction work tremendously by making use of a good servicing oscilloscope as the foundation unit of our set. As you know, the picture, or more properly, "image tube," which corresponds to the loudspeaker in a sound set (used in high-definition television), is a cathode-ray tube. The cathode-ray tube in your oscilloscope can be made to serve this function reasonably well.

You have in your oscilloscope 2 deflecting amplifiers connected to the deflecting plates in the cathode-ray tube; you also have a single oscillator tube which is connected to the amplifier that goes to the pair of plates producing horizontal deflection of the cathode-ray beam. (This horizontal-sweep system can be adjusted to the "line scan" frequency of the television transmitter and kept in step perfectly with it by applying the line synchronizing pulses to the oscilloscope terminal marked "External Synchronizing." The pulses are sent from the transmitter and received by the video receiver.)

The Service 'Scope
In order to adapt the servicing oscilloscope for television reception it will be necessary to provide one more oscillator. This oscillator when connected to the oscilloscope at the terminal marked "Vertical Deflection" will operate through the vertical deflection amplifier and swing the cathode-ray beam up and down.

The vertical oscillator is readily tuned to the "frame" frequency of the television transmitter, and is held in step by using the frame synchronizing pulses which are being received.

With this simple addition you can produce on the window of your 'scope a "raster" (the light-pattern produced by an unmodulated signal) exactly like the one being transmitted. It will have 441 lines interlaced, 60 frames per second, 30 complete images per second exactly like the transmitted raster. It will be kept steady and

1High-Definition Television—Modern 441-line per frame television using a wide frequency channel. Relatively fine detail is available in the transmitted image.
2Line Scan Frequency—The frequency at which the horizontal sawtooth oscillator must be set so as to produce 441 x 30 = 13,230 lines per second.
3Frame Frequency—The number of frames transmitted per second. With modern interlaced scanning 60 frames per second are transmitted and 30 complete images per second are obtained.
properly centered by the synchronizing pulses which come with the television signal when it is received. (See Fig. D.) It is now necessary merely to modulate the control-grid of the cathode-ray tube with the modulated television picture detail signal; the moving cathode-ray beam will "paint" a picture on the fluorescent screen. The control-grid of the cathode-ray tube controls the intensity of the ray and thus it controls the amount of fluorescent light which it will produce on any spot on the screen. The weaker the ray the less fluorescence it will produce, and vice versa. The actual speed of the flying spot on the screen of a 3-in. tube is about 1 mile per second.

The sound part of the television program can be received on an ultra-shortwave receiver like the Lafayette acorn-tube superhet, shown in Fig. B, or by means of an ultra-shortwave converter in conjunction with a regular broadcast receiver like the Detrola unit illustrated in Fig. A. Sound is on 49.75 megacycles.

SEPARATOR-OSCILLATOR UNIT

Now that we have our picture tube so easily taken care of, let us see what else is needed in order to get these pictures. We'll need a broad-band-pass radio set which will tune in the 46.5 megacycle television signals, and we'll need a separator for the synchronizing pulses. The separation is needed so that we can feed the pulses to the deflecting oscillators without any picture detail modulation mixed with them.

In Fig. C you see 2 photographic views of the small unit made by the author and containing both the vertical oscillator and the synch. pulse separator. You may want to build them on separate chassis or on a breadboard. The placement of parts is not at all critical. In this article we shall give you full details concerning the construction of this unit. (In a forthcoming issue, we plan to present complete construction details of a simple video-channel receiver.)

The circuit diagram of the Vertical or Sweep Oscillator is shown in Fig. 1C. Use is made of a type 885 gas triode tube. The wave shape generated is a so-called sawtooth.

This waveform is produced by slowly charging condenser C1 through the frequency control resistor R1, and then suddenly discharging it through the 885. The 885 acts as a short-circuit after being ionized by the synchronizing pulse applied to its grid. (See Fig. 1D.)

The circuit diagram of the Synchronizing Impulse Separator or "synch. pulse separator" is shown in Fig. 1A. It consists of an amplitude selector, pulse amplifier, and a pair of simple filters to separate the frame from the line sync. pulses. The amplitude selector is a 6H6G diode with cathode biased so that positive signal voltage applied to the plate must exceed a certain value before plate current will flow. Figure 1B shows the bias level required in order to pass only the pulse peaks. The 76 amplifies the pulses and feeds them to the pair of simple filters. The Frame pulse filter is a low-pass filter set somewhat above 60 cycles. The Line pulse filter is a high-pass filter set somewhat below 10,000 cycles. The filters are not at all critical because of the large difference.
BEGINNERS' 4-TUBE SUPERHET.
 "VACATION PORTABLE"

H. G. McEntee

Whether it is the call of the wilds or the wild waves that call, when you go far afield this summer, you still may have entertainment at the flick of a switch by taking along this compact and self-powered "Vacation Portable."

With the outdoor season once more here it is only natural that the experimenter's thoughts turn to portable equipment.

This effect is always produced upon the writer at this time of year and the result is usually a portable broadcast receiver of some description! Running true to form this year, the outfit shown herewith was produced. Due to a lack of time (and also energy, spring fever having set in!) it was decided to build a rather simple job with few frills and trick gadgets, which virtually always cause troubles that require tedious ironing-out. See Fig. A.

THE BATTERY PROBLEM

The superhet circuit (Fig. 1) was selected since it is very little if any harder to get into operation than a T.R.F. job, and, the added sensitivity and selectivity are a big help in a small set. Batteries are used, of course, a size being chosen which is a compromise between long life and light weight. If the rig is to be used for any length of time, as for example, at a summer camp, it would be more economical to use large batteries. A plug arrangement could easily be worked out so that the portable batteries could be used for true portable use while the heavier-duty batteries could be plugged-in when the set was used in any one place for a fair length of time. The current drain is quite low, measuring only about 300 ma. on the filament batteries and between 10 and 15 ma. on the "B" batteries. The "C" battery, of course, has no drain on it, and lasts as long as its shelf life allows.

If all the tubes (except the 2nd-detector) are run with 3 V. minus on the grids, the "B" current will be about 15 ma. With 4 V, grid bias this drops to about 10 ma., with, however, a considerable drop in output.

Since the case available offered a fair amount of space, a 6-inch speaker was decided upon, as it gives considerably better tone quality than the 3-inch size. Good tone quality made it imperative to use a P.M. dynamic speaker, and as a result the output sounds very respectable.

COIL SELECTION

Iron-core transformers and chokes are used throughout and contribute to compactness and high efficiency.

The tubes are all of standard types, the only concession to "the latest thing" being the use of octal base types. These are just as convenient and efficient as their older counterparts and the extra lugs on the sockets are certainly useful.

The oscillator coil is beneath the chassis (see Fig. C) with the antenna and I.F. transformers above (see Fig. B). Although the parts are not excessively crowded, some care must be used in layout so that no parts interfere mechanically with each other.

The case used, which has dimensions as shown in the illustration (Fig. 2) is one which was intended to house one of the Radio-Craft analyzers. It may still be possible to get a ready-made case of this size. Otherwise, one may be quite easily made up, or the receiver can be adapted to fit whatever case is on hand.

Construction is straightforward and no unusual kinks should be encountered. Both panel and chassis are of 1/16-in. aluminum, the latter being bent after the desired bending lines have been deeply scribed in the surface. A

Fig. A. The completed "Vacation Portable" is stable and easy to operate.

Fig. B. Compactness is the word; both in layout of parts and placement of batteries. Larger batteries are recommended for continuous operation.

RADIO-CRAFT for AUGUST, 1938

www.americanradiohistory.com
nice grain finish may be imparted by applying powdered pumice and water to the surface in long, straight strokes. An alternate suggestion is to dip the pieces in a strong lye solution, which will impart the familiar satin finish. Either finish should be applied after all work of cutting and drilling is finished.

All components are mounted on the chassis except the speaker and antenna trimming condenser, which are fastened to the panel only. When all construction work is completed, wiring may proceed according to the diagrams in Fig. 1, A and B. Wiring should be very carefully checked when finished. Remember that a misconnection in a powerseline-operated receiver usually means, at most, a little smoke or a blown fuse, but on a battery-operated receiver, a wrong connection very often means a new set of tubes and batteries.

Use rather heavy wire for the filament circuit, Nos. 14 or 16 being about the right size.

ALIGNMENT

If a powerful broadcast station is located nearby, the receiver may be lined up without the use of a signal generator, although use of the latter is recommended in any case. The I.F. transformers come from the manufacturer peaked at a definite frequency so that it is usually possible to get a strong signal through, after which it is only a matter of trimmer adjustment.

During initial I.F. line-up a stronger signal will be obtained if the antenna is temporarily hooked directly on the grid of the 1D7G.

When I.F. alignment is complete, R.F. alignment may be taken care of. An R.F. trimmer condenser is brought out on the panel. A portable receiver is called upon to work with every conceivable type of "aerial" from the

(Continued on page 106)
NEW CIRCUITS IN MODERN RADIO RECEIVERS

No. 11

The details of the modern radio receiver circuits that make them "different" from previous designs are illustrated and described each month by a well-known service engineer.

F. L. SPRAYBERRY

(1) TUBE CONTROLLED A.V.C. DELAY
Unlike the straight valve scheme with a definite point of "threshold" or release, this circuit provides a continuous, regular delay mechanism.

The ultimate A.V.C. voltage (see Fig. 1A) is formed by two voltages in series, one across R19, the conventional circuit, and another across R24, another voltage. Second-detector coil L2 supplies the rectified I.F. signal component and a bias voltage similar to, but less than, the ordinary A.V.C. voltage. This is the drop across the 0.25-meg. resistor and is supplied to the grid of the A.V.C. control tube. This allows a predetermined current to flow through R24, setting the potential at the A.V.C. control tube plate P at a definite potential. This is the reference voltage to which is added the drop developed across R19 by the action of coil L1 and the right-diode section.

Now for a small signal, there will be little bias applied to the 6C5 control tube and its regular cathode bias will allow a large current to flow in its plate circuit, including R24. Point P will, therefore, be somewhat negative with reference to Q. For a low signal there will be little additional voltage in series with this produced across R19. The voltage at R will, therefore, be just a little more than minimum bias for the controlled tubes. As the signal input increases, the bias for the 6C5 A.V.C. control tube increases, cutting the current through R24 so that point P becomes more positive, and at the same time the negative drop P — R increases to slightly over-counteract this former process.

Thus the true A.V.C. voltage at R is the sum of Q — P and P — R. The drop Q — P reaches a limit of zero at cut-off bias of the 6C5 control tube, while the drop P — R is proportional to the signal and will continue to increase. In this way the A.V.C. delay is extended into the greater part of the entire control range of the A.V.C. system.

(2) PLUG-IN PUSH-BUTTON TUNER
Emerson Model AY. Detachable pushbutton assembly simply plugged into a socket makes 6 predetermined stations tunable by pushing a button.

Provided with the Model AY Emerson receiver is a pushbutton assembly (see Fig. 1B) which may be used at the option of the owner. Two band switch positions provide for short-wave (5.6 to 19 mc.) reception and broadcast reception for manual tuning, while a 3rd position disconnects the variable tuning gang and connects the plug-in unit with its fixed and adjustable condensers, and other coils suitable for them.

(3) IMPROVED DETECTOR FOR LOW-POWER CIRCUIT
RCA Models 95X and 95XL. New suppressor connection to stabilize tube action and grid return method to eliminate degenerative effect.

This detector refinement (as shown in Fig. 1C) permits (Continued on page 108)
NEW TUBES FOR TELEVISION AND RADIO

902 C.R. TUBE

First on the list of tubes this month is a new low-voltage cathode-ray tube of the high-vacuum electrostatic-deflection type. See Fig. A. This new tube, designated as the type 902, will be of interest to the radio engineer, serviceman, amateur, and experimenter.

The 902 is small in size, having a 2-inch diameter fluorescent viewing screen and operates with an anode No. 2 voltage as low as 400 volts and as high as 600 volts. It is provided with two sets of electrostatic plates for deflection of the electron beam. The brilliant luminous spot produced by this new tube has a greenish hue. The 902 is electrically interchangeable with the 913, provided the anode No. 2 supply is 400 volts or more.

Because of its relatively low cost, small size, and its ability to produce a bright image at low voltages, the 902 is especially suited for use in portable oscillographic equipment.

The bulb of this tube, except for the screen surface, should be enclosed in a grounded metal case—preferably iron, to reduce the effect of extraneous fields. The fluorescent screen is of the phosphor No. 1 (medium-persistence) type. It has good visual properties as well as high luminous efficiency.

Terminal connections are shown in Fig. 1; characteristics data are given in Table I.

1851 TELEVISION AMPLIFIER PENTODE

Next on the list is the type 1851 television amplifier pentode, shown in Fig. B. It is intended for use by the amateur and experimenter in experimental television receivers.

This new pentode features extremely high grid-plate transconductance (9,000 micromhos). It is recommended for use in the R.F. and I.F. stages of the image amplifier as well as in the first stages of the video amplifier when several video stages are used.

When minimization of changes in input capacity and input conductance is not accomplished by leaving a portion of the cathode-bias resistor un-bypassed, it will be found advisable to operate the 1851 with circuits heavily loaded by resistance and capacity. Although such circuits minimize the effect of the relatively small variations in tube capacity and conductance, they also cause some sacrifice in gain.

When the gain of these stages as well as that of the video stages is controlled automatically, it is recommended that the series-screen-resistor method be employed for obtaining screen-grid voltage. This method of obtaining screen voltage from the plate supply is satisfactory for the 1851 because its suppressor-grid practically removes the effects of secondary-emission phenomena. With this method, the screen-to-cathode voltage will rise as the control-grid voltage is varied from minimum to maximum. This rise of screen-to-cathode voltage above the normal maximum value is allowable because the screen and the plate current are reduced simultaneously by a sufficient amount to prevent damage to the tube.

Terminal connections are shown in Fig. 1; data, in Table II.

0A4G GLOW-DISCHARGE RELAY TRIODE

An exceptionally useful tube, with many possible applications in the control of moderate amounts of current with medium voltage swing, is the type 0A4G glow-discharge relay tube, triode, shown in Fig. B.

The 0A4G is intended primarily for service as a relay tube and is designed especially for use in an electrical system for the remote tuning and control of line-operated radio receivers. It can be actuated by R.F. impulses generated under the control of the user and transmitted over the power line that supplies the radio receiver. Only a small amount of electrical energy is required to actuate the 0A4G. Being of the cold-cathode type, it does not consume power when the receiver is not in use. A remote-control system using the 0A4G provides a simple method for eliminating special cables and gives the user a large choice of control positions.

The remote-control capabilities of the 0A4G can be utilized by the ingenious experimenter in numerous ways.

Terminal connections are shown in Fig. 1; data, Table III.

WL-629 SMALL-THYRATRON TUBE

The rapidly increasing demand of industry for a small but reliable thyatron led to the development of the WL-629 shown in Fig. B. This tube has been designed to fit the need for a compact and inexpensive industrial-type thyatron for control purposes which would operate under any air temperature conditions.

The new WL-629 thyatron has been designed pri

(Continued on page 110)
WIRING SCHOOLS FOR SOUND

"Thousands of schools . . . will obtain their radio and P.A. equipment this very summer," says the author, a radio and sound engineer.

L. M. FEILER

In selecting proper equipment for a school radio sound system, the first requisite is a complete knowledge of the requirements to be filled by such equipment. The chart in Fig. 1 shows the many uses to which this type of equipment has been successfully adapted.

For the average high school installation, a central control unit is usually located in the principal's office, with loudspeakers in the classrooms, gymnasium, auditorium, cafeteria, etc. Provision is made for the selection of microphone, radio, and phonograph. The larger installations sometimes have several channels, allowing simultaneous selection of two or more programs to be reproduced by independent groups of speakers. A typical central control unit is shown in Fig. A.

After the complete requirements have been determined, it next becomes necessary to choose an amplifier, having sufficient power output for proper sound distribution, taking into account loss in lines, transformers, etc. The following power levels have been found to serve best:

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>POWER (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classrooms</td>
<td>1</td>
</tr>
<tr>
<td>Study halls and rooms</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory and lecture rooms</td>
<td>1</td>
</tr>
<tr>
<td>Small auditoriums</td>
<td>3 to 5</td>
</tr>
<tr>
<td>Large auditoriums</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Small gymnasiums</td>
<td>3 to 5</td>
</tr>
<tr>
<td>Large gymnasiums</td>
<td>5 to 10</td>
</tr>
<tr>
<td>Cafeterias</td>
<td>5 to 10</td>
</tr>
</tbody>
</table>

CHOOSING THE LOUDSPEAKER

It is standard practice to use 6- or 8-in. permanent-magnet dynamic speakers for the classrooms. Complete units, housed in scientifically designed, attractive wall-mounting cabinets are available. Such units are designed to be especially effective in the frequency ranges which give most intelligible speech and music reproduction.

In the construction of the cabinets, only sound radiated from the front side of the speaker diaphragm is directed into space, since the speaker is enclosed in a rigid enclosure. This results in improved performance in the frequency range, extending from 400 cycles well up into the higher frequencies. Proper enclosure design and placement of absorption material effectively controls higher frequency resonance. The usual resonance in the 110- to 160-cycle range, which causes the familiar "boomingness" in improperly-designed baffles, is entirely eliminated, because the rigid enclosure allows no uncontrolled mass of air to escape. This advantage further makes the location of the speakers entirely independent of surroundings.

Where cost is the deciding factor, baffles constructed of plywood are used. A flat job will result if the finished cabinet is sanded and then stained to match the woodwork in the rooms. This should be followed by 2 or 3 coats of "gymnasium floor finish" (spar varnish), rubbed down with steel wool, resulting in a hard glossy finish.

(Continued on page 127)
MICROPHONES EXPLAINED FOR BEGINNERS

Fundamental principles of operation of every basic type of microphone in general use today are described. Construction details of high-quality units are illustrated.

THE 5 most common types of microphones used for P.A. systems and broadcast studio work are: the carbon, condenser, ribbon or velocity, dynamic or moving coil, and crystal. Each one has its advantages and disadvantages and so we shall consider each type in the order named.

CARBON MICROPHONES
The carbon microphone depends for its operation on the varying resistance of a carbon element when subjected to varying pressure.

The usual arrangement of this type unit, for best fidelity, consists of 2 carbon buttons one on either side of the diaphragm. In a properly-built carbon microphone— is stretched and air damped so that the effects of self-resonance vibrations are negligible, giving a reasonably uniform output at all ordinary audio frequencies.

This unit has the disadvantage of a background noise called “carbon hiss,” which is caused by the passage of current through the granules. It has a high maintenance factor and must be handled carefully. On the other hand it has the advantage of a very good power output level of -30 db., together with low output impedance, making it possible to have the microphone some distance from the amplifier. See Figs. 1, A and B.

CONDENSER MICROPHONES
The diaphragm of the condenser microphone constitutes one of the plates of a variable air condenser, while the back plate, which is separated from the diaphragm by a film of air about 1/1,000-in. thick, acts as the other plate. See Fig. 1C. Capacity variations of this condenser, in series with coupling condenser C, develop minute A.F. voltages which are then amplified by a 1- or 2-stage “head” amplifier. In actual practice, the condenser and head amplifier (or “preamplifier”) are all housed in the same case and the whole unit is called a condenser microphone.

After the signal leaves the head amplifier, it has about the same output level as a moving Coil type. The same principle of stretching and damping the diaphragm is applied to the condenser type as is used in the carbon microphone, thus giving about the same fidelity of output. However, there is a noticeable absence of background hiss, and the ruggedness of the unit is a decided advantage.

RIBBON OR VELOCITY MICROPHONES
The ribbon-type microphone is so named because the armature is a light corrugated ribbon of aluminum alloy. See Fig. 1D. This type is also called a velocity microphone because the voltage induced in the ribbon is proportional to the instantaneous velocity of the air in the sound wave. The aluminum ribbon is suspended in the field of a permanent magnet and when sound waves strike the ribbon it vibrates, cutting the magnetic lines of force. Whenever a moving conductor cuts lines of magnetic force, an electromotive force is induced in the conductor. Thus in this case we will have set up in the ribbon a small e.m.f. whenever it vibrates. Since the mass of the ribbon is extremely low, an excellent frequency response is obtained, extending well beyond the upper limits of the regular stretched-diaphragm-type microphone.

(Continued on page 118)
HOW TO MAKE A COMBINED HEARING-AID AND INTERPHONE

Something new! An Electric Hearing-Aid, Detective-phone and Inter-office Telephone—all in one unit. New “audio A.V.C.” circuit eliminates blasting on loud sounds.

C. W. PALMER, E.E.

AIDS to the hard-of-hearing have achieved quite useful results in the past, especially those devices which depend on electronic means for sound magnification. In many cases people who imagine they are “stone deaf” find that they have no difficulty carrying on a conversation by using a “hearing-aid” having tubes and batteries. Amplifiers have been developed and employed in offices, churches, theatres, and such places where near-deaf people may have need for hearing-aids. Permanent installations have been put in many theatres and churches while portable units are used by many thousands in their daily work. Hearing-aids are also used to permit near-deaf people to hear radio programs from radio sets which are operating at normal room volumes. It also aids thousands of handicapped business men and executives (as shown above) to carry on their business same as usual.

Where operation is desired in homes and offices the electric light lines can be used to advantage to conserve batteries (used in the usual type of pocket hearing-aids). Vacuum-tube amplifiers can increase the sound level to any desired value, and with low background noise. The unit here described and illustrated (see Fig. B) incorporates the advantages of small size, adequate gain, low background noise and last but not least, it includes audio automatic volume control.

AUDIO A.V.C.

This “audio A.V.C.” circuit permits weak, far-away sounds to be built up to the full extent of the amplifier, while loud noises and sounds are cut down to the level controlled by the position of a volume control which may be set by the user to suit the condition of his hearing. This A.V.C. action is very similar both in circuit and action to the A.V.C. systems used in modern radio receivers, except that instead of acting on R.F. or I.F. amplifiers, the gain control circuit is in the audio amplifier of the unit under description.

In designing the circuit (see Figs. 1 and 2) of this hearing-aid, advantage was also taken of several other factors.
or applications which may logically be incorporated without much additional expense to the maker and yet greatly increasing the usefulness of the device.

INTERPHONE
First, a switch has been included permitting the permanent-magnet or "P.M." speaker to be connected to the output of the amplifier, using it as a speaker instead of as a microphone. This changes the unit into an effective audio-type interphone or inter-office telephone and several of these units can be used, for 2-way or "talk-back" operation, in an office or factory in just the same way as any of the commercial interphones now being made and sold.

DETECTIVE-PHONE
The permanent-magnet dynamic speaker has been mounted in a small box which can be detached from the amplifier and connected at a distance from the main amplifier, thus permitting the unit to serve as a "detective-phone"—by hiding the small microphone box in a room to be "watched."

HEARING-AID
The microphone may also be used at a distance from the amplifier when used as a hearing-aid, permitting the amplifier box to be placed in a desk drawer or other suitable place with only the microphone in view. Or, when listening to a radio program, the microphone can be placed near the radio loudspeaker, while the amplifier, with its volume control, can be placed next to the user's favorite easy chair.

Other applications equally as useful will, no doubt, be discovered by anyone using this versatile device.

THE CIRCUIT
An examination of the circuit in Fig. 1 shows that 2 tubes supply the action of 2 amplifier stages—2 amplifier tubes, 1 rectifier for power supply and 1 diode for A.V.C. rectification. The two tubes supplying this unusual combination of actions are a 12A7 pentode-diode and a 25A7 pentode-rectifier. The 12A7 pentode is the 1st A.F. stage, following the 3-inch permanent-magnet speaker which is applied as a dynamic microphone. This pentode is coupled to the pentode section of the 25A7 which acts as the 2nd stage of the 2-stage amplifier, feeding into either the hearing-aid or a phonograph turntable, whichever is preferred by the hard-of-hearing person. A portion of the signal in the plate circuit of the 25A7 is fed back through a condenser to the diode section of the 12A7 where rectification takes place. The rectified signal is filtered through a resistance-capacity network and fed back to the grid-circuit of the 12A7 pentode section, thus changing the grid bias of this input tube. The diode section of the 25A7 tube supplies the rectification necessary for plate supply of the two tubes. The filaments of the two tubes are connected in series in the usual A.G.C.-D.C. practice. A low-resistance filter choke and two electrolytic condensers filter the rectified output to reduce hum level to a very low value.

Mechanically, the amplifier is built on a small aluminum chassis and is kept as small as possible for reasons of portability.

The permanent-magnet dynamic speaker is mounted in a separate box of the same cross-sectional dimensions as the amplifier box, but just deep enough to enclose the unit without the coupling transformer which is mounted on the amplifier chassis. This coupling transformer has a 3-ohm winding to match the voice coil of the speaker, and a 7,000-ohm winding to give a large voltage step-up and high impedance for feeding into the grid of the tube, yet sufficiently low to permit use in the plate circuit of the 25A7 pentode when used as an interphone.

The actual positions of the parts can be best determined in actual construction, as the spacing is very definitely limited and changing even one or two parts will prevent the dimensions shown from being used.

The illustrations show in general how the parts are laid out and will be a useful guide to the constructor in making a similar unit. The unit is housed in a small wooden box of the indicated dimensions (see Fig. 3). This box can be made from several empty cigar boxes or from any suitable thin wood. The outside can be painted, stained or—as in the original model—covered with leather. The latter makes a neat appearance which is also durable.

In wiring the unit, care must be taken to keep grid and plate leads separated and far away from any of the A.C. wiring, in order to keep the hum level at a minimum. Wire the circuits which pass through the chassis, first, then add the various condensers and resistors required. The following parts were used in the original model of the unit.

LIST OF PARTS
One Utah 3-in. permanent-magnet dynamic loudspeaker;
One speaker coupling transformer—midget type, 3 ohms to 7,000 ohms;
One Arcturus type 12A7 tube;
One midget-type low-resistance 30 hy. choke;
One Cornell-Dubilier midget tubular 8 mf. 200 V. electrolytic condenser;
One Cornell-Dubilier midget tubular 16 mf. 200 V. electrolytic condenser;
One Cornell-Dubilier midget tubular 25 mf. 35 V. electrolytic condenser;

(Continued on page 123)
PHILCO 28-14T

An intermittent hash or roaring noise, which completely obliterate any received signal may be caused by the browning of the high-frequency condenser at an audio rate. An ohmmeter will not show up the condition as the inherent inertia or time lag of the instrument will not respond to fast current impulses. Disconnecting the suspected condenser is about the only satisfactory method of testing a true condition.

The symptoms were puzzling at first. The signal generator was applied to the I.F. and the last-detector grid, the trouble being definitely localized in the mixer circuit. It was found that the hash disappeared when the 5AG6 osc. grid was shorted, indicating that a form of noise modulation in the grid circuit was responsible for the distortion being generated by the shorting condenser.

Filings or punctured mica will cause this fault.

WILLIAM MOORE

"BIRDIES"

If one station on the radio set comes in with a birdie (sounds like the set is oscillating) check the I.F. against the station's. If the twice the I.F. is equal (or nearly equal) to the station's frequency, your trouble is "I.F. 2nd-harmonic beat notes." This is caused by the last-detector current through setting condensers at a frequency which beats with the oscillator to form an I.F. signal.

To cure this trouble shift the I.F. slightly so as to eliminate all beat notes, then realign the R.F. and oscillator sections.

LOUIS DEEN

ATWATER-KENT 185, 185, 525

If circuit occurs when volume control is turned on full, replace the double 250 mmf condenser (Atwater-Kent part No. 53330) with two 260 mmf, bakelite condensers. This condenser connects from the plate of the 58 I.F. tube to the circuit diode plates of the 3AF. This condenser increases in capacity enough to cause this trouble and is difficult to locate without proper test equipment. Nearly all of the late Atwater-Kent sets use this type of condenser.

EUGENE McCULLOUGH

EMERSON MODEL 26

Hum:--Open-grid-return filter condenser allows hum to be increased by grid of 47 tube from A.C.-modulated bias supply.

Oscillation:--Open-circuited volume control or broken grid connect wire to volume control resulting in high gain and regeneration in the R.F. stage and a deteriorated screen-grid condenser in the R.F. stage. Coupling between R.F. and detector grid wires.

To eliminate oscillation when the volume control is at maximum and the antenna is disconnected, increase the cathode condenser to 0.2 mf. and the screen-grid filter of the 88 R.F. to the same value. Also, unseat the screen to ground with a 16 mf, 200 volt unit.

The control-grid lead of the 67 detector should be re-routed directly to the top of the gang condenser. A shielded wire is used, of course, but shielding is soldered to the tuning condenser frame and to the tube shield compartment.

WILLIAM MOORE

CROSLEY SETS

We have found on the Crosley River, Firestone and other sets similar to these, that are manufactured by Crosley, that what appear to be a noisy tube, loose connection or caused condenser plates are all due to improper ground connections on the tuning condenser rotor shaft.

Ground with small gauge, flexible wire.

EUGENE W. WILLIAMSON

MOTOROLA 75

Recently this receiver, after being in service for a few years with no trouble was repaired by an expert. It was found to have a defective high-frequency condenser 0.01 mf., 1600 Vc, with a 0.91 mf., 600 Vc. After paying the bill which was not small, the customer had trouble-free operation for 3 weeks when the set was brought to me "dead." The trouble was easily spotted. The replacement had broken down and caused a complete short of the transformer. By putting in the proper replacement this set operated beautifully and should give long, trouble-free service in regard to the transformer also.

Little story that all Service Men should abide by. Don't try to put something over on a customer. He eventually learns about the harm to your business, by the least, is great.

W. B. HEATH

CANADIAN WESTINGHOUSE 512

After trying all the usual tricks, a most annoying hash-baffling source of oscillation in a Canadian Westinghouse 512 Series receiver was finally found to be due to an open connection between the No. 1 base-pin and shell of the GL7 tube. The trouble was discovered simply by jabbing a screwdriver into a shaped spot on the GL7 shell and the receiver chassis.

DEFOREST CROSLEY 851

(Using Old-Style Glass Tubes)

When replacement of the later-style tubes having a different shape, don't change time trying to rehabilitate the weird and wonderful tubes with the new tube. Place them firmly in the ash-can and substitute "coat" shields of the correct size. After you have adjusted this matter you will frequently find that reception is extremely weak and distorted. Plug your analyzer into the last audio stage. If there is little or no voltage at the tube, look at zero grid volts. Look at red resistor (25,000 ohms, on rear resistor strip). This will be slightly

charred, the result of an extremely leaky or shorted A.F. bypass condenser. Replace both resistor and condenser, the latter with a 0.28 mf., 125 volt, electrolytic condenser.

STEWARD WARNER MODEL 33K "KING"

When the complaint is the common one of noisy, erratic or intermittent reception, always check for defective mica condensers. Also check for carbon resistors which have (usually) increased in value; one 500 ohm resistor recently tested had increased to 2,000 ohms. Also bond the rotor of the variable condenser to ground (chassis) with flexible insulated wire.

MOTOROLA 83

When the 3/16-in wide copper ribbon dial-drive cable breaks, as it often does within a short time in this set, a quick and excellent repair is effected by using a thin strip of soft leather, readily obtained from shoe repairers. Stretch the leather for a minute before using. It is then advisable to ground dial assembly by bonding bracket support, directly behind tuning shaft, to chassis.

G. ROGAL


STEWARD WARNER 1845, 1855, 1865, 1866 Magic Keyboard Operating Data (Including Data on the 845A, 855A, 865A, 866A "Kings")

We frequently receive complaints of improper operation of the Magic Keyboard Mechanism because detector condensers are not familiar with what the mechanism can and cannot do, or because of failure to read instructions, they do not set it up correctly.

For satisfactory Magic Keyboard operation, the following points must be carefully observed by everyone using, demonstrating or selling the Keyboard.

1. Often the mechanism is not locked up tightly enough after setting it up, thus the set will drift. When the last button has been released by pushing in and pulling out the set-up knob, turn the set-up knob about one turn to the left and dial pointer will go to the left end of the dial scale. After this, keep forcing the set-up knob in the counter-clockwise direction. Force it just as hard as it is possible to do by hand.

2. All automatic tuning receivers should be operated on a good outside antenna to give maximum signal strength. An inside aerial, while it may permit satisfactory reception for a manually tuned set will not provide sufficient signal to properly operate the A.F.C. during automatic tuning.

3. Buttons should be set only to nearby, powerful stations, since Automatic Frequency Control cannot function properly unless the signal strength is good. Weak or fading stations should be tuned manually. If the user insists on automatic tuning, however, it should be advised that automatic tuning of these stations is not advisable as manual tuning.

4. Before setting in the receiver on for at least 20 minutes so that all parts are at their normal operating temperature.

5. In the Models 1866 and 1866, the tone control must be in one of the first 3 positions (counterclockwise). The 4th (fully-clockwise) position, broadens the tuning control and must not be used during set-up.

6. If a button has been set-up and released, do not push this button again until the mechanism is locked up. Do not try to check the setting of the buttons by pushing IF/C, etc., before being locked, as this will change the settings.

7. Tune very carefully when setting the stations, making use of the visual tuning indicator. When releasing the last button by pushing in the set-up knob, turn the set-up knob to the right, i.e., the right-hand buttons should be set up last.

STEWARD WARNER CORPORATION

ARVIN--818, 828A, 828B, 738CB, 738A, 838CB

Complaint, hum:--Located ground lug on 64T7G tube socket. This lug is fastened to the chassis by a rivet which attaches the 64T7G socket to the chassis. Bend this lug over and solder to the chassis. Recheck for hum. If soldered properly the hum level will be very satisfactory.

ARVIN--818, 828, 828AT, 838AT, 838A, 838CS

Complaint--Fading:--Probably poor grounds. Use the 250,000 ohm plate resistor of the 6F6G tube in addition to the usual 56 ohm valve resistor. Connect the first tap down from "B-" on the voltage regulator circuit, to the valve resistor, 837. This voltage tap supplies the power for the 6F6G grid base. Recheck for hum. This should reduce hum to a satisfactory level.

ARVIN--1427

Some of the 1427 models drift off from one station to another 10 kc. off frequency. To cure, check each individual condenser on the chassis. If any are loose or cracked, replace it with a porcelain or bakelite base type. If this last detector condenser strip is of the bakelite type, it should be replaced with a porcelain condenser.

NELSON-SWARE INDUSTRIES, Inc.

(Continued on page 119)
NEW ULTRA-FLEXIBLE P.A. AMPLIFIERS

A tiny preamplifier, and a tiny power amplifier, combine to produce a “clean” output of 20 watts.

McMURDO SILVER

THERE are today a number of Public Address amplifiers available for almost any type of installation. Some are good, and excellently designed, and some produce only the raucous sounds heard in many a poor installation. In the main, price and maker’s reputation are the best guide to quality. In the search for simplicity, however, user’s convenience has been noticeably neglected, and the usual installation generally consists of microphone or other input devices, a single amplifier unit embracing all functions of pre-amplification, voltage amplification, power amplification, volume and mixing control, and maybe tone control, which then feeds a combination of loudspeakers.

In many cases this multi-function single amplifier unit is an excellent choice, but it does not possess certain very desirable features of inherent flexibility which permit it to cope with many specialized installations. For example, if it is split up into separate units of preamplifier and driver, power amplifier flexibility is tremendously improved.

Under this desirable condition, volume and mixing controls can be located where most convenient, can be duplicated as at many positions as desired, and power output and number of speakers may be easily increased or decreased through adding or removing preamplifiers and speakers whenever this becomes desirable or necessary. Through such amplifier handling the very maximum of flexibility may be had for each individual installation, which can easily be altered without obsolescence at any future time and definite design benefit of isolation of preamplifier and power supply circuits obtained.

(Continued on page 112)

RADIO WITTIQUIZ

FREE — A 1-year subscription to RADIO-CRAFT to each person who submits a Wittiquiz that in the opinion of the Editors is suitable for publication in RADIO-CRAFT. Read the following Wittiquizzes; can you spot the correct answers? Now send in your idea of one or more good Wittiquizzes.

(99) A voice coil is—
(a) A funnel-shaped piece of metal that directs sound from a magnetic speaker (sometimes called a horn). 
(b) A low-resistance coil placed at the apex of the cone in a dynamic speaker. 
(c) Certain vocal cords surrounding the Adam’s apple.

AUSTIN METCALFE, Sask., Canada

(100) Electrons are—
(a) Small germs which jump from the hot filament in a vacuum tube to the plate because the plate is more comfortable. (b) Held for the purpose of putting persons into public office. (c) One of those particles projected from the cathode of a vacuum tube.

(101) Is a trickle charge—
(a) The state tax which we pay when we buy something? (b) A small electric charge to maintain the voltage of a storage battery? (c) The money that we pay for electricity that is lost due to a leaky filter condenser in a radio set?

JOHN PENAZ

(102) A static machine is—
(a) A stabilizer device used in a radio set to minimize the effects of static. (b) A machine which produces electromotive force by friction. (c) Any person who is a gossip.

(103) The hydrometer is used—
(a) To measure the gravity of the solution of a storage cell. (b) To test a condenser. (c) In the construction of radio test instruments.

CLEO JONES

(104) Thermal agitation is—
(a) A term used in connection with the measurements of heat units. (b) The heating of the I.F. transformer which broadens the frequency response. (c) Free electrons moving around at random continually in any conductor, producing tiny electron currents. (d) The heat produced in vacuum tubes, which is responsible for the blue glow which is emitted in proximity to the tube electrodes.

(105) A solenoid is—
(a) An electromagnetic relay used in television to keep the sawtooth waveform in synchronism with the incoming signals. (b) A byproduct of the celluloid industry. (c) The choke coil used in the rectifier circuits of test instruments. (d) A helix consisting of a number of turns through which current flows.

(106) In radio reception the so-called mixer simply is—
(a) The 1st R.F. tube in a 3-stage tuned-radio-frequency receiver. (b) A studio master control man who mixes two or more separate programs on a pair of lines simultaneously. (c) The 1st-detector, in superhet-type receivers, which detects at the same time the output of the mixer. (d) The 1st-detector, in superhet-type receivers.

(Continued on page 124)
THE LATEST RADIO EQUIPMENT

PUSHBUTTON "TRIMMER-IN" (1640)
(Meissner Mfg. Company)
Unlike preceding types of pushbutton tuners which tune stations independently of the set's tuning condenser, this new unit requires only the set's regular tuning condenser (left set at minimum wavelength), and then "trims-in" any one of 7 pre-set stations. An additional button reverts the set to manual tuning. This attractive unit mounts either vertically or horizontally; and may be used on either T.R.F. or superhet. receivers.

INDUCTANCE-TUNED PUSHBUTTON TUNER (1641)
The PBH tuner is an automatic device designed for a superheterodyne receiver with an I.F. of 466-468 kc. This unit consists of 2 circuits, antenna and Colpitts oscillators, adjustments being made from the front; both circuits are tuned simultaneously by a single adjustment. The use of individual oscillator coils for each pre-set station instead of trimmer condensers, eliminates fine-tuning drift. Inductance padding is provided which permits 3-point alignment crossover over the entire high-gain coils are used.
The unit has 5 buttons and provides band coverage as follows: Buttons 1 and 2, 1,210-1,400 kc.; buttons 3-4-5-6, 1,070-500 kc.

25-WATT SOUND SYSTEM (1642)
(Allied Radio Corp.)
Note: This sound system was designed to operate with highest efficiency from either a 6-V. storage battery or an AC-DC 10-60 cycle source, but furthermore, this new sound system includes a tunable which (presumably) may be operated on the same current supplies.
The basic circuit incorporates 4 high-gain stages using 2-637G, 3-6N7G, 2-6L6G, 2-024 tubes. Features include: inverse feedback, 2 universal microphone input channels, dual phonograph input, separate volume controls for phone and microphone input, dual tone controls, built-in power supply, multiple speaker selector switch. A special crystal microphone and two 12-in. P.M. dynamic speakers complete the set-up.

"TELEVISION" CONVERTER (1643)
To receive ultra-high frequencies in the wavelength range of 670 to 12 meters, the 2S to 63 megacycle converter here illustrated has just been released. This range of course includes the spectrum of ultra-high frequency experimental television broadcasters; the high-fidelity audio channel of these stations thus can be heard on standard broadcast receivers.
Incorporates 3 metal tubes and operates on A.C.-D.C. supply. Connects to the antenna and ground post of any broadcast receiver and should be a real moneymaking item for Service Men. Planetary reduction drive affords finer tuning. Multiple switch automatically connects antenna to either converter or receiver as desired. Tested by Radio-Craft, this instrument functioned quite perfectly; as well as designed to receive the high-fidelity audio programs of W9XJ.

REMOTE-CONTROLLED HIGH-FIDELITY RECEIVER (1644)
(McMurdo Silver Corp.)
The "ORPHEON," states the manufacturer, is a super-high-fidelity receiver. This 5-watt receiver is designed to allow tuning of that portion of the public interested only in the fine tone quality available from a few local stations (within 100 miles), in the frequency range of 550 to 1,500 kc. This range, you will note, includes the special high-fidelity channel between 1,250 and 1,500 kc. The per-dynamic loudspeaker and 25-W. amplifier are located in the large Chippendale-styled console while the tuber unit, which may be placed at any convenient location in the room for remote tuning, is housed in a compact "jewel box" cabinet (diaI graduations are "movie projected" onto a little window). The large console will also accommodate an automatic record-changer for those insisting upon a complete phono-radio installation.

INEXPENSIVE MODULATION INDICATOR (1645)
Known as the Modulite, the device here shown is also designed as an inexpensive means of correcting over-modulation in ham transmitters. Modulite is a .5-in. glas tube, 12 ins. long, lined with a fluoroscopic material identical to that in a cathode-ray tube, and filled with inert gases and mercury. The bombardment of positive ions and the presence of ultra-violet resulting from ionisation of the mercury, cause the lining material to fluoresce, the rise and fall of the glow indicating relative modulation. Green glow indicates modulation is OK; red glow, over-modulation.
Over-modulation is instantaneous and is indicated by a red line in the tube above the higher band, and may then be easily corrected by the "hammer.

The Modulite performs work hitherto accomplished only by means of oscillographs and other expensive equipment far outside the average ham's reach.

COMPACT VELOCITY MIKE (1646)
(Amperite Company)
In spite of its small size, this velocity-type microphone—said to be the smallest complete unit ever made—is complete with output transformer, cable connector and switch, and also has the output (-70 db., open line) of the large velocity. It can, therefore, be used on all high-gain amplifiers.
Frequency response range is 60 to 7,500 c.p.s., + 2 db. Can be used for speech or music and is obtainable in either low impedance (model ALC) or high impedance (modc ABX). Although designed to fit the standard 12-27 microphone stand, it also makes an excellent hand microphone. The case is of molded rubber, trimmed with chrome. Size of head: 1 1/4 x 2 5/8 in.

VACUUM THERMO-COUPLE (1647)
Here illustrated is a thermo-couple which consists of a thermocouple and a heater filament mounted in an evacuated glass bulb. These thermocouples are available in 2 types: the contact-type and the separate-heater type. In the contact-type the thermocouple and the filament are electrically connected to the heater element. This type can be used (with a suitable D.C. millivoltmeter) for measurement of D.C. and A.C., of any frequency, up to 20 megacycles. In the separate-heater type the couple is isolated from the heater by an insulating bend which, though it insulates the

Manufacturers are invited to utilize these columns to bring improvements and new devices to the attention of technicians interested in every phase of Radio, Electronics and Public Address.

Inexpensive modulation indicator. (1645)
Small velocity mike contains transformer and switch. (1646)
Sensitive thermocouple in evacuated tube. (1647)
New line of multi-matching transformers. (1648)
More parts available to television constructors. (1649)

RADIO-CRAFT, for August, 1938

www.americanradiohistory.com
NEW TELEVISION PARTS (1649)  
(RCA Manufacturing Co., RCA Parts Division)  

With the new television parts just announced, and other standard parts already available, it is now possible for the amateur experimenter who is equipped with sufficient technical knowledge to assemble (television-receiving tube) defective circuits for use in experimental television receivers.  
The new parts listed for sale include (see photo) a deflecting yoke (A), 2 power transformers (B), a vertical-Scan output transformer, vertical and horizontal-Scan oscillation transformers, a horizontal-Scan output transformer, 2 power supply condensers (C), and a power supply resistor (R).  

"HAM" TRANSMITTER FOUNDATION (1650)  
(Weston Electrical Instrument Corp.)  

The Foundation unit illustrated herewith makes available efficient, compact and easy assembly of 600-W. amateur transmitters. All parts are arranged so that the transmitter proper is joined together in one compact unit. It is a self-supporting unit mounted to a front panel which also houses the dials and panel size. The unit is illustrated as a C R.F. amplifier.  

NEW A.C.-OPERATED SERVICE OSCILLATOR (1651)  

This 4-tube unit is equipped with a unique circuit providing automatic amplitude control at any desired level from 1 microvolt to 100,000 microvolts (multiplier switch has x10, x100 and x1000 settings). Its output characteristics are independent of any fluctuations in the 110-120-V. 60-cycle A.C. line. The new oscillator covers all frequencies from 1,000 kc. to 30 megacycles on the following 6 bands: 60-200 kc., 200-600 kc., 600-1,500 kc., 1,500-6,000 megacycles, 6,000-18 me., and 18-20,000 me. The 3-speed, direct-reading, 320-degree scale has 6 frequency scales, each of which averages over a foot in length; each scale is individually divided (1000's, 100's, 10's, and 1's). With hand-drawn scale divisions. The manufacturer guarantees the accuracy of this instrument as being to 0.5 per cent of the indicated frequency on 5.1 P.F. and broadcast wavebands, and to 1 per cent on the 3 short-wave bands. The attenuator scale is calibrated directly in microvolts. Unit provides an R.F. output modulated at 400 cycles, continuous wave (C.W.), output for audio frequencies from 400 cycles. A wobbler jack permits frequency-modulated input to the unit.  

SOUND DEMONSTRATION KIT (1652)  

Suitable experimenting in sound waves of high frequency enable the student to secure a better understanding of the principles of wave motions. (especially with regard to its optical analogs, in reflection, interference and diffraction, which are also applicable to television.) In all, about 30 experiments, both qualitative and quantitative, can be performed with this kit.  
High-frequency, sinusoidal sound waves are generated by a compressed-air whistle. The sound waves are transmitted through a wall, street, etc., by means of a special pick-up and amplifier unit for visible indication on a cathode-ray oscilloscope. This kit has been designed only for use by schools, colleges, etc.  

NEW REMOTE CONTROL MEETS ANY CAR-RADIO NEED (1653)  

There are 4,000,000 cars equipped with radio sets which are constantly being transferred to other cars. Herefore, each transfer required a new control with an escutcheon kit to match the new panel. This new unit is claimed to eliminate this botherome and expensive condition. For it is 100 per cent universal in every way, which is to say, its controls can be maneuvered to fit any panel operating in any car and its gearing arrangement provides all the necessary step-down ratios used in modern audio-remote receivers. These self-contained ratios are: 1:1, 8:1, 10:1, 12:1, 16:1, 20:1. Escutcheon plates and knobs are available to match the trimmings of all cars.  

NEW "DYNOPTIMUM" TUBE CHECKER (1654)  
(Radio Supply Products Co.)  

This tube checker—termed the "dynoptimum" by its manufacturer—it is stated tests all tubes under R.M.A. specified voltages and loads as approved by all tube manufacturers. This includes ballast tubes as well. Other tests provided are: hot inter-element and leakage between all individual elements, hot cathode leakage test. It also tests each section of full-wave rectifiers, duo-diodes and other multi-purpose tubes. The unit employs a 3-in. scale d'Arcynval meter with an accuracy of 2 per cent. The scale is of the direct-reading "good-bad" type, colored for easy readability.  

NEW A.C.-D.C. OZONATOR (1655)  

This "Hom-O-Zone" is an item with which the smart radio Serviceman can do considerable business; its transformer steps up the A.C. line voltage to a potential at which sparks will jump across multiple gaps (a D.C. model is available to accomplish the same result). This results in the production of ozone (O3 or concentrated oxygen) in the air of a room, by having thus become ionized, is charged of its content of impurities (tobacco smoke, odors, etc.). A really handsome and utilitarian model is the type C Hom-O-Zone shown on pg. 120. It contains no moving parts; actually performs as claimed. Manufacturer states device will not create radio interference.  

AUTOMATIC AND PORTABLE RECORDER-REPRODUCER (1656)  

An outstanding development in recording machines is shown on pg. 120. Among its outstanding unique and important features are the following:  
Switching from recording to reproducing, and vice versa, is accomplished in this machine automatically.  
Also, the amplifier is automatically altered in its characteristics to suit the well-known individual and respective requirements for recording and playback.  
The manufacturer further claims that the special belt-driven recording motor enables musical recordings to be made without wows or flutter. The recording mechanism allows any type of material to be cut. The loudspeaker, housed in the lid, may be removed for placing in the most advantageous location. Case measures 15 x 10 x 10 ins. high; weight of machine, about 35 lbs.  

NEW RESISTORS (1657)  
(Clarasfkat Mfg. Co., Inc.)  

Wire-wound fixed resistors with a choice of 2 coatings have been announced: photo-photograph A on pg. 120. Where dependability service even in the face of frequent overloads is required the inorganic cement type of resistor is recommended; the resistor may be operated at redheat without blistering, cracking or deterioration. Resistance values, 1 to 50,000 ohms, and 10 and 20 W. Also, the tarnish-protected wire-wound resistor affords maximum protection against extreme humidity as well as acid vapors or salt spray. This coating withstands continuous operation at greater power input than its watts rating, without the slightest deterioration. Resistance values, 1 to 50,000 ohms, and 5 and 10 W.  
(Continued on page 120)
ELECTRIFYING THE SERVICE OSCILLATOR

The utility of battery-powered service oscillators may be greatly increased at slight cost by modifying them for electric light line operation.

EVERY owner of a battery-operated service oscillator has undoubtedly had the aggravating experience of finding the batteries in his instrument completely dead, or at least way down, just when he needed the oscillator most, say on some rush job over the week-end. After having had this happen innumerable times we decided there was no reason why all of our test oscillators should not be A.C.-operated.

Since the large majority of all battery-operated oscillators use much the same tube layout and mechanical arrangement of parts, it was thought that it should not be hard to convert practically any oscillator to complete A.C. operation by following the same procedure as was used in our conversion of sets from battery to A.C.-D.C. operation. However, further analysis indicated the possibility of shorting the A.C. line. To avoid this a power transformer was included in our list of parts.

One other important improvement was the raising of the R.F. output voltage. For many tests it is often desirable to have more R.F. output than 22½ volts will give, so a S.P.D.T. toggle switch was included in the power pack to afford us the choice of either 22½ or 90 volts plate voltage. The switch can not be left on the high-voltage tap permanently as the R.F. output and leakage will be too high for work on some receivers. This maximum output voltage is extremely useful while making selectivity or A.V.C. measurements, or when working on badly aligned or extremely weak receivers. A pilot light should definitely be included in the oscillator when converted as this will eliminate the tendency to leave the instrument running overtime, and what is more important it should be possible to arrange some method of illuminating the dial scale. This improvement alone is worth the trouble of electrifying the oscillator, especially if you ever align car sets without removing them from the car (and who doesn't do this occasionally?).

The circuit changes necessary are relatively few and are quite simple (see Fig. 1). The battery-operated tubes, usually type 30's, are replaced by 50's. The bias on the A.F. oscillator tube should be adjusted until the best A.F. waveform is secured. This can be done either by listening or by viewing the output wave with an oscilloscope. A value of 3,000 ohms is suggested for the A.F. bias resistor. No changes need be made in the R.F. oscillator circuit, the grid and plate leads merely being moved from the old 4-prong socket to the 5-prong socket of the 66 tube, the cathode of the 56 being grounded. The old filament switch is also to be replaced with a toggle switch in the A.C. line. The exact placement of parts will depend upon the individual job. In general, though, the filter condensers, the choke and the voltage divider may be mounted in the discarded battery compartment, while the rectifier tube and the power transformer can most conveniently be mounted on the back of the instrument case. Figure A shows a typical oscillator before and after conversion. It is necessary to mount the rectifier tube on the outside of the box, due to the excess heat developed by the 5Z4. Care should be taken not to drill any unnecessary holes in the chassis as all such holes will increase the R.F. leakage. The above details should be adequate.

L. L. HOTSENPILLER

List of Parts

<table>
<thead>
<tr>
<th>Part Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two 5-prong sockets</td>
<td>2</td>
</tr>
<tr>
<td>Two National Union tubes</td>
<td>2</td>
</tr>
<tr>
<td>One Allied power transformer</td>
<td>1</td>
</tr>
<tr>
<td>One Radioakt 30 henry choke</td>
<td>1</td>
</tr>
<tr>
<td>Two Solar 8 mf. filter condensers</td>
<td>2</td>
</tr>
<tr>
<td>One I.R.C. 10,000 ohm resistor, 2 watts</td>
<td>1</td>
</tr>
<tr>
<td>One I.R.C. 20,000 ohm resistor, 2 watts</td>
<td>1</td>
</tr>
<tr>
<td>One I.R.C. 25,000 ohm resistor, 2 watts</td>
<td>1</td>
</tr>
<tr>
<td>One S.P.D.T. toggle switch</td>
<td>1</td>
</tr>
<tr>
<td>Four Cornell-Dubilier 0.1-mf. condensers, 200 volts</td>
<td>4</td>
</tr>
</tbody>
</table>

**Fig. 1. Diagram of the changes needed to electrify the service oscillator.**

**Fig. A. (Left) A typical battery-operated service oscillator before electrification. (Above) The same oscillator completely electrified. The power transformer, line switch and rectifier tube are mounted on the outside of the back cover, both for convenience in construction and ventilation. As the author points out in the text, care should be taken not to drill any more holes in the chassis and care than necessary as all such holes will increase the R.F. leakage (radiation).**

RADIO-CRAFT for AUGUST, 1938
Service Men may write, requesting answers to specific service questions. Address inquiries to Service Editor. For questions answered by mail, a service fee of 25c per question is made. Only questions of wide interest can be published.

Readers are invited to make this page their meeting place for the interchange of ideas and a frank discussion of problems and experiences, particularly those which affect the Service Man.

GRAND LEDGE, MICHIGAN

Gentlemen —

Regarding the condenser tester by Mr. Chapman of Melfort, Sask., in the April, 1938, issue.

While the panel layout is fine, I believe Mr. Chapman has made an error which could cause considerable trouble, i.e., using bleeders to reduce the voltage at the normally high-voltages of the supply. Mr. Smith's training taught me that this would overtax the rectifier tube and probably damage one or all of the following: the bleeder used to reduce voltage, the transformer or the choke.

I would suggest a bleeder with 5 or 6 adjustable taps and the total resistance to be of the order of approximately 25,000 ohms, and the taps to be used for the various voltages.

Also note Mr. Chapman uses a single range, 0-10 ma. meter. It would be bad when testing a condenser having a leakage as high as 100 ma. of importance. I would suggest something in the 0-100 range with a 0-500 range also.

H. E. BECKER

MELFORT, SASK., CANADA

Gentlemen —

I am in receipt of your inquiry of March 19 regarding condenser tester and have been testing it on some work. I have found that what Mr. Becker says is quite true. The system I outlined at first puts a load on the rectifier which in turn makes it necessary to use a power pack of very high output. This, of course, does away with the matter of compactness which is one of the essentials to make the outfit practical. I am using your system.

Mr. Becker's letter makes it abundantly clear that the voltage divider system which he suggests is exactly what I found was necessary. When I reconstructed it made use of several resistors in series, which, of course, is the equivalent of the tapped voltage divider he suggests.

I regret that I had not discovered this error before sending my article in to you. I am enclosing before asking your approval of a new letter (Fig. 1) with corrections which is for your benefit if you wish to use it for correction in publication.

The suggestion Mr. Becker makes in regard to the additional meter ranges is a good one and I am also including this in the circuit diagram.

A. J. CHAPMAN

Photo—Atlas Sound Corp.

"Ringling Bros., Barnum & Bailey Circus" was more than just the name of a world-famous entertainment troupe to Kirk Frits of Brooklyn, N. Y. To Kirk it meant dollars and cents—when he sold the circus on the idea of using Atlas weatherproof (marine-type) loudspeakers which could be hung outdoors and operated in all kinds of weather; and wherever ruggedness was needed. This feature helped Kirk sell the circus the entire associated sound system! (Continued on page 125)

Radio Craft for August, 1938

99
ARVIN MODEL 6 AUTO-RADIO SET
5-tube superheterodyne; pushbutton tuning (no dial at all); range, 1,540 kc. to 510 kc.; output, 3.3 watts; battery drain, 5.7 amperes.

BALANCING INSTRUCTIONS
(1) Connect the balancing oscillator to the grid cap of the 6A8 tube through a 0.002-mf. condenser. Place a 0.2-meg. resistor between the grid cap of the 6A8 and the grid clip which normally fits on the cap of the 6A8 tube. This will maintain the grid bias on the tube during alignment.

(2) Adjust padder 1, 2, 3, and 4 for maximum output, at 655 kc.

(3) Rotate the Variator shaft to its midpoint position.

(4) Reading from left to right the pushbuttons cover the following frequencies:

- Frequency within range of the respective buttons.
- Final adjustment of the antenna padders should be made with the receiver installed in the car connected to the car antenna.

SOCKET VOLTAGES
Normal filament voltage is 5.8 V. Plate voltages: 6A8, 190 V.; 6K7, 190 V.; 6Q7G, 120 V.; 6K6G, 187 V.; 6X5G, 215 V. A.C.

Screen-grid voltages: 6A8, 90 V.; 6K7, 90 V.; 6K6G, 190 V. Cathode voltages: 6Q7G, 2V. Anode grid (1,000-600 kc.): 6A8, 18.5 V. Grid bias: 6A8, 2.2 V.; 6K7, 2.2 V.; 6Q7G, 2 V.; 6K6G, 15 V.

POINT-TO-POINT RESISTANCES
All readings taken to ground unless otherwise specified; speaker connected and tubes in sockets.

- 6A8
  - Cathode: 0 ohm
  - Screen-grid to "B-": 0 ohm
  - Plate to "B-": 0 ohm
  - Anode to "B-": 1.1 ohms
  - Oscillator Grid: 60,000 ohms
  - Control-grid to "B-": 2.3 megohms
  - 6K7
    - Cathode: 0 ohm
    - Screen-grid to "B-": 0 ohm
    - Plate to "B-": 15,000 ohms
    - Control-grid to "B-": 15,000 ohms
    - 6Q7G
      - Cathode: 0 ohm
      - Screen-grid to "B-": 0 ohm
      - Plate to "B-": 700 ohms
      - Control-grid to "B-": 2 megohms

COIL TRANSFORMER AND SPEAKER RESISTANCES

- Antenna Coil Primary: 1.1 ohms
- Antenna Coil Secondary: 1.2 ohms
- Oscillator Variator Primary: 0 ohm
- Oscillator Variator Secondary: 1.2 ohms
- 1st I.F. Transformer Pri.: 12 ohms
- 1st I.F. Transformer Sec.: 12 ohms
- 2nd I.F. Transformer Pri.: 220 ohms
- 2nd I.F. Transformer Sec.: 220 ohms
- Output Transformer Pri.: 0 ohm
- Output Transformer Sec.: 0 ohm
- Power Transformer Pri.: 220 ohms
- Power Transformer Sec.: 220 ohms
- "B" Filter Choke: 220 ohms
EMERSON MODEL AZ-196 (CHASSIS AZ)

6-Tube superheterodyne; 2-bands (540 to 1,730 kc., 5.6 to 18 mc.); pushbutton tuning; "Miracle" Dial and Tone Chamber; A.V.C., power output, 5 watts.

ALIGNMENT

To align the I.F. Channel, turn tuning condenser to minimum capacity, then feed 456 kc. through a 0.82-mf. condenser to the grid cap of the 6A7 and adjust the 1.I.F. trimmers for maximum response.

To adjust the wavetrap, feed 456 kc. to the antenna through a 200 mmf. condenser and adjust the trimmer screw (rear screw) of variable condenser.

To align the short-wave band, set the dial to 15 mc. Feed 15 mc. through a dummy antenna (400-ohm resistor), and adjust the S-W oscillator and antenna trimmers for maximum response.

To align the broadcast band, turn band switch to "broadcast" and set dial at 60. Feed a 600-ohm signal into the set through a standard dummy antenna (or a 200 mmf. condenser). Adjust the broadcast series-padder condenser for maximum response. Rotate dial to 140 and feed a 1,400-ohm signal into the set. Adjust broadcast oscillator and antenna trimmers for maximum response. Repeat all operations.

ADJUSTMENT OF STATION BUTTONS

To align station buttons refer to Fig. 2 for frequency ranges; wait at least 15 minutes, after turning set on, to attain a uniform temperature. Turn wavetrap switch to broadcast reception and adjust station selector knob for desired station. Then turn wavetrap switch to "automatic" position. Outside-cabinet adjustment is provided by respective buttons having slots into which a thin coin will fit.

VOLTAGE ANALYSIS

Readings should be taken with a 1,000 ohms/volt meter. Voltages listed are from point indicated to ground (chassis). All readings except cathodes, heaters, and "B+" at rectifier were taken on 200-V. scale. Line voltage for these readings was 117.5 V., 60 cycle, A.C.

<table>
<thead>
<tr>
<th>Tube</th>
<th>Plate</th>
<th>Grid</th>
<th>Plate</th>
<th>Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAT</td>
<td>227</td>
<td>75</td>
<td>0</td>
<td>165</td>
</tr>
<tr>
<td>ES6</td>
<td>227</td>
<td>75</td>
<td>0</td>
<td>6.3</td>
</tr>
<tr>
<td>EGTG</td>
<td>105</td>
<td>78</td>
<td>9</td>
<td>6.3</td>
</tr>
<tr>
<td>T6</td>
<td>227</td>
<td>11.5</td>
<td>0</td>
<td>6.3</td>
</tr>
<tr>
<td>6ACG</td>
<td>213</td>
<td>0</td>
<td>0</td>
<td>6.3</td>
</tr>
</tbody>
</table>

"B+" at the 60-tube's filament—300 V.; Voltage across field—75 V.

Grid bias for all tubes is developed across resistors R10 and R11. The total voltage should be 118 V. Voltage measured across R10 should be 2.2 V. To check bias on GAT and ES6 tubes, measure the values of R12, R15 and R14. See schematic.

TUNING UNIT

PARTS VALUES

C1, 250 mmf. mica; C2, 180 mmf. mica; C3, 120 mmf. mica; C4, 75 mmf. mica; C5, 50 mmf. mica; C6, 6.001-mfg., 600 V. tubular.

R1, 3,000-ohm, 1/4-W. carbon resistor.

Fig. 1. Schematic diagram of Emerson Model AZ-196 receiver.

Fig. 2. Schematic of the pushbutton tuning unit. Each pushbutton has its own frequency band from which the station for which it is to be set must be chosen.

Fig. A. Model AZ-196 receiver with "Miracle" Dial and Tone Chamber.
RADIO SERVICE
OF CAPACITY, INDUCTANCE AND
A factory technician tells you how to make important measurements—including ratios with just an A.C. voltmeter

GEORGE

THE purpose of this article is to emphasize how many useful measurements may be made by the radio serviceman using only a modern rectifier-type A.C. voltmeter and a small testing transformer. For service purposes, extreme accuracy is not essential. Speed and convenience of measurements are the most important factors. For this reason the simple ohmmeter circuits are the most popular with servicemen for measuring resistances. Capacity measurements can be made with the same degree of accuracy and convenience.

Inductance measurements can be made just as simply and conveniently, but a correction factor may be desirable. The ratio of all kinds of audio and power transformers can also be determined with very little effort.

CAPACITY MEASUREMENTS

With a rectifier-type A.C. voltmeter, having a sensitivity of 500 ohms-per-volt and full-scale at 2, 20 and 200 volts, and a small transformer capable of supplying up to 2 milliamperes A.C. with good regulation at these voltages, condensers may be measured over a range from 0.1-mf. to 20 mf. With the addition of a simple shunt, measurements may be made up to 200 mf. The foregoing values are for 25-cycle operation. On 60-cycles the range would be trebled to 0.003-mf. to 100 mf. With other meter sensitivities and meter scales, other ranges and capacity measurements could be made.

DEGREE OF ACCURACY

An experimental check on the calibration of such a meter, indicates that an error of plus or minus 10 per cent may be expected at either end of the meter scale and an average error of plus or minus 3 per cent may be expected over the center part of the scale. This check was made on the usual service-type, 3-inch meter.

The transformer circuit used is shown in Fig. 1. It will be noted that an autotransformer is used to secure ample capacity with small space. The primary of the transformer is tapped in 3-volt steps to secure the proper output voltage on line voltages varying from 105 to 185 volts. The secondary is tapped at 2, 20 and 200 volts, to supply the necessary full voltage for each of the voltmeter scales.

Terminals are provided for the A.C. voltmeter and terminals are also provided to connect the capacity to be measured. A switch is connected across the binding posts marked X. When this switch is closed, the line voltage control may be adjusted to give full-scale reading of the meter. The purpose of the shunt shown in the diagram will be explained later.

In the above circuit, if a condenser is connected across the X terminals, the transformer will cause a current to flow through the condenser and the A.C. voltmeter in series. The greater the capacity, the greater will be the current and deflection of the meter. The calibration of such a meter and circuit is given in Fig. 2A, for 25 cycles and Fig. 2C for 60 cycles. If the meter scales available are not 5, 50 and 200, as in this case, the transformer secondary would have to be redesigned to give voltages equal to the full-scale voltages available.

In this case, the calibration chart or scale could not be affected by the change in voltage directly. The calibration scale would depend inversely on the meter resistance and the frequency of the test voltage.

If the meter had a sensitivity of 1,000 ohms/volt and a 200-volt section of 500 ohms/volt, the capacity calibration would be the same. Figs. 2A and 2C should all be divided by 2.

In order to extend the range of measurements to higher values for measurements of electrolytic condensers, a shunt is provided to vary the resistance of the meter without changing the scale. The shunt reduces the sensitivity of the voltmeter of the 2-volt scale from 500 ohms/volt to 50 ohms/volt, thus multiplying the capacity calibration by 10. This shunt further extends the circuit will draw more current from the tapped transformer. Accordingly the 2-volt section of the transformer has been made capable of carrying greater current than the 2- and 20-volt sections of the secondary. The shunt should not be used except on the winding designed for it.

MEASURING ELECTROLYTIC CONDENSERS

In measuring electrolytic condensers, only the 2-volt tap of the transformer and scale of the meter should be used; 2 volts A.C. is low enough that it is harmless to any electrolytic condenser and enables an approximate measure of its capacity to be made. It should be noted that the method of measuring capacities is open to considerable error if the condenser is partially shoted or has high series resistance. For this reason, an additional check on the condition of the condenser is advisable. If the condenser will take a charge when connected to a source of proper voltage, and discharge again when its terminals are short-circuited, it is generally safe to assume that the condenser leakage is negligible, and that the indicated capacity is sufficiently precise.

In the case of electrolytic condensers, any undesirable series resistance will make the capacity of the condenser ap
PEAR TO BE LESS THAN IT ACTUALLY IS. THIS IS NOT A SERIOUS LIMITATION OF THIS METHOD OF MEASURING CONDENSERS AS A CONDENSER WITH A HIGH SERIES RESISTANCE HAS A LOW FILTERING EFFICIENCY AND SHOULD BE DISCARDED JUST THE SAME AS A LOW-CAPACITY CONDENSER.

IT SHOULD BE NOTED, HOWEVER, THAT WET ELECTROLYTIC CONDENSERS, PARTICULARLY IN THE LARGER SIZES, LOSE THEIR CAPACITY IF THEY ARE NOT IN USE FOR SOME MONTHS. SUCH A CONDENSER, WHEN TESTED ON 2 VOLTS WILL SHOW A CAPACITY OF POSSIBLY 25% LOWER THAN THE SAME CONDENSER AFTER IT HAS BEEN RE-FORMED BY BEING PUT INTO SERVICE ON NORMAL VOLTAGE.

SELECTING PROPER SCALE AND VOLTAGE
When the supposed capacity of the condenser is approximately known, of course, the proper scale and voltage can be selected beforehand, but when the approximate size of the condenser is not known, they must be selected by trial. The secondary tap should correspond with the full-scale voltage of the meter range in use. That is, every time the secondary voltage tap switch is moved, the A.C. voltmeter scale should be changed. These operations should be performed in such order that the voltmeter is not overloaded by excessive voltage.

INDUCTANCE MEASUREMENTS
Inductance measurements cannot be made with the same degree of satisfaction as capacity measurements, largely for the reason that the inductance of an iron-core reactor is not constant, but varies widely under different conditions. In most circuits the direct-current component passing through a reactor or transformer tends to greatly reduce its effective inductance. Similarly the inductance varies greatly with the value of alternating current flowing through its windings. At low values of alternating current the inductance may be comparatively low. As the alternating current is increased, the inductance of the reactor increases until saturation is reached when the inductance again decreases.

In Figs. 2B and 2D we have given the calibration of an A.C. voltmeter taken to have a sensitivity of 2,500 ohms/volt, used in conjunction with the circuit of Fig. 1 to measure inductance on 25 and 60 cycles, respectively. This calibration is given for 2,500 ohms/volt sensitivity rather than for 500 or 1,000 ohms/volt sensitivity as there is less necessity for a correction factor due to the resistance of the inductance. The resistance of the inductance, if appreciable compared to the reactance under test, would cause the reading to be high.

It is possible to use a simple correction chart to compensate for the effect of the resistance to the reactance. The writer has prepared such a chart, which he will be glad to furnish to any Servicemen who are interested.

The calibration charts given in Figs. 2B and 2D may be applied to any other sensitivity of meter used on the same frequency of test voltage. It should be remembered that the inductance calibration is directly proportional to the resistance of the meter. If a 500 ohms/volt meter were used instead of a 2,500 ohms/volt meter, the calibration given for inductance should be divided by 5.

CONSTRUCTION DETAILS OF THE AUTOTRANSFORMER
Now we come to the constructional details of the 25-60 cycle transformer assembly which can be used for this purpose.

The constructor will realize, of course, that there are many modifications that could be made and still achieve the same object. The circuit of the transformer assembly complete is shown in Fig. 1A. The autotransformer principle is used for simplicity and small size.

The cross-section area of the core is 0.9-square inch. The punching used is .025-inch thick and is illustrated in Fig. 3A.

The thickness of the stack of laminations is 1-5/16 ins.

The autotransformer's coil is wound on an insulated tube, 1/32-in. thick with inside dimensions 23/32 x 1-9/32 ins. The length of the tube is 1-9/32 ins. The main winding consists of 5,956 turns of No. 32 enamelled copper wire, 109 turns per layer, approximately 54 full layers and 20 turns on the last layer which is filled level with paper. Between each layer is wound 1 turn of 0.0006-in. Kraft paper, 1-9/32 ins. wide (if fibre end-washers are used to make a complete winding spool, these should be 3/4-in. thick and the Kraft paper between layers will then be 1-1/32 ins. wide instead of 1-9/32 ins.).

See Fig. 3B for taps.

After winding this main section with its proper taps, wind 1 turn of 0.002-in. Kraft paper, 1-9/32 ins. wide. The 2-volt secondary section consists of a single layer of 61 turns of No. 28 enamelled copper wire, wound on top of the previous section.

The final insulation on top of the coil is 1 turn of 0.005-in. treated rope cement paper and 1 turn of 0.004-in. fish paper, both 1-9/32 ins. wide. All starts, finishes and taps should be tied to the coil and protected when crossing the layer by a strip of varnished cloth. The coil should be dried thoroughly and impregnated with any standard thin gum. The complete assembly is illustrated in the photographs of Figs. A and B.

"APARENT" AND "ACTUAL" STEP-UP (OR DOWN) RATIOS
If we were to take an ordinary audio input transformer with step-up ratio of 3 to 1 and apply 20 volts A.C. to the primary, the secondary voltage would be 60 if there were no losses in the transformer or measuring circuit. The effect of any losses would result in the measured secondary voltage being less than the primary voltage times the step-up ratio. With an ordinary A.C. voltmeter having a range of 1,000 ohms/volt and a scale of 200 volts maximum.

(Continued on page 123)
SHORT-CUTS AND KINKS

Three cash prizes are awarded for the most practical Short-Cuts and Kinks published in this department. They are: 1st Prize $10, 2nd Prize $5, 3rd Prize $5. All others judged good, and published, are given Honorable Mention. Send in your pet ideas; they may earn money for you and certainly help others.

FIRST PRIZE—$10.00

USING OLD A.C. VOLTMETERS. Service Men who have old A.C. voltmeters with very low voltage, full-scale, such as 0-3 volts or 0-4 volts, find very little use for them in present day A.C. receivers. However, by the addition of a shop-made transformer, they may be made to read low, medium or high voltages. Such transformers are built with described is sufficiently accurate for all set measurements, even up to 1,000 volts or more by the use of series resistors. See Fig. 1.

An old audio transformer, such as in the RCA catalogues of old, are a good size, the smaller the better. Remove all old windings and use original cardboard core, with side pieces cut to fit, and cement in place to just fit inside window of laminations.

If a 3-V. A.C. Weston 476 is used, which I have, the primary will require about No. 24 or No. 26 enamelled wire, 45 turns, and 4-volt, 60 turns. (Core cross-section divided and squared by 6, will give number of turns required for your particular laminations. If it is 1/16-in. wide and 3/16-in. thick, then 1/16 x 3/16 = between 10 and 11 turns-per-volt. 10 is OK, for it isn't used for any great length of time, and so will not overheat.)

Several layers of tape, varnished cloth or heavy brown paper is shellacked in place, for insulation. Then, start winding the secondary, which is continuous. For the top section, 8 volts, wind 120 turns in even layers, using about No. 28 enamelled wire; for the next tap, wind 110 more (for the 14-V. tap), using No. 32 E.E. wire; then, 360 turns of No. 34 for the 40-volt winding. If there is sufficient room and you want to include a 150- or 160-volt tap, then (for a 150-volt tap) add 1,550 turns of very fine wire, such as No. 38 or No. 40 enamelled, in layers with a thin sheet of paper between each layer.

Having finished the coil, shellac and immediately wind several layers of tape or paper around and shellac. Put the laminations in place and, if a small metal box such as coil shield with lugs for mounting is handy, place in can and fill with pitch or wax; this makes a neat job.

Having only wound to 40 volts, I used resistors (1-watt carbon) for higher voltages, namely, 160 and 750. Use several 1-watt resistors in series for 750-volt reading, as it should be about 6-watt resistor to drop this voltage. It requires about 5,020 ohms for the 150-volt reading and about 21,000 ohms, 6-watt, for the 750-V. reading.

This whole affair can be put in a small box size about 4 x 7 in., and 3 to 4 inches deep. An aluminum panel makes for an attractive-looking product. This arrangement, to avoid shock or firework, must be well insulated! By the simple addition of a right-size resistor to make the meter read full-scale with 110 V. circuit, condensers can be checked, chokes measured, etc. It is the next handiest thing to the ohmmeter, which in my case it matches in size and shape.

D. V. CHAMBERS

SECOND PRIZE—$5.00

IMPROVED DRILL PRESS. While rummaging in my junk-box, I found an old electric sweeper motor and from it I devised the following drill press, which cost me 65c. (See Fig. 2.) It is supported on a 5 1/2 x 4 x 1/4-inch piece of strap-iron, the motor, a chuck, bolts, and odd pieces of wood. The strap-iron is made into 2 L-shaped pieces as shown in Fig. 3, planed out to 4 x 4 near one end with blocks and bolts. The chuck is drilled and tapped to fit the motor's armature and tapped. If the armature is not threaded, a collar may be used and the chuck left as it is. The assembly may be seen in the drawing. The strap-iron pieces form sliding bearings for the 2 x 4. A piece of wood is used as a tongue, being hinged to the 2 x 4 and to the floor. It is a good idea to lengthen the bolt-holes in the floor hinge and leave a little play when bolting down. The other hinge is fastened tightly.

This little press is fine for radio work as it leaves both hands free. The work rest may be the bench with a hole cut for the 2 x 4, or an adjustable rest may be worked out to fit your need.

ROBERT SANFORD

THIRD PRIZE—$5.00

CAR RADIO NOISE BALANCER. Recently I installed a radio set in a car and was able to use the ordinary methods of shielding and suppressing.

After some experimenting I found that the noise was produced by means of a bucking-coil, in the antenna circuit, under the dash of the car. This coil is 5 ins. in diameter (see Fig. 3) and consists of 3 turns of heavy bell-wire, one end of which is connected to the shielded antenna lead of the radio, the other end to the antenna lead-in. By means of very little experimenting, while set in operation and the car running, the exact place or position in which the coil should be mounted can be determined.

When this position is found the coil can be clamped to the speedometer cable by means of 2 metal straps. The coil should be taped together all the way around to make it stiff.

The voltages set up in the coil buckles that set up in the antenna lead-in. No suppressors or shielding is needed.

FLOYD M. GLASS

HONORABLE MENTION

A SIMPLE, COMPACT, 1-PIECE SOLDERING IRON REGULATOR FROM AN OLD ELECTRIC SOCKET. Procure 1 electric light bulb socket, one 1/4-inch and 2 plug receptacles, as shown in Fig. 4A. The pull-chain controls the bulb only. The cutaway hookup of the socket is shown by diagram in Fig. 4B.

To make the regulator from this socket you simply rewire it as shown in Fig. 4C. All this wiring is done within the socket. When through (Continued on page 108)

Fig. 1. Making use of low-scale A.C. voltmeter.

Fig. 2. Ingenious home-made drill press.

Fig. 3. Noise-bucking pick-up coil for car radio.

Fig. 4. Socket adapter soldering iron control.

Fig. 5. Handy test-bench electric outlet.

Fig. 6. Ground clamp makes good battery terminal.

Fig. 7. Tests 'B' batteries under "load" conditions.
SUPERIOR PRESENTS 4 INSTRUMENTS

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SPECIFICATIONS:
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- 0-25 volts D.C.
- 0-50 ma. D.C.
- 15 volts A.C.
- 25 volts A.C.
- 50 ma. A.C.
- 0.1 ma. D.C.
- 0.5 ma. D.C.
- 10 ma. A.C.
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Model 1110-S comes complete with tubes, test leads, carrying handle. Size 12" x 9" x 6 1/2". Shipping weight 15 pounds. Our net price...

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- Designers perform by the use of only five emitters at maximum, and many tests done.

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BOOK REVIEW

Please Say That You Saw It in RADIO-CRAFT


Here is a publication prepared in textbook style which the student in radio will find particularly useful; especially, in view of its being a revised edition of a widely-known radio book for either home or class study.

New practical problems have been added dealing with the circuits and constants upon which activities are based. Of exceptional importance is the fact that detailed information concerning the features of present-day receiver design and other recently developed devices, brief statements of television transmission have been added. Have you ever wondered how and why set designers arrive at component values? Read this book for the answer.

Chapter headings are as follows: Fundamentals; Ohm's Law; Production of Current; Inductance; Capacity; Properties of Alternating-CURRENT Circuits; Resistance; Properties of Cells; Condensers; The Vacuum Tube; The Tube as an Amplifier; Audio Amplifiers; Design of Audio-Frequency Amplifiers; High-Frequency Amplifiers; Detection; Receiving Systems; Rectifiers and Power Apparatus; Oscillators, Transformers, Etc.; Facsimile and Television Transmisison.
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Please Say That You Saw It in RADIO-CRAFT

BEGINNERS' 4-TUBE SUPERHET. "VACATION PORTABLE" (Continued from page 87)

fabled bedspringing to and including a water pipe. No input circuit can be expected to tune efficiently with such a variety, so the trimmer is used to compensate for the mismatch. The R.F. trimmer on the gang condenser should be opened wide, since the manual trimmer takes its place. Alignment should be made with the manual trimmer set at about mid-scale and with an antenna of moderate length. The variable core of the oscillator coil may be found helpful in getting the tuning range set satisfactorily.

Note that the screen-grid of the 1D7G is varied together with the screen-grid of the 1D5GP. This is somewhat contrary to general practice, but it overcomes a certain blocking or overloading of the 1D7G which occurs if the latter is run at full screen-grid voltage when very strong signals are being received. Although no provision was made on this set for headphone operation, this feature may be desired for some applications, so a headphone jack is shown on the circuit diagram. When the phones are plugged in, the speaker is cut out. Due to the fact that no D.C. can reach the headphones, crystal phones may be employed as well as the more common types.

General case and chassis dimensions are given (Fig. 2) to guide those who are starting construction from scratch.

LIST OF PARTS

One Raytheon 1D7G tube;
One Raytheon 1D5GP tube;
One Raytheon 1E5GP tube;
*Two 45-volt batteries;
*One 3-volt battery;
*One 7½-volt battery;
*One 5-inch P.M. dynamic speaker, with transformer to match;
One Meissner I.F. transformer, No. 5740;
One Meissner I.F. transformer, No. 6131;

---CHASSIS LAYOUT---

(1/16" THICK ALUMINUM)

(BEND DOWN ON DOTTED LINES)

---FRONT PANEL LAYOUT---

(1/16" THICK ALUMINUM)

---CARRYING CASE---

NOTE—ALL DIMENSIONS ARE IN SIDE (COVER IS 1 1/2 DEEP).

Fig. 2. Although of course any desired metal may be used for the chassis of the "Vacation Portable," aluminum is particularly recommended in view of its lightness; it's easy to work, too. The carrying case can be made from cigarbox wood, but the sides are fairly standard and little trouble should be experienced in obtaining the case already made. It should be fairly sturdy, however, because the batteries add considerable weight.

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A perfectly matched assembly—25 watts undistorted beam power—3 separately controlled high gain input channels (2 mike, 1 phono)—Line input 135 watts, 110V, 50—60 cycle. Tubes: 3-6P5, 1-6C5, 2-6L6G, 1-5Z3. Two Wright-DeCoster 12" P.M. dynamic power speakers with 1½" bakelite voice coils—power handling capacity each speaker 15 watts.

Write for complete catalog and discounts

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TOMORROW'S TELEVISION SERVICING

(Continued from page 81)

Students at American Television Institute are taught to work with actual television apparatus and to build up working units from the requisite components. Here you see 2 of the students putting the finishing touches to the cathode-ray equipment of a television receiver.

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Give YOU a pocket card of credentials. Give YOU our big expert technical staff as a department in your service business. We will give you the RIGHT answers to your "impossible" service problems. Give YOU (if you belong to a local servicemen's club) access to our National Speakers' Bureau — future speakers for your meetings. Give YOU advance technical information on new circuits.

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The RSA is an independent organization, owned and operated — NOT FOR PROFIT — by its members. It has the backing of the entire Radio Industry in its aim to make servicing a real business, with profits. The idea is "REAL PROFIT" at the end of each week!

The RSA is already the largest and most powerful group the service business has ever seen. JOIN NOW and get in on all its benefits!

RADIO SERVICEMEN OF AMERICA

JOE MARTY, JR., Executive Sec., 304 S. Dearborn St., Chicago.

MAIL THIS COUPON —

RADIO SERVICEMEN of AMERICA

304 South Dearborn St., Chicago, Ill.

Gentlemen: I wish to make application for membership in the Radio Servicemen of America.

Name ________________________________

Home Address __________________________

City ____________________ State _______

Firm Name ____________________________

Address ________________________________

I am enclosing $2.00 National Valury Due.

Bill me $2.00 National Valury Due.

Please Say That You Saw It in RADIO-CRAFT

SHORT-CUTS AND KINKS

(Continued from page 104)

HONORABLE MENTION

HANDY SERVICE BENCH OUTLETS. Here's how I use an A.C.-D.C. 300-ohm cord instead of a regular electric cord, on the service bench. I have connected a 3-wire cord across 2 double electric sockets, using the 2 lower connections for 115-volt outlets, and the 2 upper for miscellaneous, small A.C. voltage tests, which are obtained by changing light bulbs of different watts, in one socket and using the other for test leads. (See Fig. 1.)

Placing a 7-watt lamp in one socket, you get 90 volts at the other. For 10-watt lamp you get 80 volts: 25-watt lamp, 60 volts: 60-watt lamp, 25 volts: 75-watt lamp, 15 volts; and 100-watt lamp, 6½ volts.

W. F. ONDER

HONORABLE MENTION

PERMANENT BATTERY CLAMP. In servicing a car radio and other 6-volt jobs I often misplaced my battery terminal clamps. It was on one of these occasions I tried using a ground clamp that was lying on the bench. I found that this worked out swell. Now I just leave this clamp permanently on the battery. (See Fig. 6.) They do not pop off when you turn the set over for voltage readings.

JIM GERTICH

HONORABLE MENTION

BATTERY TESTER. In Fig. 7 is shown a "B" battery tester that will test "B" batteries under load.

Service Men who do rural radio repairing will find this tester very handy. The diagram is self-explanatory. A switch may be hooked in series with the milliammeter lead to disconnect the meter from the circuit so the meters may be used for other purposes.

Operation is very simple. Connect the test leads to the battery to be tested. Be sure the potentiometer is turned all the way to the left. Turn the potentiometer slowly to the right, watching the milliammeter till the reading is between 20 and 30. The voltmeter reading will tell you what shape the battery is in. Open or high-resistance connections may be easily found in this procedure.

EDWIN BOEHM

HONORABLE MENTION

TIME SWITCH. Enclosed you will find an idea of mine which I wish to enter in the Short-Cut ideas contest. It is a simple, inexpensive method of turning on a radio set at any pre-determined time and can be assembled in a few hours. As the diagrams herewith show the only parts needed are an alarm clock, a phonograph stop switch and a thin strip of spring brass, bent as per drawing, its size depending on the type of alarm clock used.

The operation is as follows:—Turn on your radio set and tune in the station you want to hear next morning. Then set switch arm "A" (Fig. 8) in the "off" position and rest it on the alarm clock. The alarm will be set for the time shown in Fig. 8B. Now set your alarm clock in the usual way and forget about it all. When the alarm goes off the alarm winding handle will unwind or turn, pushing up switch arm "A" whichleck and mechanically turns on the radio receiver, lights, etc.

This little device can be made for the small sum of 65c (cost of switch) provided you already have the alarm clock. The switch assembly, for appearance sake, can be enclosed in a small box.

A. A. SCHMIDT

HONORABLE MENTION

NOVEL MICROPHONE STAND. An excellent microphone stand of the type used in broadcasting studios can be easily made from a discarded dressmaker’s figure. (See Fig. 9.) These figures can be obtained for next to nothing, and at the stands that they are provided with are designed to support considerable weight, they will be found to be far sturdier than the usual microphone stand. The better-quality figures are provided with a pedal or thumbcrew for adjusting the height, and all that is necessary to convert them into a microphone stand is the removal of the figure.

GEOFF NICHOLASTEV, JR.

HONORABLE MENTION

ON-OFF ALARM LEVER

SWITCH ARM 'A'

BOLT SWITCH TO BRASS BRACKET AND SOLDER. AFTER SWITCH IS ADJUSTED TO CLOCK.

W. F. ONDER

HONORABLE MENTION

SERVICEMEN!

October Radio-Craft will tell you how to make a 38-range, bench-type radio set tester, with PUSHPULL SELECTION of the meter ranges!
NEW CIRCUITS IN MODERN RADIO RECEIVERS
(Continued from page 88)

better quality action for a detector limited to a low-voltage supply. Any change in the drop across the cathode resistor, due to changes in modulation level at the transmitter, is transmitted through grid C1 to the grid-return and thus keeps the cathode and grid at a relatively constant potential difference with respect to such signal change so that its operation is more uniform. It greatly reduces the tendency toward degeneration (which is undesirable at this point in the circuit). The suppressor-grid is connected to the ground side of the filament and thus is somewhat more negative than the cathode. While this causes a decrease in the Gm of the tube and its gain, it provides a more uniform operating characteristic through the fact that the suppressor-grid is maintained at a constant potential. It will permit the detector to handle a greater signal with these other advantages.

(4) VIBRATOR WINDING USED FOR FILAMENT SUPPLY

Crosley Model 66T. A highly efficient and effective method of adapting the power supply of a circuit to 110 volts A.C. and 6 volts D.C. is used.

Figure 1D is the circuit of a universal input transformer having a 110-volt primary winding for use on 110 volts and a single other primary winding acting either as the vibrator primary or as a filament secondary when 110 volts A.C. is used. The filaments are all in parallel, the rectifier being isolated from the rest with chokes. In the position of all the switch points shown (position 1) the 110-volt supply is used. Note that the vibrator winding has a tap to provide 6.3 volts (slightly higher than that required for the vibrator primary). In the other position (2) of the switch points which are all controlled by one knob the 110-volt primary is disconnected and the vibrator and 6-volt supply comes into use. In this position of the switch the filaments are all supplied by the 6-volt battery.

(5) ELECTROLYTIC CELL SERVES FOR DETECTOR BIAS AND R.F. MINIMUM BIAS

Fairbanks-Morse Model 42, Power detector using the control-grid of a 1Si tube and an electrolytic cell to bias it, and supply the controlled tubes with the proper minimum bias, is features in the circuit.

Sufficient signal in this 2nd-detector grid (see Fig. 1E) will be rectified by the grid filament circuit and charge the electrolytic cell. This will provide a 2nd-detector bias and a minimum bias for the 1st-detector and I.F. tube. This will be maintained as long as is the signal peak at the grid antenna of the grid filament circuit and the voltage of the bias cell. A.V.C. voltage will add to this at the grid end of the circuit but when the signal is extremely low, all bias values will be likewise low and the sensitivity of the receiver will be increased accordingly.

UTILITY AUTO RADIO ANTENNAS

Anyone who looks at a modern radio-equipped car no doubt gets a lot of pleasure from the sophisticated out-croppings due to present-day radio antennas. Illustrations 1, 2 and 3 (left to right) show the common garden variety of auto antenna. But why not have utility combined with beauty? (5).

NOT A FIRECRACKER IN A CARLOAD

because these highly efficient etched-foil dry electrolytes are equipped with special vents to permit the normal discharge of the harmless, odorless electrolytic vapors. The new Cornell-Dubilier type BR “Beavers” are “over-size” in quality, “under-size” in physical dimensions—designed to give the kind of service you’d expect from larger, more bulky units. C.D type BR “Beavers” are ideal replacement filters—attractively priced, too!

A. V. C. SUPPLY

For the A. V. C. supply for the new detector and the second detector, a voltage of 150 volts is used. This is derived from a 12-volt battery by using a D.C. to A.C. changer and a D.C. to A.C. transformer. The 100-watt supply for the A. V. C. is derived from the 12-volt battery by using a D.C. to A.C. transformer. The 100-watt supply for the A. V. C. is derived from the 12-volt battery by using a D.C. to A.C. transformer.
A. C. ELECTRICAL POWER
from a windmill, from available Waterpower, from your Automobile, from your Motorcyle, from your Bicycles, from Pedaloe-machines (for the transportable Radio Transmitters, Strong Floodlights, Advertising Signals) do you want to operate AC Radio sets from 25 V. DC form Light systems; operate two generators in series to get 200 V. AC; obtain two new basic AC, etc., etc.

There Are Over 25 Applications of some of which are:
A. C. Dynamo lighting from stutis to ten 99 Watt, 110 Volt lamps. Start Wave Transmitter supplying 111 Volt AC for controlling 32 Electric Operated, for Control of Electric AC power, for operating Telephones, for controlling Address System, for controlling Electric Elevators, for controlling Electric Address Systems, for operating Elevator, Puddle Address Systems, Electric Elevators on motor boating, in Electric Lighting, etc. Using Lighting, Solar, "fire" apparatus, Telephony, Puddle Watersheet for Lighting or other purpose. Airplane for lighting strong search lights or electric signs. Laboratory work, etc., etc.

4. 4 or 5 HP, needed to run generator.

BLUEPRINT 22 x 28 in. and Fire-Page 89/3 12 in. INSTRUCTION SHEETS and BLUE PRINT with Generator.

Send $2.90 deposit below C.O.D.

WELLWORTH TRADING COMPANY

AUGUST, 1938

RADIO-CRAFT

Fig. 1. Terminal connections of the new tubes described in this article.

NEW TUBES FOR TELEVISION AND RADIO

(Continued from page 89)

marily for electronic control applications where small load currents are involved, and will provide the same degree of sensitivity and circuit stability that is inherent in the higher capacity thyratrons.

Any relays which will operate within the tube's ratings may be connected directly in the plate circuit. Thus, no additional amplification is necessary and the whole control unit can be made very compact, which is a definite advantage in most applications.

Terminal connections are shown in Fig. 1; data, Table IV.

The data on the types 902, 1851 and OA4G tubes were supplied by courtesy of RCA Victor Co., Radio Division, and address of manufacturer of the type WL-629 will be supplied upon request to the Information Bureau of Radio-Craft. 902—Table I

<table>
<thead>
<tr>
<th>Description</th>
<th>Voltage (A.C. or D.C.)</th>
<th>Current (Amp.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater voltage</td>
<td>6.3 volts</td>
<td>0.6 amperes</td>
<td></td>
</tr>
<tr>
<td>Focus voltage</td>
<td>175 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control voltage</td>
<td>180 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak voltage</td>
<td>350 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>5 max. milliwatts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typical operation: Heater voltage</td>
<td>2.3 6.3 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode voltage</td>
<td>400 600 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid voltage</td>
<td>100 150 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted</td>
<td>For suitable luminous spot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deflection sensitivity:</td>
<td>0.08 0.10 mm./volt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input</td>
<td>11.5 mmf.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>3.5 mmf.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum overall length</td>
<td>3-1/2 ins.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum diameter</td>
<td>1-5/8 ins.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1851—Table II

<table>
<thead>
<tr>
<th>Description</th>
<th>Voltage (A.C. or D.C.)</th>
<th>Current (Amp.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater voltage</td>
<td>6.3 volts</td>
<td>0.45 amperes</td>
<td></td>
</tr>
<tr>
<td>Direct interelectrode capacities:</td>
<td>0.08 0.10 mm./volt, D.C.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-to-plate</td>
<td>0.62 max. mmf.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input</td>
<td>11.5 mmf.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>3.5 mmf.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum overall length</td>
<td>3-1/2 ins.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum diameter</td>
<td>1-5/8 ins.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Maximum Ratings and Typical Operating Conditions

Plate voltage | 300 max. volts |
Screen-grid voltage | 150 max. volts |
Screen-grid supply voltage | 300 max. volts |
Typical operation and characteristics: | Condition I | Condition II |
Plate voltage | 300 volts |
Screen-grid supply voltage | 300 volts |

Please Say That You Saw It in RAdio-Craft

AUGUST, 1938

Fig. 2. At A is shown a schematic relay circuit using the new cold-cathode glow-discharge relay triode. At B is shown the grid-glow or thyatron-type tube in a simple relay control connection.
Typical television-anode voltage (peak) 70 max. volts. R.F.-anode voltage 5.5 min. volts. Sum of A.C. and R.F.-anode voltages (peak) 110 min. volts (A schematic relay circuit, using the type 6AK5 tube in A.C. operation, is shown in Fig. 2A.)

ANNOUNCEMENTS made at intervals on the video channel:
W3XG - Approx. schedules, Tuesday, 7:30 p.m., Thursday, 8:00 p.m., C.B.T. No audio channel but announcements are sent on the video channel. All pictures are broadcast from 35 mm. film.
W3XX - Approx. schedule, Tuesday and Thursday, 7:15 p.m.
W3XAX - Schedules uncertain.
W3XAO - Announcement title reading, "W3XO - Wunsch, San Francisco, Calif.," simultaneously, Washington Post March, by Sousa, on aural. Also, 38 horizontal bright bars, on the visual; simultaneous 100-cycle tone on aural.
Operating time schedules: nightly, except Sunday and holidays, 6:30 to 7:15 p.m. and Monday 9:00 to 10:00 A.M., Wednesday 11:00 to 12:00 noon and Saturday 2:00 to 3:00 P.M. (additional schedules occasionally). Has been on the air continuously on announced schedules since first official broadcast on 44.3 mc., December 25, 1931. Images recognition and demonstration at 20 miles.
W3XPF - Characteristic signal or symbol not standardized at present. Scanning equipment at receiver: C.R. sync, circuits adopted narrow vertical sync. pulses and amplitude selection. Operating time schedules experimental; no fixed schedule.
W3XAL - Schedules indefinite. Identifying signal or symbol W3X.
W3XG - Approx. schedule Monday to Friday, 8:00 to 4:00 P.M.
W3XBS - No identifying signal or symbol. No regular schedule.
W3XG - Operating schedule irregular. Field test only, one vertical service, synchronizing for best interlacing. True high-fidelity due to transmission of video frequencies up to 4.2 mc.
W3XDR - Identifying symbol is RP (trade-mark). Daylight operation only. No schedule. Equipment laboratory development rather than regular programming.
W3XFP - Operating hours irregular. Sets in area recording reception. Several experimental television receivers have been set up within 2 or 3 miles of each other. The receivers are a part of the development used in television research. The frequency band occupied by the transmitter is 2.5 mc. on each side of the carrier. This band width is close on the air and well outside the overall characteristic of the system. The frequency has served as the basis for the design of the television and sound transmitters installed in the Empire State Building in New York City.
This station operates a 30-kw. sound and image transmitter as licensed by the F.C.C. Transmitter is portable or mobile in vicinity of Camden, N. J.
W3X2 - No identifying signal or symbol. Approximate schedule is Monday, Tuesday and Thursday, 10:00 to 1:00 A.M. Television broadcast is on 45 mc. Now developing equipment to broadcast sight and sound from standard 24-frame film. Triode spiral multiple 45,000, 125 lines is used for sending motion picture film while broadcasting talking pictures. W3XAT for pictures and W3XGY for sound.
W3XBT - No regular operating schedules.
W3XFP - Operating schedules irregular. Field test only. Phases are adopted for first synchronizing for best interlacing: True high-fidelity due to transmission of video frequencies up to 4.2 mc.
W3XAD - Operating hours irregular.
Sets in area recording reception - Several experimental television receivers set up within a radius of 2 to 3 miles for experimental purposes.

Additional information - This station is used by the Manufacturers Radio Equipment Co. for development of experimental broadcast service.

This station operates a 50-watt sound and image transmitter as licensed by the F.C.C. The frequency band occupied by the transmitter is 2.5 mc. on each side of the carrier. This is determined by measuring the overall characteristic of the system. Transmitter is portable or mobile in vicinity of Camden, N. J.
W3XG - Operating hours irregular. Sets in area recording reception - Several experimental television receivers set up within a radius of 2 to 3 miles for experimental purposes.

Please Say That You Saw it in RADIO-CRAFT
NEW ULTRA-Flexible P.A. AMPLIFIERS
(Continued from page 95)

Proceeding along this line the writer has developed the units illustrated in Fig. A. At the left is the transmitter and fully hum-free driver and power amplifier developing 25 watts output at not over 3V total harmonic distortion when supplied with a 1-volt signal. Next to it is another desirable innovation in p.a. speakers—a really efficient 15-in. loudspeaker conveying 15 lbs., the electrostatic-conversion efficiency of which increases effective sound output to compare with that of a 50-watt amplifier carrying customary loudspeakers. The small box at the right is a completely self-powered A.C. or D.C., 2-channel preamplifier-mixer having one high-gain and one line-fidelity channel. One—or two numbers with outputs connected in parallel—may feed one, or a number, of the power amplifiers through up to 50 ft. of ordinary shielded microphone cable—or at a greater distance, through No. 19 twisted telephone pair if simple and inexpensive plate-to-line and line-to-grid matching transfer lines are placed at either end of longer lines. The new dynamic microphone, having high output of -52 db. and high-fidelity frequency response, gives a good size comparison of these units.

Each may be easily assembled from standard, readily available parts. The units seen in Fig. A make up as a complete A system having one input of 105 db. gain and a second of 67 db., as for phonograph or radio inputs, a frequency response flat to 2,000, from 30 to 80,000 cycles including loudspeaker, a power output of 20 watts, completely hum-free operation and the toll convenience, reliability and volume control in a small, easily transported and self-powered unit.

The preamplifier is diagrammed in Fig. 1. It is A.C. or D.C. operated through a 156-ohm resistor cord and plug of 610-ampere current carrying capacity, 15 used as a rectifier, and a filter consisting of two 8-mf., 200-volt dry electrolytic condensers in conjunction with a 4,000-ohm, 1-watt resistor-filter "choke." One 6J7G is used instead of an ordinary microphone cable used for low-level microphone operation, and feeds the one triode of a 6FQ9—two tubes are used for the output of both channels. The volume, or mixer, control for this channel follows the 6J7G so that at a point of high signal, it will introduce no contact noise in operation. The low-gain channel feeds through the second volume-mixer control into the second triode of the 6FQ9, which functions as an electronic mixer since its plates are in parallel. Provided with plate load resistor and 0.025-mf. output coupling condenser the only terminals may connect across the grid leak resistor of a following amplifier tube, or to the primary of any grid plate-to-line or other coupled transformer. Parts values are all indicated on the diagrams—and if ordered the preamplifier could be arranged to obtain plate and filament power through the power amplifier—which it can easily supply as well as an extra 15 watts of power for exciting the fields of additional speakers, powering a radio receiver, or any desired use.

In constructing such a preamplifier, it should be made small and compact for convenience, with short wiring connections, and a very short 6J7G grid lead to the microphone jack should be kept away from A.C. wiring, as well as be used only with a shielded microphone cable and plug such as is always necessary with high-gain amplifiers. Microphone channel gain is 53 db. and phonograph channel gain 23 db. No other special precautions are necessary—except to reverse the power plug if at first the circuitry does not work. The power amplifier is diagrammed in Fig. 2. It consists of one triode of a 6FQ9 as voltage amplifier, its second triode as inverse-feedback, balanced phase-inverter driving the tube beam power tubes to 20 watts output class AB, and a 123 rectifier. As the circuit indicates, it is simply itself, yet presence of both terminals may militate—a total of 105 for both preamplifier and power amplifier. One 6-prong socket is for speaker connection, while the second 4-prong socket provides input connections to grid and ground, 8.5 volts A.C. at 2.7 amperes for heater and 275 to 300 volts at 100 ma. for plate or additional speaker high frequency field power. The specified 16-in. giant speaker also receives 15 watts of field power through its plug connections to its series and shunt fields.

Though simple, but quite meticulous, design of both circuits, excellent frequency response, high gain, almost negligible distortion and a good 50 watts of power are obtained with an ordinary D.C. power plug if at first the circuitry does not work. The preamplifier is only 6 1/2 x 3 1/2 in. and the power amplifier 16 x 5 1/2 x 4 in. All parts are easily obtained in this country and in Europe.

A Dicessor tube, with the associated scanning and focusing coils and amplifier, is mounted closely adjacent to the projector, and is associated with the usual horizontal and vertical scanning and scanning power supplies and controls.

This development is believed to be a very definite contribution to the motion picture art, making it possible to reproduce motion picture film of a higher degree of excellence than is usually obtained in this country and in Europe.

SUITE DISSECTOR TUBE

The technique of building the Dissector tubes utilised with this projector has progressed to a point where very excellent sensitivity is obtained. These tubes include a stage D.C. "multiplier," a product of the Farnsworth organization, which multiplies the photoelectric current and makes it further amplified by thermionic amplifiers. These tubes inherently give excellent contrast and definition, as is generally recognised in this country and in Europe.

MANY NEW RADIO BOOKS

have been added to the ever-popular RADIO-CRAFT LIBRARY SERIES. Please turn to page 174 and read the announcement on all the books in this series.

Please Say That You Saw It in RADIO-CRAFT
TELEVISION EXPERIMENTS
WITH A SERVICING 'SCOPE

(Continued from page 85)

in frequency between the two types of pulses. The complete separator-oscillator unit may be partially tested before the vision or video receiver is built. A sound or audio (the audible, or "tele-audio") portion of the television program as we call it to avoid confusion with the odd-sounding video or image portion of the program—Editor! receiver or converter tuning to 46.5 megacycles can be used for the test. A sound receiver will pass the frames, synch. pulses with a min. and weaken the line synch. pulses very materially.

TESTING "THE WORKS"

To test the complete set-up, tune the receive to the television signal. You can recognize the signal by its characteristic sound. It is an unvarying harsh receiver. The power may be obtained directly from the oscilloscope. The author found that this was very easy with the Du Mont type 164 service 'scope; it will probably be relatively easy with many other make sets. Connect the wiring diagram supplied with the unit by the manufacturer. Terminals may be mounted on the oscilloscope case so that it can be easily disconnected and taken out to a job if need be.

The power also may be obtained from any conveniently available power pack. Connect the vertical oscillator to the "V" terminal on your 'scope. Turn the amplifying control knob so that all resistance is "in"; set the synch. pulse intensity control on the oscilloscope at any high point. Adjust (by means of the controls on the oscilloscope) the size, shape and intensity of the raster or pattern appearing in the oscilloscope window. Now bring the amplifying control knob up until the "raster" begins to "dance"; reduce this control until the "dancing" just stops. Frames will now be observed on the screen. This frame will probably be running away either up or down. Adjust the frame frequency control knob. The frames will slow down until they will "lock" into a steady position. Further turning of the frame frequency adjustment knob in the same direction will cause the frames to gradually resume their running away but now in the opposite direction. If the frames fail to lock into a steady position, advance the synch. pulse intensity control until they do.

Let us disallow you right now if you have any idea that the sound receiver will be able to put pictures on your screen. The television carrier is 60 cycle buzz at 15 megacycles; a sound receiver will pass a band of frequencies less than 15,000 cycles wide or 0.01-megacycle. (Television carrier with sidebands varies 3 megacycles.)

The author, having obtained good pictures with a receiver made in 1933-'34 with the old broad-definition 60-line television set-up, has made arduous and exhaustive tests on a variety of sound receivers to obtain results that will enable him to pass a broad broadcast band but found that there is no superheterodyne receiver at present on the market with an L.P. sufficiently high to permit of enough "broadening". The test on T.R.F. receivers, on the other hand, varies when such broadbanding is attempted.

The video receiver to be described in a forthcoming issue, however, has tubes having an extremely high amplification factor and made especially for television (RCA type 1651) so that enough gain may be retained in the broad-band tuner and video frequency amplifier.

The author of this article is instructor in Applied Electricity at New York City's Brooklyn Technical High School; he is also operator at WNYC Auxiliary at the School.

LIST OF PARTS FOR SEPARATOR—OSCILLATOR

One Cornell-Dubilier condenser, type DTHI, 0.2-mf., 600 V., C1;
One Solar condenser, 0.1-mf., 1,600 V., C2;
Two Cornell-Dubilier condensers, type DTHI, 0.1-mf., 600 V., C3, C4;
One Cornell-Dubilier condenser, type DTMII, 0.01-mf., 600 V., C5;
One Centralab resistor, type 648 potentiometer, 4 mega., R1;
One Centralab resistor, type 648 potentiometer, 5,000 ohms, R2;
One Centralab resistor, type 648 potentiometer, 15,000 ohms, H1;
One I.R.C. resistor, 1/2-W., 0.1-meg., R4;
One I.R.C. resistor, 1/2-W., 1,000 ohms, R5;
One I.R.C. resistor, 2-W., 0.1-meg., R6;
One I.R.C. resistor, 1/2-W., 1 meg., R7;
Two I.R.C. resistors, 1/2-W., 15,000 ohms, R8, R9;
One I.R.C. resistor, 1/2-W., 10,000 ohms, R10;
One I.R.C. resistor, 1/2-W., 3,000 ohms, R11;
One Du Mont 1/2-inch choke coil without core, L1;
One Du Mont type 855 tube;
One National Union type 75 tube;
One National Union type 6HBG tube;
One aluminum panel 7 x 10 ins. high, 1/16-in. stock;
one iron chassis, 7 x 9 x 2 ins. high, 1/16-in. stock;
one 4-connection terminal strip, and insulators;
one 5-connection terminal strip, and insulators;
Five knobs;
Two 6-prong sockets;
one octal socket.

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Calling All Servicemen!!

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TECHNIQUES

The TECO T-20 Set Tester is a complete testing laboratory that includes all the necessary equipment to test any type of receiver. It is designed to be easy to use and to provide accurate results. The TECO T-20 Set Tester is a great value for the money and is sure to be a valuable addition to any service shop.

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TECHNOLOGY

The TECO T-20 Set Tester is a state-of-the-art testing laboratory. It is designed to be easy to use and to provide accurate results. The TECO T-20 Set Tester is a great value for the money and is sure to be a valuable addition to any service shop.

TECHNICAL SPECIFICATIONS

The TECO T-20 Set Tester is a complete testing laboratory that includes all the necessary equipment to test any type of receiver. It is designed to be easy to use and to provide accurate results. The TECO T-20 Set Tester is a great value for the money and is sure to be a valuable addition to any service shop.

TEST EQUIPMENT CO. OF AMERICA

139 Cedar Street, New York, N. Y.
system may produce multiple signals of sufficient intensity and time-phase displacement to be objectionable.

TRANSMISSION LINE REFLECTIONS

Under ordinary conditions, at most installations, it is necessary to use transmission lines be
tween the antenna proper and the receiver in order to control properly the point of signal
pick-up. If the maximum dimension of the antenna system (transmission line plus an
tenna) is of the order of 1/2 wavelength, the line is not properly balanced and terminated at
the receiver, reflections in the antenna net
work may cause a loss of detail in the repro-
duced picture.

Thus the problem of preventing blurring or
double images can usually be divided into the following 2 parts:
1st—The antenna must be made non-suscepti-
ble to strong secondary waves from external
reflecting media; and
2nd—The antenna and its transmission line
must be so arranged that reflections from the receiver end of the sys-
tem can not bound back to the outer end of the antenna and be reflected there to re-enter
the receiver as a delayed signal.

It is difficult to describe in words the appear-
ance of images of multiple-secondary waves in
reception, and difficult to show it clearly by
illustrations produced by the photographic and
printing processes. Figure B1 to B4 are views show-
ing a small section of a Kinescope screen reproducing a transmitted picture, under different conditions of multiple signal reception. The illustrations are of course
not clear or representative of the general appear-
ance of the screen when viewed by the eye. These figures are intended merely to show the relative effects of antenna change. Each set was taken on
the same receiver with different antennas, but
without any changes in receiver tuning. A de-
tailed description of the appearance and the ef-
effects of each of the received image will be given later.

SOURCE OF SPACE WAVE REFLECTIONS

It is to be understood that the reflecting me-
dium need not be a metallic object. The specific
inductivities of conducting stone, brick, paving
material, and ordinary soil, are sufficient-
ly greater than that of air to have high effi-
cients of reflection for television frequencies
at some angle to the horizontal. Therefore almost any surface can act as a reflector, if its dimen-
sions are comparable to, or greater than, one-half
wavelength.

If the transmitting antenna is within line of
sight of the receiver antenna, and a plane
surface parallel to the line of sight is located be-
tween the two and within sight of both, the
strength and direction of reflected energy will
depend upon all of the dimensions of the
g eo met rical orientation of the 3 objects.
However, it can be shown by multiple calcula-
tions that only within a radius, from the transmitter,
of about 6 times the combined transmittin
and receiving antenna heights (above such a
surface) can reflections of this nature be suf-
ficiently delayed to cause a loss of detail in the
reproduced image. This, of course, is based
on our present standard of 441-line, 30-frame per
second transmission of the same-order of re-
cieving locations, more than a mile or two from
the transmitter, where reflections are trouble-
some, the reflected energy reaching some plane
other than that parallel to the ground.

Large buildings surrounding a receiving loca-
tion offer ample opportunity for multiple-path
reception even when the transmitting and re-
cieving antennas are within line of sight. If the
are hidden from each other by tall buildings
or by hills, the direct signal may be so greatly
attenuated that the reflected energy exceeds that of the direct path. Use example this
was noticed recently at a receiving location
where there is a big hill located at the trans-
mitting antenna by a nearby building. In this
case, the single strong reflected wave produced
was quite strong, and which image position
and intensity indicated it had travelled about 300 feet further than the direct wave. The receiving doublet was rotated to a position where the large direct signal (which was much the weaker of the
two) and good reproduction was obtained. The
most satisfactory indicator for determin-
ing the presence of undesired reflected waves and
for aiding in the determination of their source, is a tape recording of the received signal
on a probable doublet on the end of a long pole. It is necessary, of course, that the transmitter be in operation at the time of test. The transmitted image be stationary and of such a nature that either blurs or blackens (detected at the edge of vertical lines) or the presence of the image, is readily apparent. A single black verti-
cal in the middle of a white background would
sufficient.

The effect of orientation and rotation of the
portable doublet on the direct and reflected signal, is best determined by the receiver, together with a calculation of the relative signal in path lengths of the displacement of the two images on the screen, will usually indicate the probable source of the
reflection quite accurately. In many cases such information may turn out to be of
only academic interest, since it will often be
found that the correct answer to the problem of
proper location and construction of the fixed re-
cieving antenna can be determined only by empir-
ical investigation.

MINIMIZING SECONDARY SIGNALS

Probably the most generally useful type of televi-
sion-receiving antenna is the double, or double-double, connected to the re-
ciever by means of a low-impedance, twist-

ded transmission line. It is, however, possible to reduc-
e receiving locations this will undoubtedly com-
pletely satisfactorily receive a normal case and
thought are in its installation. Even in a
many places where multiple-path reception is
not the receiver, the same type
may be made to serve satisfactorily by orientation to
minimize the reflected signal, or by shielding it from
the reflecting surface. This may be done by placing it in proper relation to existing con-
ductors such as metal flashings, copings, eaves-
trims, parapet walls, etc. or by screening it
exclusively by trying different positions and noting the
foregoing. Another method of shielding a receiving doublet from reflected waves is
place to a second, unloaded dipole near it and in
the same orientation. This may be done by
negative values of light intensity. This was
followed by 5 more reflected signals varying in
time of arrival and amplitude. The last of
these is displaced by an amount which indicated
that it had travelled 3.8 microseconds longer,
and thus about 3,700 feet further, than the
direct wave.

It is interesting to note that in this case
orizontal synchronisation a result was
satisfactorily. The whole pater on the
le left as though the receiver had synchronised
on the received signal which was un-
doubtedly due to partial destruction.
the true horizontal pulse by the strong,
short-delay single-path receivers. Figure B2 was
taken with the doublet and transmission line connected normally to the
receiver and with the doublet adjusted to that point where the
minimal secondary images. However, it can be
seen that these were not completely satisfactory for good reception. Two principal
reflections are still apparent. These are displaced one from another and are thus of
800 feet and 2,300 feet. A very faint trace of the
doublet received signal, which is strong in
B1, still remains.

The antenna for Fig. B3 was the same as for
Fig. B2 except that one end of the doublet was
lengthened by adding a 1/2-wavelength wire

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ANY TELEVISION ANTENNA FOR GOOD RECEIPT?

(Continued from page 55)
BEHAVIOR OF TRANSMISSION LINE AND LONG WIRE ANTENNAS

The long-wire antenna at the License Laboratory is necessary only because its directional characteristics, if correctly terminated, are in direct to reflected-signal ratio. At, or near, the boundaries of the service area of a television transmitter it is sometimes necessary to use something other than a simple dipole and twisted pair for the antenna, since this will raise the signal well above the receiver's hiss level.

Rubber-dielectric, twisted-pair lines dissipate a considerable amount of the received energy if they are many wavelengths long. Measurement of several types of such lines indicates that the average attenuation to be expected is at least 15.6 and 2.8 db per wavelength at 50 mc. Therefore, a pair in signal strength may often be obtained by the use of an open-wire line, particularly if the distance from the antenna to the receiver is 500 feet or more. The attenuation of the average, close-spaced, open-wire line is about one-tenth of that of twisted pairs. However, if this is used, its increased impedance will cause the antenna to operate less efficiently unless the two are connected together in such a manner that the damping of the antenna is about the same as with the lower-impedance line. This can be done by the use of the well-known Y connection which is common in amateur transmitter practice.

It is also necessary for the input impedance of the receiver to be at least approximately matched to the higher-impedance line in order to realize the increased-signal level. In some recent tests it has been found that small reactive impedances as inductive component as part of the input impedance at the balanced-input terminals of the receiver may increase the impedance of this line input a measured about 100 ohms; therefore, when using a 100-ohm line, two small series condensers (one in each wire) were inserted to cancel the reactance. If, however, the reactance was large, the input resistance became 500 ohms, which was the impedance of the open-wire line. This made it possible to add a parallel behavior of the two lines without making changes in the receiver input-coupling circuit.

Under some conditions the energy picked up by the 2 wires of the transmission line acting in parallel may exceed that in the antenna proper. If there is no receiver input in particular, is well balanced, ground, the low from antenna cannot enter the receiver. If, however, the circuit does exist, the energy from this source may give rise to considerable trouble. This is particularly true if the entire length of line is greater than 100 feet or more. In this case the unwanted signals may be reflected back and forth between the receiver and the outer end of the antenna producing a new image, slightly displaced from the previous one, on the screen and thereby obliterating much of the horizontal detail.

The energy loss in twisted-pair lines is usually sufficient to cause a loss in them (back and forth) for a sufficient length of time to cause blurred reproduction before being attenuated sufficiently. However, energy travelling on the 2 wires in parallel is often subjected to much less attenuation and can travel for much greater distances. Therefore, the system allows some of it to enter the receiver.

A marked example of this effect was noticed recently. When the receiver was doubled and twisted-pair line gave no indication of extraneous reflections, but the signal level (about 900 microvolts) was somewhat too low for a good signal-to-receiver-noise ratio. Therefore, it was decided to install some type of long-wire antenna and open-wire line as an experiment to determine just how much this could be increased without resorting to means other than those which will be at the disposal of the average Serviceman. Existing supports were not available for a rhombic antenna which would have had to extend from the lead-in point in a direction toward the transmitter. Therefore a single, 5-wavelength antenna, was placed between 2 tall trees which were on a line about 20 degrees from the direction of the transmitter. The 2-inch spaced transmission line was Y connected to the antenna across a point 5-wavelengths from the end toward the transmitter. With this arrangement it was realized that the major portion of the received energy would have to travel to the far end of the antenna, be reflected there, and then travel back the entire length before leaving the transmission line. Furthermore, the whole system was, of course, unbalanced with respect to ground. A test of the operation of this antenna showed that it delivered about 10 times as much signal voltage to the receiver as the doublet and twisted pair. A large portion of this was due to an increase in height above the old antenna; the rest of it was accounted for by increased antenna and transmission-line efficiency. However, the reproduced image was decidedly poor. The radical loss of horizontal detail which resulted was at first assumed to be due to a too sharply defined resonant characteristic of the antenna proper; however this proved not to be the case. The cause of this was found to be end-to-end reflection of that energy which flowed down the transmission-line wires in parallel. The distance from the receiver to the outer end of the antenna was about 175 feet. The blurring of some wavelengths extended for a distance which indicated that at least 3 complete round trips (1,050 feet) were made over this path by the extraneous signal before it was sufficiently attenuated to be unnoticeable.

The difficulty was corrected by shortening and grounding the transmission line at its bottom end of tapping off a short length of low-impedance line for a lead-in at an empirically determined point a few feet above the ground. This would normally be expected to that terminating resistor between the shorting bar and the ground connection would be required to prevent reflection of unbalanced signal energy at that point; in this case it was not necessary. The final form has been delivered somewhat less signal to the receiver than when first installed with this arrangement; it still gave a 15 db improvement over the half-wave double. This was sufficient to raise the signal well above an acceptable minimum.

CONCLUSIONS

Some locations within the service area of a television transmitter will not require individuals receiving-antenna study and design to meet conditions at those locations. It appears probable that a standard antenna design, or any single preventative of multiple reception, can not be prescribed for all receiving locations, especially where service from 2 transmitters in the same area is to be obtained. Experimental performance has been obtained in every case studied, by means described in the paper.

The above article has been reproduced, by special permission, from the April, 1938, issue of the Radio Review.

NEW BOOKLETS

CHARACTERISTICS CHART AND SOCKET CONNECTIONS—A new 16-pg. booklet (1275-B) including this title has just been released. Unlike the previously available, more detailed characteristics manual, this handy little "breakdown" of tube data comprises only the actual tabular matter and socket connections ordinarily found only in large chart. Available upon request to RCA Mfg. Co., or in a number of Radio-Craft stores.

TRANSMITTING TUBES—Air-Cooled Types. This second 16-pg. booklet (3010), also available from RCA Mfg. Co., contains data similar to the first; and, in addition, illustrations of the tubes, prices, considerable theoretical discussion and the diagram of a 30-mc. transmitter.

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wave and Long wave receivers. Send 25¢ to Dept. RC-85, Sylvania H. Corp., Emerson, Pa., for your copy . . . today.

DOMESTIC TELEVISION

Projection-type television with screen of 3 x 5 ft. is demonstrated over wires by Kolorama Labs. (Irvington,
N.J.) last month. Interfacad, the 225-line images were reported by Variety to have ob-
served flicker and line-trace; Motion Picture Herald, stating that the product was
wrinkled with "the average home motion pic-
tures," went on record as saying that "The dem-
stration showed up satisfactory, but there is no noticeable flicker," despite the
fact that the field frequency is 24 second
which the B.B.C. found that a television sys-
tem is its large-size image, in light-greenish-blue,
obtained by a mechanical-scanning system; new-
test running for an hour.

General point-to-point videophone (as your
managing editor dubbing the Teuton's combined
telephone and television, B.B.C. on tele-
vision, which has been in operation for some time over the
90-mile link between Berlin and Leipzig.

The second telephone and vision 'phone system, the name "telephone-and-vision"
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tainment and business angles of operations by KOMO and KJR, Seattle, while section 2, prepared in part from material supplied by the U.S. Bureau of Foreign and Domestic Commerce supplied data, in both statistical and dramatic form, concerning the growth in the Northwest and its coverage by the N.B.C. affiliates.

HAM "OPS" 

HAM radio had several innings last month, as per the following amateur-radio items:

Hot item of the annual convention of the New England Association was the A.R.R.L. schedule for the year, which will be met at press date, is announced first-hand account by big-chief, B. K. Warner, of his recent long-distance amateur service to New England radio operators at the International Telecommunications Conference. Highlight No. 2 at the convention will be the initiation into the Royal Order of the Wouf Hong, classical semi-secret society pledged to good operating practices throughout the U.S.

The Chicago Area Radio Club Council anticipates an attendance of 3,500 amateurs at an amateur radio show and convention to be held at the Sherman Hotel in September. The in-makers have plenty time to cook up code-practice ideas.

The radio amateur's "Bible" is now available in a Spanish edition, according to the A.R.R.L. (Puerto Rico). The book, about 75,000 copies will be printed annually, including 15,000 copies outside the United States and Canada! Revista Telegrafica will publish it.

The Hiram Percy Maxim Memorial Award, a bronze replica of the Wouf Hong, goes to the amateur who has most meritoriously contributed to the record of amateur radio accomplishment for the year in the U.S. The winner this year is the New York Wouf, who will be honored with an award at the New York Times last month disclosed one day's-give-away to public radio. When Gov. Blanton Winship's military aide, who was in charge of the ceremony, a little known fact to the world, i.e., that President Roosevelt, to listen to the Inaugural Day speeches, got the death of his sister in Hawaii, he obtained further details from his brother-in-law and the microphone was whisked to the hotel. The name of the winner is to be announced via the amateur radio station of H. Guillemly, who succeeded in contacting the Army post at Honolulu.

CLARIVOYANCE

ARM O N E D, telephonically, last month, Rhos Island in the East River, New York, enlisted the aid of fire and police departments of Manhattan and the Bronx. A passing boat, presumably off station, to try and alert fire and alarm wires from the Island, leaving in its wake a jumble of 5,000 telephone(PR) punched holes, in the day was Deputy Fire Chief Harold of the Bronx, who forewarn 2 years ago (said the N.Y. Post), "It's not a bad system, we have a 2-way emergency radio set which he will to the Island was part of the solution he had formulated.

MORE FIGURES

WORLDWIDE, 70,000,000 radio sets are in use, according to a New York Sun report of last month discussing a say-so by B.B.C. lotter's figures were garnered from data released by the International Broadcasting Union—which makes the whole thing official. The N.Y. Sun also quoted a "prominent radio editor" as having figured that present-day tubes reach a useful level about 1-billion and different workable radio circuits, a good 1/7 billion of which each week is lost in the box of more than 8 tubes (including the rectifier). Each new tube manufacturer announces, about double the present number of practical circuits.

How many's a billion circuits? Well, if you wired-up a set to have a new circuit complete in 1 minute, and then try all the circuits, hours. At every day, you'd have polished off your billionth circuit at the ripe old age of about 3,000 years. As of Canada, radio ratings are based on the basis of more than 100,000 radio sets in a home, according to the B.B.C. lotter's figures, but it is not stated in the report. The B.B.C. lotter's figures are not based on a complete survey of all radio sets in use in the country, but are based on a sample of a small number of homes. According to the B.B.C. lotter's figures, the number of radio sets in use in the country is estimated to be more than 100,000.

SOUND USAGE

SPOTTING Musak—static and advertising-free music over wires—last month. Motion Pictures Harvey and Warner Brothers, present owners, anticipate a great future for the concern by expanding Musak's activities to the basis of more than 8 Music-makers, according to the B.B.C. lotter's figures, are based on a sample of a small number of homes. According to the B.B.C. lotter's figures, the number of radio sets in use in the country is estimated to be more than 100,000.
Microphones Explained For Beginners

(Continued from page 91)

This extended range of audio response is not so far at variance as it may seem, for it does add brilliance to the reproduction of sound from musical instruments.

The unit so described is approximately the same as that of a condenser-type microphone, so it also requires a 2-stage amplifier to bring the output level up to about 30 db.

The velocity microphone is a low-impedance device, but it always has a coupling transformer. In the See Fig. 1F. It consists of a tuned feedback network in addition to the line impedance to that of this coupling transformer, the amplifier may be located some distance from the microphone. Provided the connecting cable is properly shielded.

The dynamic microphone is of a rugged nature and also possesses a very marked directional effect, the greatest response being obtained at right-angles to the plane of the ribbon. An "acoustical labyrinth" is sometimes provided to enhance the directional characteristic by absorbing 1/2 of the high frequency energy. The dynamic microphone is of such a nature that its operation is very quiet and free from noise or hiss.

Dynamic Microphones

The operation of the moving coil or dynamic microphone, like the loudspeaker, is fundamentally that of a conductor moving in a magnetic field, thus generating an e.m.f. in the coil. See Fig. 1F, which describes the unit in which thin duralumin "in a high-grade unit" is pressed into a dome shape for stiffening. The condenser action consists of an improved range; improved frequency response is achieved by providing an "air passage" to afford outlet for the high frequency wave.

The moving coil microphone is made from this aluminum ribbon cemented to the diaphragm, and moves in the air space between the "tail" and the permanent magnet is composed of cobalt alloy steel which will remain magnetized for a long period of time.

The moving coil microphone is quite rugged and is not affected by the mechanical shock of impact. The output level is approximately 10 db. higher than that of the condenser-type microphone, or about 80 db.

The low impedance of the dynamic microphone makes it possible to locate the pre-amplifier some distance from the microphone itself. Its frequency characteristic of the dynamic microphone is quite uniform from 35 to 10,000 cycles, so it has a good fidelity response to sounds in the normal audio range. This type unit has no inherent noise, and due to its very rugged construction can stand quite a bit of rough handling.

Crystal Microphones

Two types of crystal microphones are in common use today, to wit: 1st, the sound-cell type (Fig. 1G), in which the sound waves act directly upon the crystal; and 2nd, the condenser type (See Fig. 1F.) which uses a diaphragm to the center of which the crystal is attached by means of a mechanical link. In either of these units, the principle of operation depends upon the piezoelectric effect or voltage produced in certain crystals when subjected to mechanical stress (bending, etc.).

The sound-cell unit is an assembly of 2 "bimorph" Rochelle salt crystal elements in a bakelite frame. The bimorph elements, in turn, are each made up of 2 crystals with electrodes attached, cemented together so an applied sound will cause a bending of the assembly and produce an e.m.f. output. The way is such that mechanical shocks have little effect on the unit.

No diaphragm is used, the sound impulses actuating the crystal elements directly. An exceptionally wide (frequency range, even into the super-audible band and down to zero frequency, may be obtained from this unit. Of the 2 types, the crystal microphone is the one which has the better frequency characteristics. Its output is very high, however, so it requires greater amplification. This type microphone is not as widely employed for full-range musical pickup, being used to such much greater output, eliminating in most cases the need for a preamplifier, but it has the disadvantage of limited frequency range of application. The crystal microphone is most used for voice work.

This article has been prepared from data supplied by courtesy of Coons Electric School.
instead, a so-called "miniature radio receiving set," the pattern the experimenter holds in his or her lap and to which an earphone is connected, picked up some of the radiations from a copper wire loop around the auditorium and from copper leads placed under carpets and seats. Microphones concealed in the movie screen pick up the sound from the talkie's loudspeakers. This apparently is the old "induction telephone" scheme, but modernized to employ an amplifier, etc.

A correspondent of Time magazine naively suggested last month that the War Department would have spared a deficit of $96,000 had electrical transcriptions been used in place of flesh and blood service. It seems that a super-power amplifier and the transcription could be used to simulate a 21-gun salute with lower volume on the amplifier to give the effect of fewer guns. (Aren't the shots fired in sequence any more?)

MISCELLANEOUS

TINY Holland, recalling how a boy once saved a dog by using his finger to plug a leak, is once again looking to the youth of the land to help fend off enemies of a different sort. According to L'Industria (Milan, Italy), last month, the Dutch and British military authorities that radio amateurs with radio-transmitter-equipped bicycles were able to give an alarm in widespread military exercises and defense camps for relay to anti-aircraft defenses, that an airplane might be shot down.

Across quadrillions of miles of interstellar space came cosmic energy from galaxies which operated a radio receiving set in June, 1938, at a novel exhibit in Rochester, N. Y.: the radioteletype-writer, ordinarily used on an ultra-short-wave circuit by International Business Machines Corp., to receive news bulletins, was operated by means of a relay actuated by a cosmic-ray detector or "Geiger-Muller counter."

Golden Gate International Exposition, San Francisco's big-to-do about plenty, has scheduled July 10 to 17, 1939. Radio and electrical engineers will take an active part in a week-long exposition at the Fair on July 13. With WHK (1,900 kc) at Cleveland limited to facsimile transmission between the hours of 1:00 to 6:00 a.m., United Broadcasting Company's technical supervisor, E. L. Gove, conceived the idea of effecting more intensified experimental facsimile work by getting permission to put their short-wave set on the air at 38.6 megacycles with facsimile programs 21 hours of the day.

Apropos of Ireland's first experimental short-wave transmitter, revealed in a Daily debate on the Broadcasting Estimate and reported by Ireland's Own (Dublin, Earl), it is expected that Irish listeners will be deprived of the station's programs since its signal probably will not drop down much inside a 300-mile radius. Incidentally, we are soon to have an E.I.R.E. Chapter (Irish [Eire] Institute of Radio Engineers) to operate with the regular schedule of the convention, in Chicago, of a well-known manufacturer, a service school will be held under the auspices of the parts and service division. The service school, according to a statement, last month, from their company's parts and service manager, will cover every technical field in the entire new 1939 line.

This service study, it is believed, will eliminate any difficulty which might ordinarily arise with service departments trying to familiarize themselves with new equipment.

A Texas radio school last month announced the acquisition of an RCA "SOS alarm" or automatic emergency device, an emergency-type transmitter with short-wave attachment, latest-design long- and short-wave receivers, and a direction finder for tracking the wireless "rescuer" with the 20th anniversary of its founding as a non-profit business and radio school."

Eastern Electronic Research Association held an Annual Convention at Hotel Pennzy, (1,390 kc.) last month. Addressed purpose in life, of E.E.R.A.: "...an organisation of physicians, scientists and laymen representing various schools of practice, branches of science and health promotion, interested primarily in the development and application in practice of methods employing the detection and identification of radiant emanations as an aid to diagnosis, and the use of high-frequency waves as a means of treatment."

Of its 10 officers and directors, 7 are titled "Dr." In its program, under "Appreciated Offers of Helpful Service Co-operation," we find another strange bedfellow as "Radio-Craft Publications, Inc.," and "Longchamps' Restaurant".

OPERATING NOTES

(Continued from page 94)

SOCKET BREAKDOWN

I had an interesting although uncommon service job the other day. It was turned on upside down and sparked and smoked at the socket prong of the type 80 rectifier. Upon inspection the tube was found to have been all the way to the base, when the prong was loose and could not be tightened. The prong was pulled and replaced with a new one, and the tube went back in and was perfect.

It seems that when the socket had become wet at the 2 plate prongs, the high voltage took this path instead of through the plates of the tube. This high voltage, some 700 volts, burned the bakelite socket at that point and carbonized it, making a high-resistance path; when the set was turned on the voltage ran across this high-resistance path, shorting the high-voltage supply and thus supplying no voltage to the plate. The socket was welded on and not with a rattle. It took a sharp screwdriver with a thin edge and broke away the rattle, and put the connecting wire in the socket instead of between the plates thus destroying the high-resistance path. The set returned normal.

(A similar case might occur in a place where the temperature would be extremely humid causing moisture to form on the socket base.)

ALBERT Stock

Does your radio library include a copy of March built-in 14-page, 1688-98 JUBILAR SOUVENIR NUMBERS are still available at the original price of 50c.

$125 TELEVISION RECEIVER NOW ON THE MARKET?

(Continued from page 74)

may falsely claim to be selling stock in the company. Hence the apparatus produced by the company has consisted of loudspeaker systems for ships, but this work is being put aside for the production of television receivers, one of which the company plans to have 250 made as the initial lot. If, as seems likely, they proceed with their plans, it will probably force television out of the laboratory and into the home. Should the public evince interest in purchasing video receivers, other companies such as RCA, Farmworth and Philco may be forced to meet competition by manufacturing their own, and if this is done, it is practically certain that concerns—possibly program sponsors—will be found to provide video entertainment comparable in interest to radio entertainment or home movies. (Editorial note:—The simulated image shown on the C.-H. tube, in Fig. A, has been "faked in" merely to show the manner in which the image area appears when the 3 x 4 aspect ratio is obtained. Our Information Bureau will gladly supply manufacturers' names and address of any items mentioned in these pages. Do not enclose a stamped and self-addressed envelope.

At the 1939 Golden Gate International Exposition there will be held on Treasure Island the first international convention of the DX-ers—club of radio listeners whose object is making remote air programs.

Radio & Technical Publishing Co., 42 Astor Place, New York, Dec 36
Radio-Craft for August, 1930

Four NEW 10¢ Radio Books!

Radio Fans Everywhere—these little ten cent text books give you an excellent foundation for the study of radio. They are clearly written, profusely illustrated and contain over 15,000 words in each book.

You'll be amazed at the wealth of information these volumes have. They are handy for review or reference books.

NO. 1—HOW TO BUILD 4 DOERLE SHORT-WAVE SETS

The DOERLE PICKUP (Locates magnetic fields) is used as the basis for each of the four receivers described in this volume. The circuits are thoroughly explained, so that you can understand thoroughly the principles involved in each one.

NO. 2—HOW TO MAKE THE MOST POPULAR ALL-WAVE 1- AND 2-TUBE RECEIVERS

This volume shows you how to make the most popular all-wave 1- and 2-tube receivers, using the DOERLE PICKUP. You will learn how to choose the right tube and make the right adjustments to get the best possible performance from your receiver.

NO. 3—ALTERNATING CURRENT FOR BEGINNERS

This volume introduces you to the principles of alternating current, and shows you how to use it in radio equipment. You will learn how to connect the tubes and other components, and how to adjust the tuning for best reception.

NO. 4—ALL ABOUT AERIALS

This volume explains the different types of aerials used in radio, and shows you how to build and install them. You will learn how to connect the aerial to the receiver, and how to adjust the tuning for best reception.

These "ETN's" are hermetically sealed in an aluminum case which is externally insulated by a layer of an impregnated-paper sheath. Designed for operation involving a maximum of 20-30 seconds per hour.

"DISPLACEMENT" PICKUP (Locates Water Leaks, etc.)

The "DISPLACEMENT" pickup, here illustrated, incorporates a crystal element which is actuated directly by a suitable drive pin which bears against the vibrating body. A partial list of applications for these type DP-11 pickups includes: acoustical studies; localized sound analysis; medical studies; production testing of all kinds of bearings, crankshafts, etc.; location of sources of noise or vibration in any reciprocating or rotating machine;

101 Hudson Street
New York, N. Y.

MAIL COUPON TODAY!

(1651) Continued

A NEW metal-clad resistor of the same make, photo B, has its wire, wound on a special heat-resistant bakelite core, permanently imbedded in a moisture-proof bakelite which in turn is encased in a metal jacket; maximum mechanical and electrical security is thus obtained. Resistance values range from 10 to 10,000 ohms; watts rating is 3.3.

SWIVEL-MOUNTED LOUDSPEAKER

PATENTED acoustical features are said to be incorporated in this "Vibroloc" loudspeaker. Claim is that "even the smallest 'radio' will bring you full-range concert tones and the volume expansion necessary for symphony performances." Just how this may be accomplished was not made clear in literature furnished to

THE LATEST RADIO EQUIPMENT

(Continued from page 97)

Radio-Craft.) Data follows for the unit illustrated: power range: 15 W., normal; fidelity, "full tone range"; outside dimensions, 15 x 15 x 15 in.; inside dimensions, "non-accessible chamber designed for speaker supply." Swivel mounting permits locating instrument almost anywhere; finish is per specification, or heavy-grained teakwood; use in radio and P.A. applications.

MOTOR-STARTING ELECTROLYTICS

(Cornell-Dubilier Electric Corp.) SERVICE MEN, especially, will be interested in this new type ETN dry electrolytic condenser illustrated, since it is especially suited as a motor-starting unit, for use with fractional- or small-horsepower motors of the type used in refrigerators, oil-burners and similar appliances.

Above is shown a swivel-mounted loudspeaker; housing seemingly is triangular. (1651)

Latest sideline item for Service men is the "cataphone" shown at left and described on pg. 97. (1651)

Many new and useful features are incorporated in the automatic and portable reproducer illustrated above and described on pg. 97. (1651)

At A, "stereo-composite" and non-mute-cored type of wire-wound resistor (see, pg. 97); at B, metal-clad type of resistor. (1657)

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measuring transmission of vibration through different materials; measuring or recording the vibration of airplanes, automobiles, buildings, or pipe lines; water leak detection.

NEW 20-WATT PERMANENT-MAGNET DYNAMIC LOUDSPEAKER

(1661)
Wright DeCoste, Inc.

Designed to handle 20 watts continuously, a new P.M.-field dynamic loudspeaker, the type N-12, here illustrated, is available in 3 types, with response characteristics as follows: low-frequency type, 50-2,500 cycles; standard type, 60-8,000 cycles; wide-range type, 60-25,000 cycles.

12-TUBE MANTEL-TYPE ALL-WAVE RECEIVER (1662)

The Lafayette receiver shown here is available with either an A.C. or an A.C.-D.C. chassis. With either chassis, its outstanding point of merit is its exceptional effectiveness in a radio set of such small proportions; its 4-band circuit operated, phonograph input, 40 watts input, 15 watts output, a high output, 50 watts, into 4 ohms, 175 to 555 meters and 835 to 2,850 meters—the latter range being especially interesting in view of the European long-wave broadcast stations. Has R.F. preselector on all bands; full A.V.C. noise-reducing control, tuning "eye," beam power output, and so-called "ultra-widerange tone control."

The "Vertex" relay shown here is said to be the first mercury relay which does not require tilling of the tube and in which all mechanically-moving parts are sealed-in-glass. As a result, these relays are said to be highly reliable and efficient in operation and take up less space than any other mercury relay. The glass case contains a cylindrical plunger which floats on a mercury bath. When the solenoid winding outside the tube is energized the plunger is drawn, magnetically, down into the mercury which is displaced upward until contact is made with an upper electrode.

NON-TILTING VERTICAL MERCURY RELAY IS SEALED-IN-GLASS

(1663)

The compact all-iron-wound set shown at left has a high degree of compactness. (1662)

New motor-starting electrolytic has insulating sleeve. (1659)

Mercury relay. (1643)

"Displacement" Wide-frequency-range P.M. dynamic handles 20 w. (1661)

Servicing Questions & Answers

(Continued from page 99)

set is bumped and makes that racket. I have undersoldered the wires to the tuning condensers, and I have cut out the neutralizer condensers, with no results as regards locating the trouble. I have tested all of the bypass condensers. Shorting the grids of the 2nd and 3rd R.F. tubes to ground will clear the noise. Also by shorting the primaries of the 2nd and 3rd R.F. tubes will clear the noise. Perhaps you may have something on this set or any advice that you can give me.

P.S.—With the tuning condensers well open (around 1,200 or 1,400 ke.), the noise is much worse when the ANT. and all test leads are disconnected from the set.

(A.) Noisy reception such as you are experiencing with a Majestic 181 receiver is often due to loose or undersoldered leads to the antenna trimmer. Check the grounding point, usually at the trimmer assembly. Clean ground contacts and securely solder grounding leads to the gang condensers, using nuts on power unit receiver cable strip.

As a further measure, disconnect leads to gang condenser stations. And apply high voltage from the receiver across each gang section in turn. Rotate the motor plates with the voltage applied. (64) Edward Furuto, New York City

(A.) I have a Philco 42 D.C. in the shop, which drops in volume after playing for about 18 minutes. The volume is restored, but light electric clicking occurs. The volume will be restored to normal. This condition continues until it is impossible to restore normal volume until the set is closed and allowed to cool. Will you please advise me where to look for trouble? (65) Ed Savaria, Philadelphia, Pa.

The cause of the fault in your set is an improperly seated or broken bakelite-plug condenser employed in this receiver. The open-circuit usually consists of a break in the leads running from the bakelite-plug, either at the lug or within the case. With the receiver operating, you will find such lead on each of these condensers with some insulated object. Tap the case gently with the handle of a screwdriver. This procedure quickly discloses the faulty condenser. Shunting each condenser with a unit of similar capacity after the receiver has faded, is another method employed by many Service Men.

(67) M. Gentleman, Vancouver, B. C.

Tell a friend you saw it in Radio-Craft. We supply Free Parts List of matched kits for building any circuit described in this or any other magazine. Just specify what you want.

NEW P. A.

ALLIED RADIO CORP.
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FREE! RADIO BUILDER LISTS

FREE! FREE KITS

Please Send me your FREE Spring-and-Summer catalog. (66) Albert Stines, Shenandoah, Pa.

When the receiver is turned on, after being shut off for about 5 minutes, it has excellent reception. After being on about 15 minutes or less the volume becomes weak. If the volume control is turned back a bit it comes back to normal reception with a "shlog." If the volume control is tuned

(Continued on page 127)

Setting New Standards for Midget Condenser Performance

A whole lot of better than you ever thought a small condenser could possibly be made—that, in brief, is the Sprague Atom! They're better, in fact, than lots of other makes of condensers two or three times their size.

Sprague Atoms are small enough to fit in anywhere—and believe us, they'll stand the strain. They're made 12 to an exclusive Sprague etched foil process that puts more capacitance in a given space per inch into a condenser than has ever been put there before. And don't worry about "blow-ups." There's not a "firecracker" in a car-load.

Here's where you SAVE MONEY!

Atoms are made in a complete line of capacities and voltages including DUAL-CONDENSATIONS—just the thing for the makers of inexpensive "duplicate" replacements. And they'll save you money! Last price on the market. Atoms is only 60 c. Other capacities priced proportionately lower. Send list by leading jobbers or in handy kits.

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Just think of it—you can get absolutely FREE—the smallest CANDID CAMERA ever made. It actually fits in your vest pocket. This powerful midget camera takes snapshots or time exposures that will astonish you. They're clear, sharp, and make excellent enlargements.

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- Made of light, durable, unbreakable metal alloy.
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- Scientifically correct—adjusted for time-exposures, also snapshots—shutter locks when not in use.
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Send your subscription today to RADIO-CRAFT for One Year (12 issues) and receive absolutely FREE one of these truly remarkable cameras. New subscribers are accepted or you may extend your present subscription for another twelve months under this offer. Mail your remittance of $3.50 to the publishers of RADIO-CRAFT today. (CANADA AND FOREIGN $3.15)

You will promptly receive your FREE CANDID CAMERA by return mail, sent Postpaid. Film rolls available at the same time at ten cents each.

The illustration below shows the construction of the handy CANDID CAMERA offered to you with your subscription to RADIO-CRAFT.

RADIO-CRAFT, 99 Hudson St., New York, N.Y.

A RADIO SCRIPT SHOW GOES ON THE AIR

(Continued from page 79)

... and the facts to Kellogg's advertising men, and "Girl Alone" is signed up for a local test campaign on WMAQ.

... "Girl Alone" soon requires William Cole, one of the control supervisors (who relaxes before this complicated station control board while programs are on the air)...

... then works feverishly in the split seconds of program changes)...

... to connect "Girl Alone" with other stations on the N.B.C. Red network.

Because thousands of listeners respond to...

... mail hooks in the local test campaign...

All photographs in this article are by Modern Advertising staff photographers except the following:

Page 76 Column 1 Frame 3 .......................... Maurice Seymour
Page 76 Column 1 Frame 4 .......................... N.B.C.
Page 77 Column 1 Frame 7 .......................... Maurice Seymour
Page 77 Column 2 Frame 1 .......................... Maurice Seymour
Page 77 Column 2 Frame 3 .......................... Jun Fujita
Page 78 Column 1 Frames 4 to 7 .......................... N.B.C.
Page 78 Column 3 Frames 1 to 6 .......................... N.B.C.
Page 122 Column 1 Frame 4 .......................... Foto-ad

Please Say That You Saw It in RADIO-CRAFT
HOW TO MAKE A COMBINED HEARING-AID AND INTERPHONE

(Continued from page 93)

Two Cornell-Dubilier 0.1-mf. 400 V. paper condensers.
Two Cornell-Dubilier 0.002-mf. postage stamp mica condensers.
One Cornell-Dubilier 0.006-mf. postage stamp mica condenser.
One Clarostat 0.5-meg. volume control with switch.
Two I.R.C. ¼-watt 10,000-ohm resistors.

Fig. 1. Directions for making the case for the Electric Hearing-Aid.

Measurements of Capacity, Inductance and Audio Transformer Ratio

(Continued from page 103)

mum, a typical "3-to-1" audio transformer might show a measured secondary voltage of 50 volts when 20 volts A.C. was applied to the transformer primary. This would indicate that the apparent step-up ratio transformer was 50- to-20 or 2½- to-1. We know that this apparent step-up ratio is lower than the actual step-up ratio.

If we were free to take the same transformer and apply say 200 volts A.C. to the secondary winding, we would observe with an ordinary 1,000 ohms/volt A.C. voltmeter, an indication of say 63 volts across the primary winding. This would signify an apparent step-down ratio of 500-to-63 or 8.1.

That is, when we use the same transformer as a step-down transformer instead of as a step-up transformer, its measured output voltage due to circuit losses is lower than the theoretical output voltage. This results in the apparent ratio being higher than the actual ratio. Consequently if we measure the ratio of a transformer, as a step-up and as a step-down, we know that one apparent ratio is higher than the actual and one lower than the actual and that the actual ratio must be somewhere between the two apparent ratios.

By using higher-resistance voltometers, the apparent ratio whether measured as step-up or step-down becomes more nearly equal to the actual ratio and in most types of audio transformers, the values of a step-up and step-down ratio as measured with a 1,000 ohms/volt A.C. voltmeter are sufficiently close together that the actual ratio may be assumed to be half-way between the two apparent ratios. In any case, 2 measurements make it possible to tell how accurately the measurement is being made.

FINDING RATIOS WITH 1 MEASUREMENT

Measurements made on approximately 100 different types of audio transformers indicate that if the following rules are observed, transformer ratios can be measured with a single ratio measurement correctly within 10%. These rules are:

For Class A Input or Intermediate Transformers
Apply 200 volts A.C., 25 or 60 cycles on the secondary or high-turns winding. Measure the output voltage of the transformer across the primary or low-turns windings with a A.C. voltmeter having a resistance of 500 ohms/volt or higher. The ratio of the input voltage to the output voltage will be equal to the step-up ratio of the transformer within 10%. The indicated ratio will always be a little higher than the actual ratio.

It is not advisable to apply more than 100 volts to the primary of an output transformer at commercial power frequencies as due to the low reactance of the primary, the current in the primary is expended largely in the form of heat developed across the resistance of the winding, the test transformer may be overloaded and the accuracy of the measurement greatly impaired.

Class B Driver Transformers
Measure the same as class A input transformers but use a applied voltage of 20 volts instead of 200 volts A.C.

The circuit of Fig. 1 may be used for audio transformer measurements. To do this the proper voltage tap and voltage divider switch under test should be selected; the line-voltage check switch should be closed; the shunt should not be used and the proper winding of the transformer as indicated above should be connected to binding posts marked A.C. and D.C. The A.C. voltmeter should also be connected temporarily to these binding posts, and the line voltage control adjusted to 25 or 200 volts as may be required. The voltmeter should then be disconnected from its present position and used to measure the voltage developed across the other windings.

(For the author of this article is in the Service Division of Canadian Westinghouse Co.—Editor.)
How They Work.

on All

A

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Selection

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RADIO WITT QUIZ

(Continued from page 96)

put of the local oscillator and the incoming signal, with its output circuit tuned to an intermediate frequency. (c) That effect produces in a receiver when an interfering signal "rides through" on the carrier of the station to which the receiver is tuned.

(107) Birds in or tweets in superhetas. are evidence usually of—

(a) Cross-modulation from an unwanted station while tuning for lower frequencies. (b) Oscillation in the R.F. or high-frequency amplifier and 1st-detector circuits which shows up as squeals with tuning. (c) Interference attributed to birds on your antenna lead-in thus causing signal swings. (d) Lack of or poor selection noted by a CW station's image frequency beating with broadcast station programs.

F. A. UMALLI

Manila, Philippine Islands

(108) Cross talk relating to radio means—

(a) An interference between signal carriers. (b) A person talking into a microphone from a short distance. (c) A call for a DX station from the members of an audience in a broadcasting station.

(109) Radio men know that the space charge is—

(a) Negative electrons emitted from filament fill the space surrounding a heated filament. (b) Rental charged for shop space. (c) A fee charged by Federal Communications Commission from the stations during their absence from the air.

SUGITO MAZAWA

(110) A fluorescent screen is used in connection with —

(a) Motor cars? (b) Motion pictures? (c) Oscilloscopes? (d) Screen-grid tubes?

JAMES OLIVE

Christ Church N.Y., New Zealand.

(111) We all know that a helix is—

(a) A device for controlling an undamped wave. (b) A small condenser. (c) A hollow, conducting coil or solenoid. (d) A direction finder used for navigational purposes.

(112) We all know that the formula for Ohms law is—

(a) I = E X R. (b) R = I X E. (c) E = I X R. (d) I = E X R.

JAMES FREED

(113) Did you know that an acceptor is—

(a) An official appointed to control free broadcasting? (b) A circuit of inductance and resistance arranged and tuned so as to throw impedance currents of a lower order. (c) A high impedance to currents of any other frequency? (d) A sound equalizer Inductor? (d) A direction finder?

(114) A cage antenna is—

(a) A cage used to keep wild animals in. (b) An antenna placed in a cage to protect it from the weather. (c) An antenna, having conductors, which consists of a group of parallel wires.

G. R. WALLACE

(115) A swaying choke is—

(a) An act of hanging a man for murder. (b) A radio choke on a hipline that can be swung to any angle to prevent hum. (c) A choke in a receiver that sways electrically to the rhythm of the music to prevent distortion. (d) A receiver choke to retard A.C. ripple and allow a smooth D.C. to flow with reserve current to handle audio peaks.

P. WILSON REIDAY

(116) Everyone knows that an erg is—

(a) A new kind of fly from Affrica. (b) A resistance-coupled audio amplifier using a space-charged screen-grid tube. (c) A measure of energy. (d) The Boston pronunciation of erg.

JAMES B. LAMB

ANSWERS

(99b) (100c) (101b) (102b) (108a) (104c)

(104d) (106c) (107b) (109a) (110c) (114c)

(114e) (116c) (118b) (114e) (118d) (116e)

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READERS' DEPARTMENT
(Continued from page 99)

PHILADELPHIA, PENN.

Gentlemen,—

An article in the June issue Operating Notes section, concerning a Philco Model 45, recommends adding a 50,000-ohm resistor from the 6A7 cathode to the A.V.C.-return. It seems to me there must be a slip-up somewhere because such a repair would nullify the A.V.C. action of the receiver, and probably cause severe overloading and distortion.

It would simply amount to a voltage divider across the A.V.C. network, and since this model uses a 2-meg. filter resistor only 1/40th of the A.V.C. voltage developed would be applied to the controlled grids, i.e., if the 2nd-detector developed 24 volts of A.V.C. voltage only 0.6-V would be applied to the controlled grids due to the added resistor.

The majority of your Operating Notes are very instructive and helpful. But I suppose something like this is bound to happen. And I must give you credit for not letting it happen very often. So with best wishes for your continued business, I am

Edward McCullum

P.S.—I am a constant reader of Radio-Craft and I think it is one swell magazine.

E. McC.

Thanks a lot for your comments—and the bouquet.

NEW YORK CITY

Gentlemen,—

Many times I have had occasion to refer to a back number of Radio-Craft only to find that the page I wanted had been clipped and pasted into another notebook because of a diagram that was on the other page.

Lately I have devised a card index system which keeps my back numbers intact and also helps in finding the needed information much faster.

A 3" x 5" card is used for each model of each receiver, the page number on which any information pertaining to that particular receiver is entered in the center and to the right the issue of Radio-Craft in which the information appears.

The entire system is very inexpensive and I think it will help many Service Men to have such a file in the shop. I do not make a card unless I have some information on the receiver.

Some fellows will say it is a day's work to sit down and copy a list of make and models and will fail to use the system, but if a fellow were to start with the current issue of Radio-Craft and there and then file the information on the receivers, and each month add to that, he would have a fine reference file in a few months.

The file that I use was purchased along Canal Street (New York City) some place. It is a metal cabinet about 16 x 5½ ins. and cost $60, including 200 cards and the index.

Hoping this is of some help to some one, some place, I remain a constant reader of the greatest radio publication going.

Russell McKee

Thanks very much for the "index" information, and for your commendatory remarks. We hope that each future issue will continue to merit your approbation.

Fig. 1. Corrected schematic diagram of Mr. Chapman's condenser tester described in the April, 1938 issue of Radio-Craft, Reader's Department, page 492.

Fig. 5. The above 2 graphs were mentioned but inadvertently were not reproduced in the article, "'Bi-Fonic' Sound Magnifier." In the July, 1938 issue of Radio-Craft. Curve A illustrates the comparative performance of a 4-in. dynamic reproducer in each of 2 types of housings and a plane baffle; curve B, comparative performance of a 12-in. dynamic reproducer in either of 2 housings.

Please Say That You Saw It in RADIO-CRAFT.
OPPORTUNITY AD-LETS

You will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and individuals from all parts of the country. No matter what your field of interest may be—radio, picture tubes, supplies, automobile accessories, the opportunity to make money, you will find the most attractive of the month. Advertisements in this section five cents a word for each insertion. Name, address and initials must be included at the above rate. Cash must accompany all classified advertisements unless previous arrangement is made. No advertisement will be inserted if it is obvious or misleading. Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading offers or announcements must reach us not later than July 5th.

RADIO-CRAFT FREE SWAP COLUMN

Space in this department is solely for the benefit of our readers, who wish to exchange radios, parts, supplies, books, etc. The editors, if asked, will assist in this

Since we receive no money for these announcements, we cannot accept responsibility for any statements made therein.

Only one advertisement will be accepted from any reader for any one issue. No advertisement to exceed 35 words, including name and address.


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Wiring Schools for Sound

On full suddenly about a second eclipses before the stars, and the light in the room appears sufficient in either location. The reproducers in the auditorium should be located on both sides of the stage, and in the gallery. The sound should be hung facing the floor, suspended from the ceiling out of the way of all apparatus. Loudspeakers for small halls are permissible in the gymnasium. Inclined wood baffle are excellent for the auditorium. Study-halls and large laboratory rooms will have one or less speakers (similarity to those in the classrooms). Cafeterias, which are usually quite noisy, require one or two 15-inch speakers, or several smaller ones distributed at several points.

SWITCHING SYSTEM

It is commonly required that individual switches be provided for controlling each classroom speaker. In those locations where more than one speaker is used, they are controlled by a single switch also. The system shown is designed for schools with 8 to 10 classrooms. Ten switches are provided with blank panel space for 30 additional positions. A 20-watt carbon resistor may be used for the resistance load on classroom lines. Resistors with higher watts ratings should be used for auditoriums and high-powered lines. If load resistors are not used, it will be necessary to continually readjust the volume level at the control cabinet as the various speakers are switched in or out.

Under some conditions it is desirable to have classroom speakers provided with an individual volume control which is located in the classroom itself. In order that adjustment of individual volume controls will not affect the other speakers, a device which maintains a fairly constant impedance is needed. This is supplied by the "L"-pad volume control. This device maintains nearly constant impedance in one direction and is limited in the other. These controls are easily obtainable at a moderate cost in a wide variety of impedances and power-handling capacities.

Monitoring or "talk-back" facilities are being installed in a large number of installations. By means of an extra position on the speaker control panel, an associated loudspeaker is connected into the output circuit of a small amplifier. This is an entirely separate unit, having its own loudspeaker and is used only for reception of the talk-back signal.

The 5 FACTOR IN WIRING

The most important factor to consider in the cost of the actual installation is the labor involved in the installation of the speaker and microphone wiring. When wiring must be installed, this is usually let to the local electrical contractor, who is best equipped for this type of work. Most installations require 2 weeks. Cost figures should be based upon this length of time, taking into consideration wages which prevail locally. Of course, sufficient margin should be allowed to cover incidental costs.

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RADIO-CRAFT for AUGUST, 1930

THE RADIO MONTH IN REVIEW
(Continued from page 79)

The work undertaken by the Conference ranges over a very large field, but only the section most likely to be of interest to short-wave listeners is dealt with here. This is the allocation of wavelengths, and now note that this Conference allocates bands of wavelengths to the various services, such as broadcasting, marine, aircraft, etc., but does not attempt to allot wavelength channels to specific stations.

Practically all the wavelengths were dealt with, ranging from as low as 1.5 meters up to 30,000 meters, and there are 4 main services which have to be considered. First of all, there is the so-called "fixed-station" service, by which is meant radio-teletype or radio-telephone between fixed stations. Then there is the maritime service, which concerns communication between ship and shore and between ships. Thirdly, we have the air service, which, of course, concerns communication with aircraft, wireless aids to navigation and landing, etc. Lastly, there is the broadcasting service, to which has recently been added television.

NEW WAVEBANDS

In the long-wave broadcasting—band—which is mainly of interest to Europe—no further allocations have been made. We next come to the medium waveband. At present it extends from 645 to 200 m., but it is planned to extend it down to 192 m. for Europe, and down to 187 m. for America and the rest of the world. Then comes what is known as the intermediate waveband—that is, those wavelengths lying between 200 m. and 50 m. For provision is made for broadcasting in a band between 2.3 and 2.5 megacycles (about 125 meters). There is then a second band spread from 4.7 to 4.9 m. (about 204 m.). These new bands, however, are reserved for broadcasting in countries lying in tropical or semi-tropical regions. In such countries a high noise level, owing to atmospheric, often prevents the successful use of the ordinary medium waveband, and the new bands have been provided for the benefit of locally the majority of the world. For instance, the band from 3.3 to 3.5 m. is not available for use in Central and South America. In other parts of the world their use is restricted in general to countries which lie within 30° north and south of the Equator.

To come now to the short wavebands—i.e., waves below 50 meters: The 40-m. band, which was 150 kilocycles wide, has been increased to 200 k., and the new figure is 6.5 to 6.2 m. A new band, 100 k. wide, between 7.2 and 7.3 m., has been created by allowing the pre-existing bands of the Americas to be shared among the nations of the American continent. This will be in the neighborhood of 41 m. Then the 31-m. band, which was originally 100 k. wide, has been increased to 200 k., the new figures being 9.6 to 9.7 m. No change has been made to the 25-m. band or the 19-m. band. The 17-m. band, however, has been extended, making it 100 k. wide, instead of 50, the new limits being 17.75 to 17.86 m. The 14-m. band has been extended from 100 to 300 k., the new band-running from 21.46 to 21.75 m.

REGULATIONS IN 1929

The Cairo Conference regulations in general will come into force in January, 1929, but the clause dealing with the registration of wavebands will not be applied until September 1 of that year. There will, therefore, be no immediate changes in present wavebands.

The Cairo Conference did not decide definitely whether or not a plan of wavelength channels for individual short-wave stations should be attempted. This would mean, of course, another world conference. The Conference, however, requested the International Broadcasting Union to collect the fullest possible data available on the subject, which will be submitted to all countries for their consideration. As the majority of the nations are in favor of holding a world conference with this object—that is, allotting short-wave channels to individual broadcasting stations—it is possible that such a conference will be held.

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