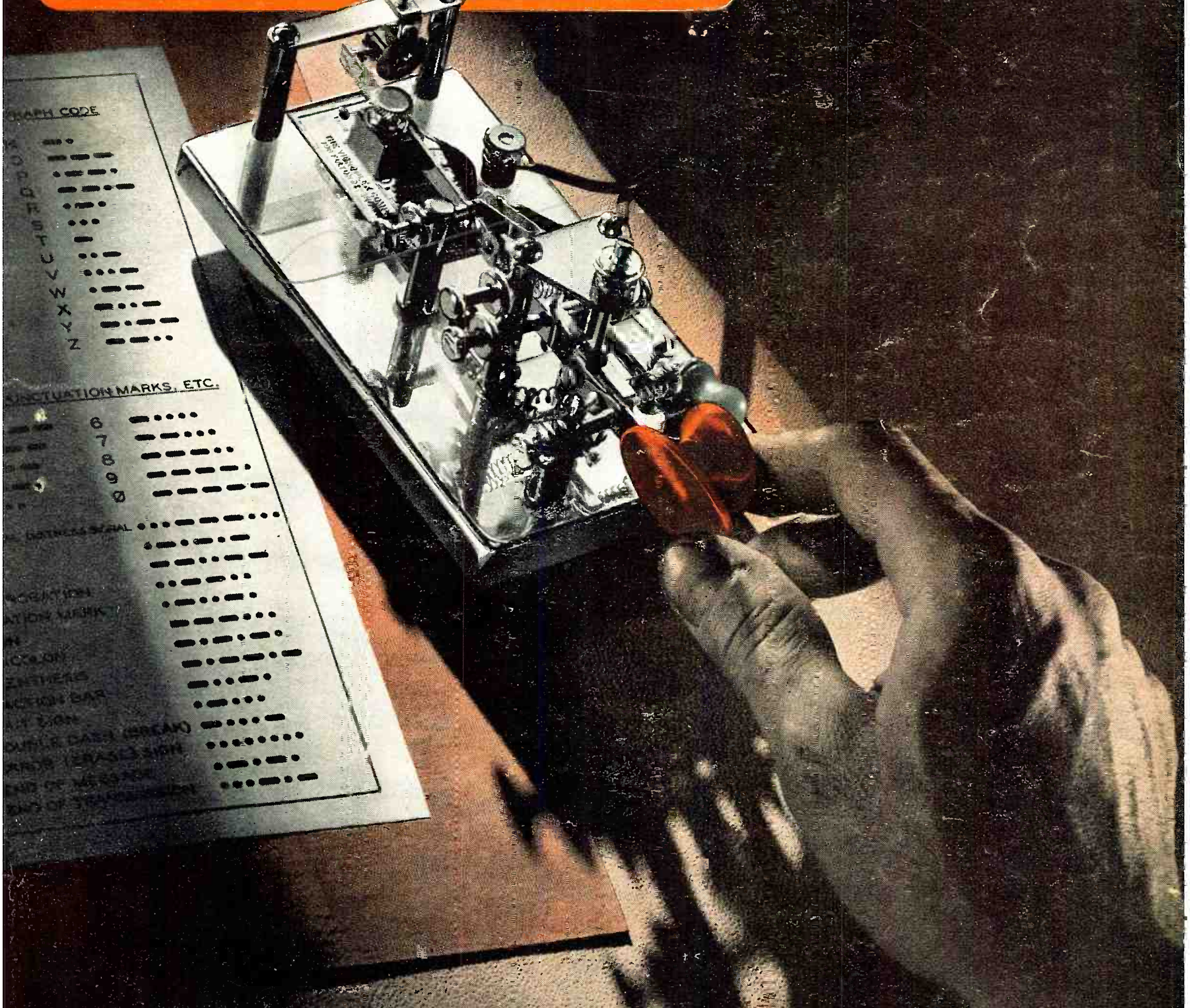
RADIO NEWS

JUNE
1942
25c
In Canada 30c



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Electronic Gadgets for Amateurs

Build Your Own FM-AM Receiver ★ R. F. Coil Analyzer

A VACUUM TUBE OUTPUT METER

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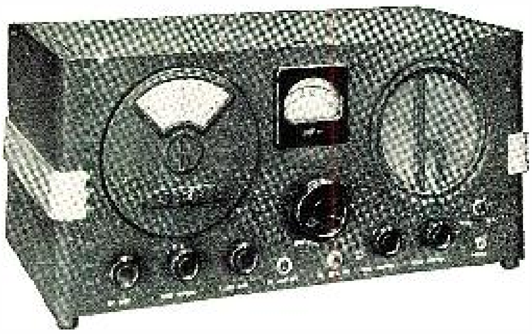
World's Largest Radio Dealer



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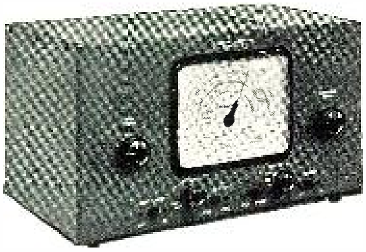

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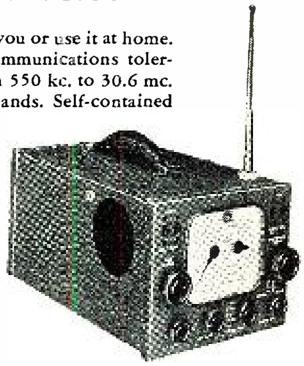

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2 Pre-selector stages
Crystal
Variable Selectivity
Formerly $189.50
"Demonstrators".................... **$79.50**

Sargent WAC 44
"Worked All Continents"
2 Pre-selector stages
All Circuits tuned from Panel
Regular $139.50. Special.............. **$89.50**

The New 1942

SKYRIDER 32

Engineered by Hallicrafters to produce superior communications performance, the new Skyrider 32 is a 13 tube, 6 band receiver covering everything on the air from 500 kc. to 40 mc. Two stages of preselection. Calibrated bandspread inertia controlled. Micrometer scale tuning inertia controlled. Tone and AC on-off. Beat frequency oscillator. AF gain—RF gain. Crystal phasing. Adjustable noise limiter. Send-receive switch—AVC-BFO switch.

80/40/20/10 meter amateur bands calibrated. Wide angle "S" meter. Push-pull high fidelity audio output. 6-step wide range variable selectivity. $149.50.

AMATEUR DIVISION
63 CORTLANDT STREET
NEW YORK, N. Y.

DAVEGA

Men NOW in Radio who Don't Think they know it All Read This

If you're a Serviceman, you don't want to see younger men with modern training getting the cream of the Radio repair business, now booming because of the shortage of new sets. If you're an Operator, you don't want to be baffled by new Radio circuits and equipment. Extra knowledge wins you extra money, promotions. Read my message, below.

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You can begin cashing in on your interest in Radio QUICK—IF YOU ACT NOW! The Radio repair business, booming because of the shortage of new home and auto Radios, offers more opportunities than ever to make $30, $40, $50 a week in full-time jobs, or $5, $10 extra a week if you hold your present job and fix Radio sets in spare time. Practically all branches of Radio need Technicians, Operators. Radio training can win extra rank, pay in Army, Navy. Find out how I train you at home in spare time for Radio's opportunities. MAIL THE COUPON BELOW—NOW!

J. E. SMITH, President
NATIONAL RADIO INSTITUTE
Established 27 Years

He has directed the training of more men for Radio than anyone else. He has helped men already in Radio to get ahead, and men not in Radio to get into Radio and win success.

Make Me Prove I Can Train You at Home to Be a RADIO TECHNICIAN or OPERATOR

Clip the coupon and mail it. I'm certain I can train you at home in your spare time to be a Radio Technician. I want to send you a sample lesson free; to examine, read. See how clear my Course is to understand. See how my Course is planned to help you get a good job in Radio, a young growing field with a future. You don't have to give up your present job, or spend a lot of money to become a Radio Technician. I train you at home nights in your spare time.

Charles F. Helmuth, 16 Hobart Ave., Absecon, N. J., writes, "I started Radio in the Marines. Later I took the N. R. I. Course. Now I am my own boss and get jobs over others who thought they had them. I owe plenty to N. R. I. Training." James E. Ryan, 119 Pebble Ct., Fall River, Mass., writes, "I was working in a garage when I enrolled with N. R. I. I am now Radio Service Manager for the M—— Furniture Co. for their four stores."

Why Many Radio Technicians I Trained at Home Make $30, $40, $50 a Week

The up-to-the-minute Radio Technician or Operator must have BOTH a thorough knowledge of Radio, and experience working with Radio parts and equipment such as my training gives you. That is why men I trained are taking advantage of the booming Radio repair business to get better jobs, to make more money in spare time, or to open their own Radio repair businesses. Others fill good-pay jobs in many of the country's 882 Broadcasting Stations, and in Aviation, Police, Commercial, Marine and Government Radio. Loud-Speaker Systems give good jobs to many. Others, in the Army or Navy, are winning promotion, extra pay, because of their Radio training. Government orders for Radio Equipment have opened new jobs for many in Radio Factories, while many have good Civilian Government jobs as Radio Technicians, Operators.

My Course Is Thorough and Practical

I give you a thorough basic training in Radio Theory and Practice which enables you to understand the operation of practically every type of Radio Equipment. I send you 6 Big Kits of Radio Parts with which you build Radio circuits and testing equipment, conduct tests and experiments which give you practical experience. That's why many men I train begin to make more money quickly and get and hold good jobs.

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Nearly every neighborhood offers opportunities for a good part-time Radio Technician to make extra money fixing Radio sets. I give you special training to show you how to start cashing in on these opportunities early. You get Radio parts and instructions for building test equipment, for conducting experiments that give you valuable practical experience. My 50-50 method of training—half with Radio parts I send you, half studying my Lessons—makes learning Radio at home interesting, fascinating, practical.

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MAIL THE COUPON—get my FREE Lesson and 64-page book, "Rich Rewards in Radio," at once. See what Radio offers you as a skilled Radio Technician. Learn how practical my Course really is. Read letters from more than 100 men I have trained so you can see what they are doing and earning. Mail the Coupon NOW—in an envelope or paste it on a penny postal.

J. E. SMITH, President, Dept. 2FR
National Radio Institute
Washington, D. C

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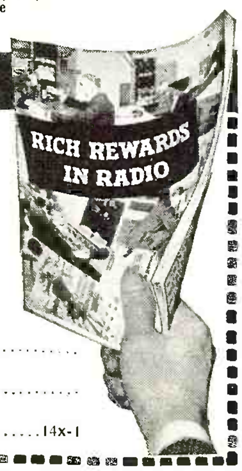
I want to prove our Course gives practical, money-making information, that it is easy to understand—what you need to master Radio. My Sample Lesson Text, "Radio Receiver Troubles—Their Cause and Remedy," covers a long list of Radio receiver troubles in A.C., D.C., battery, universal, auto, T.R.F., superheterodyne,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

GOOD FOR BOTH 64 PAGE BOOK SAMPLE LESSON FREE



J. E. SMITH, President, Dept. 2FR
National Radio Institute
Washington, D. C.

Dear Mr. Smith: Mail me FREE, without obligation, your Sample Lesson and 64-page book, "Rich Rewards in Radio," which tells about Radio's spare-time and full-time opportunities and explains your 50-50 method of training men at home to be Radio Technicians. (No salesman will call. Write plainly.) (Please check.)

( ) I AM doing Radio work. ( ) I am NOT doing Radio work.

Name.. Age..............

Address..

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by THE EDITOR

Amateur Status

THE status of the amateur and his station appears to have been finally decided upon, although in a somewhat paradoxical manner. For under a new F.C.C. ruling soon to be issued, specific amateurs and their stations will be chosen for ARP and other civilian emergency work, but they will be given new, special licenses and will be allowed to operate only in accordance with specific schedules outlined by defense authorities.

The selection of amateurs will be made by the local defense boards, who will predicate such selection on those factors that will best serve the community. Amateurs so selected will have to adhere to all of the stringent rules and regulations necessary in emergency practice, and operate only when told to. In many instances, amateurs will have to operate equipment that will, for the duration, be located in civil defense headquarters and not in their homes. Of course, if the location of the equipment is such that it would be folly to move, operation will continue at the usual spot, *but* under the direct supervision of local authorities. If in a community the equipment available is not suitable to afford adequate service, either reconstructed or new material should be installed.

In view of the importance to which this new form of "amateur" station will be put, extreme care will also be exercised in the selection of equipment that will be correspondingly closely guarded and protected. The same precautions exercised by commercial units will be applied.

In this new format of operations, the "amateur" will actually become an official radio operator for the local civil defense, with duties requiring specific watch period. In view of the arduous schedules that will, of necessity, be set up, several "amateurs" will be required at each post. And since, in many instances, there may be several operating posts in a community serving such purposes as spotting and checking, amateurs with schooling in such operations will be required. Although many "amateurs" are familiar with the UHF equipment used in such operations, the emergency operating procedure will be new. Accordingly, not only will special instructions be issued, but special training will be offered.

The importance of this new civil defense work cannot be stressed too

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RADIO NEWS

Vol. 27 No. 6

Trade-Mark Registered

The Technical Magazine devoted to RADIO in WAR, including articles for the Serviceman, Dealer, Recordist, Experimenter and Amateur

Contents for June, 1942

FEATURES

DEPARTMENTS

Member of the Audit Bureau of Circulations

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Ears of the Signal Corps!
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Signal Corps Coordination Branch

by Maj. Gen. DAWSON OLMSTEAD
Chief Signal Officer

Was born at Corry, Pennsylvania, graduated from the United States Military Academy on June 12, 1906. His early service was in the cavalry. After serving with the 15th Cavalry in Cuba and at various points in the United States, he was transferred to the field artillery. Served in the Signal Corps and during the World War he served for a time as Signal Officer of the 83rd Division. He served in France on the staff of the Inspector General of the A.E.F. He has served as Signal Officer of the Fourth Corps Area, Atlanta, Georgia; Department Signal Officer for Hawaii; in charge of the Alaska Communications System; as Executive for the Chief Signal Officer, Washington, D. C.; and as Commandant of the Signal Corps School, Fort Monmouth, New Jersey. He is a graduate of the Signal Corps School, a distinguished graduate of the Command and General Staff School and a graduate of the U. S. Army War College.

Many bottlenecks have now been eliminated in getting radio equipment to the war front in a steady stream and in large quantities.

Radio communication "on the hoof." Orders are being received from HQ.

In no period have the problems of radio design and practice been so acute as in the present war. Shortages in essential materials and manufacturing facilities plus the need for complicated varieties of equipment have created unprecedented difficulties. Simplification and standardization have thus become important factors in all-out civilian and military efforts to provide vital radio components with rapidity.

One of the most unusual of standardization policies was recently enacted by the *Signal Corps* and entrusted for its execution to a new branch in the Office of the Chief Signal Officer. It affords a more effective means of accelerating equipment production.

The new branch, known as the *Communication Co-Ordination Branch,* is headed by Colonel David M. Crawford, *Signal Corps,* one of the Army's leading radio specialists. Colonel Crawford comes to the assignment from a tour of duty with the air defense activities of the *Air Force Combat Command.* His instructions are: 1.—To co-ordinate military communications, and 2.—to reduce the number of types of equipment to a minimum consistent with the requirements of the Army's arms and services.

In order to reconcile the communication requirements of the fighting arms, these arms are represented by specially qualified officers on the *Army Communications and Equipment Co-Ordinating Board.* This board, a part of the new *Communication Co-Ordination Branch,* includes representatives of the *Infantry, Field Artillery, Cavalry, Coast Artillery, Air Corps and Armored Force,* as well as the *Signal Corps.* On the board also are liaison officers from the *Navy,* the *Marine Corps* and the armed forces of the other United Nations. It is interest-

Officers looking over map while Sgt. speaks to headquarters over walkie-talkie radio.

This operator is using cw in his transmission to other stations scattered over wide areas.

ing to note that progress has already been made in co-ordinating the radio equipment of Great Britain and the United States, utilizing the best features of inventions developed in the laboratories of both nations.

An important task of the new branch is to recommend the frequency bands to be allotted to the various arms and services. This work is similar to some of the controls exercised by the *Federal Communications Commission* in allocating frequencies to broadcast stations, commercial stations, amateurs, etc. In the case of the *Army*, the problem is complicated by the fact that the transmitters are for the most part not geographically fixed like those of a broadcast station. Instead thousands of these stations are in rapidly moving airplanes, tanks and other vehicles.

A third function of this new *Communication Co-Ordination Branch* is to insure uniformity of procedures for using the equipment in the field.

The establishment of this new branch makes a total of seven branches in the organization of the rapidly expanding *Office of the Chief Signal Officer*. The others are the *Materiel Branch,* with the responsibility of developing new types of equipment and expediting their production and procurement; the new *Aircraft Communications Branch,* which controls the procurement of radio equipment for aircraft; the *Operations Branch,* which draws up plans and procures and trains the *Signal Corps* military personnel; the *Army Communications Branch,* which operates the *War Department* fixed communication systems; the *Administrative Branch* with a miscellany of functions including the hiring and supervision of civilian personnel, financial, accounting and photographic activities; and finally the *Executive Contro Branch,* also a new branch, which has special executive duties. For more efficient management, these branches, with the exception of the *Executive Control Branch,* are grouped into a *Field Service* and a *Supply Service.*

To illustrate the standardization possibilities, let us review some types of equipment that have standardized properties or basic characteristics with wide applications. In this category, for instance, we have the famous SCR-194, popularly known as the "walkie-talkie," or one man pack set. This unique model has its entire transmitting and receiving equipment, together with battery power supply, contained in one unit and carried in a manner similar to the soldier's field pack. Its design is such that it affords a wide latitude of uses, as many of the illustrations on these pages will show.

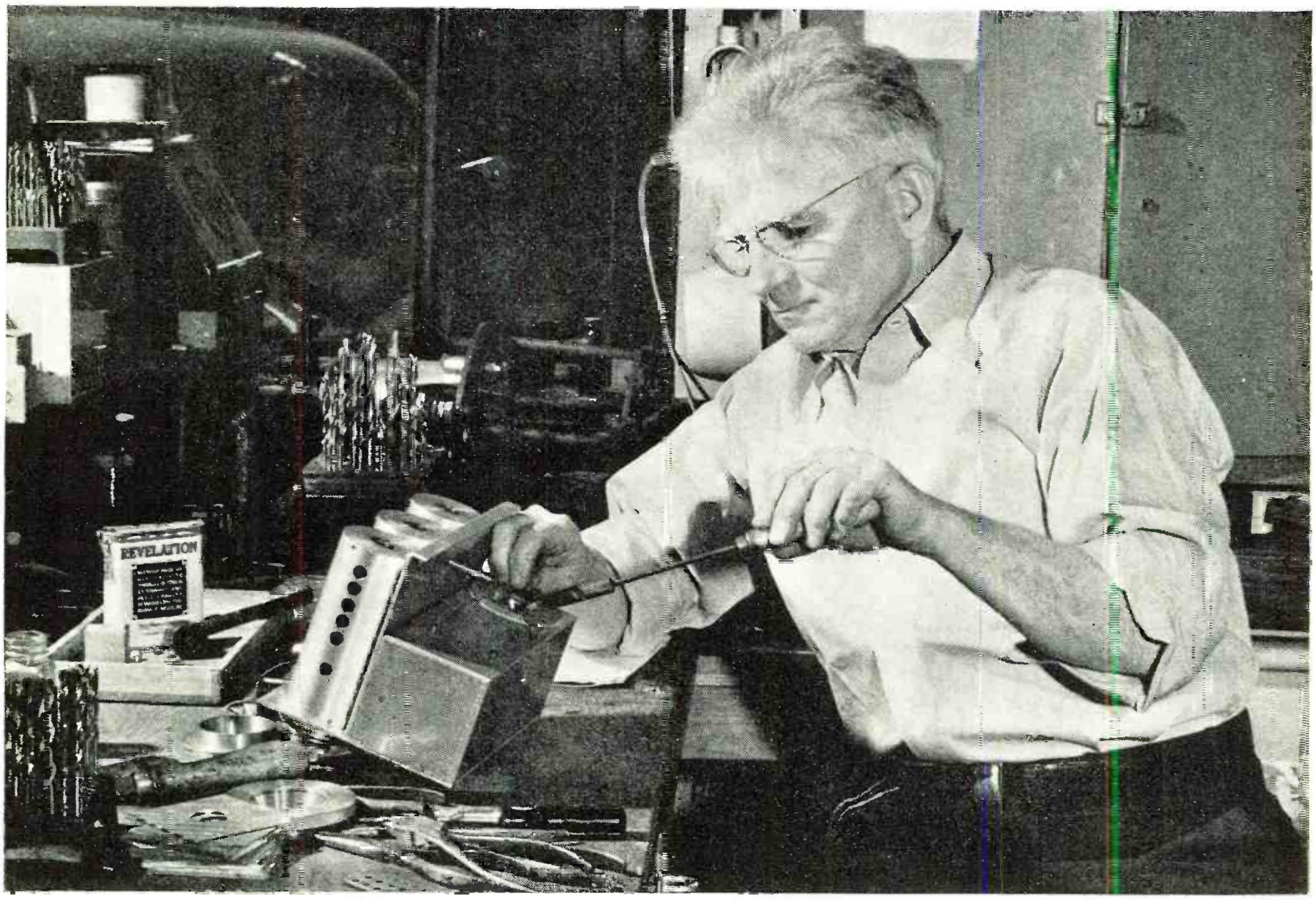
Another example is the companion unit to the SCR-194, the SCR-195, which differs in frequency range and antenna design. Both these sets have found a wide field of usefulness.

In standardization, it is essential to analyze the many varieties of application, the adaptability and flexibility of use and of course the actual reliability under all sorts of conditions. The assignment is not a simple one, for even a quick study of the many sites and complicated situations in which receivers, transmitters and other equipment may find themselves will show the necessity of an involved list of qualifications. Each of these

(*Continued on page* 59)

This radio equipment was put on display recently to show latest innovations.

URGENT NEED for RADIO MEN



Radio mechanic-technician wiring ultra-high-frequency receiver.

by LEWIS WINNER

Radio men by the hundreds are finding their place in our war effort. Both young and old are needed to fill military and civilian jobs.

THE enormous obligations of War have created an unprecedented demand for technical manpower, particularly in radio. The endless stream of War equipment now being produced, in which billions of dollars of radio units are being installed, requires the services of countless engineers, operators and mechanics. Already thousands and thousands are engaged in this important work, but thousands and thousands more are urgently needed.

So vital is this need that the *Civil Service Commission* has extended practically all openings indefinitely. Recruiting missions are even being used by various services. The most recent of such missions was organized by the *Army Signal Corps* to cover principal cities from coast to coast. The group, representing both the *Civil Service Commission* and the Chief Signal Officer of the *United States Army,* was headed by Colonel Fred G. Miller of the *Signal Corps.*

The representatives of the *Civil Service Commission* were delegated to give the *Commission's* approval to appointments on the spot. Thus it was possible to interview an applicant, hire him and assign him to duties within a few hours. This unusual procedure was necessary because of the *Army's* pressing need for personnel to maintain and operate that radio and telephone equipment.

The personnel needs of the *Signal Corps* and the types of jobs available were explained at meetings, where talks were also given by officers representing the *Office* of the *Chief Signal Officer* and *Signal Corps Laboratories.* After the program was outlined, the meeting was divided into small groups so that qualifications would be discussed. In many instances, acceptable candidates were hired immediately or shortly thereafter.

The positions available carry pay ratings from $1800 up. The exact rating depends of course on the individual's education and experience and the nature of the job for which he is accepted.

Many companies, in which men needed for *Signal Corps* engineering and technical work, are now employed, have been cooperative in releasing such men. At a preliminary meeting in Chicago recently, Lewis Atlas, vice-president of the *Columbia Broadcasting System* encouraged every employee of his company who could be spared to apply immediately for jobs in the *Signal Corps.* As a result, a number of highly qualified engineers went to the famous *Signal Corps.*

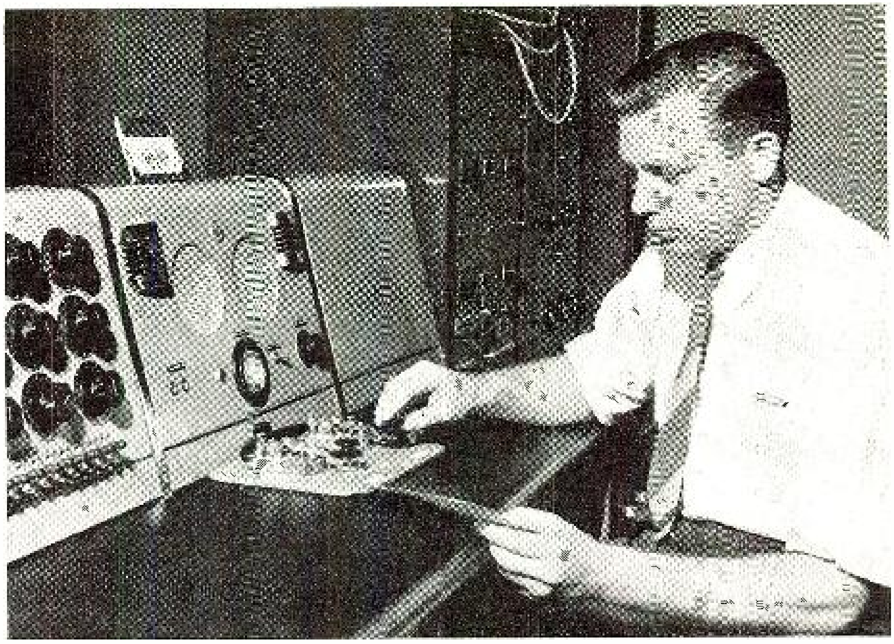
Radio mechanic-technicians represent one of the most important groups needed. Accordingly, five grade openings, from Junior to principal, and paying from $1440 to $2300 a year have been set aside for the *Navy* and the *Civil Aeronautics Authority,* as well as the *Signal Corps.* The duties in this division cover varied activities in connection with construction, assembly, maintenance, overhaul, repair or operation of many types of radio equipment. To qualify, the applicants must show that within five years immediately preceding the date of receipt of application, they have had at least from six months to three years of full time paid experience in some branch of technical radio work, or related electronic work, such as radio electrician, radio engineer, radio repairman, radio operator, etc., the exact length of experience related depending on the position sought.

The three year experience rating is required for the chief radio technician, while only six months are necessary for the assistant post. The Junior post does not require any experience. In addition the applicant must have also successfully completed a 6 months' technical radio course of resident study in an acceptable radio school, or a one year resident study in a school of engineering or technology of higher then secondary grade which has included courses in radio, or a course in a United States Defense Training program in any branch of radio. Applications will even be accepted from persons now in attendance in the foregoing courses, but such persons will not be certified for appointment until a satisfactory evidence of the successful completion of the training course has been received.

Age limits for this position are from 18 to 53. Competitors are not required to report for examination at any place. They will be rated on the type, extent and quality of their education and experience relevant to the duties of the post sought. Sworn statements and corroborative evidence will, of course, also be necessary.

Not only can men apply for radio posts, but women too, in the special six-month training source trainee-repairmen program, during which trainees are paid at the rate of $1440 a year. Qualifications necessary for this position are an amateur license (or any radio operator's license of higher grade) for at least two consecutive years provided the operator has built his own receiver and transmitter or has built such equipment for others. If a license isn't available, at least six months' full time paid experience in some branch of technical radio work, or related electronic work, such as radio mechanics, etc., may be substituted as a qualification.

Other qualification substitutes are the successful completion of at least two scholastic years of an electrical, telephone or radio repairman course in a vocational or industrial senior high school (tenth grade and higher), or the successful completion of a 6 months technical radio course of resident study in a radio school, including maintenance and repair of radio, or completion of other courses as described for the mechanic-technician posts.



Sending messages in code on latest commercial equipment.

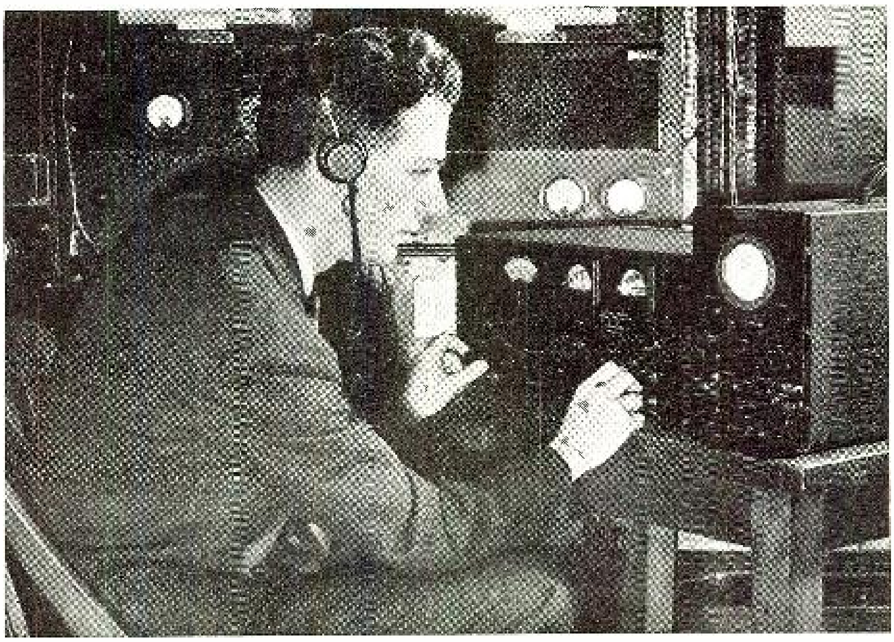
In this position, the duties will include eight hours of advanced instruction per day on the overhaul, maintenance, repair and inspection of miscellaneous *Signal Corps* equipment, including radio, telephone, and telegraph, power and light equipment. The only examination given is a written aptitude test, which will consist of problems in spatial relations, arithmetic and simple mechanics, given for applicants to this post. The age limits are from 16 to 50. Those who have not reached their 18th birthday may be employed only in accordance with the State Laws.

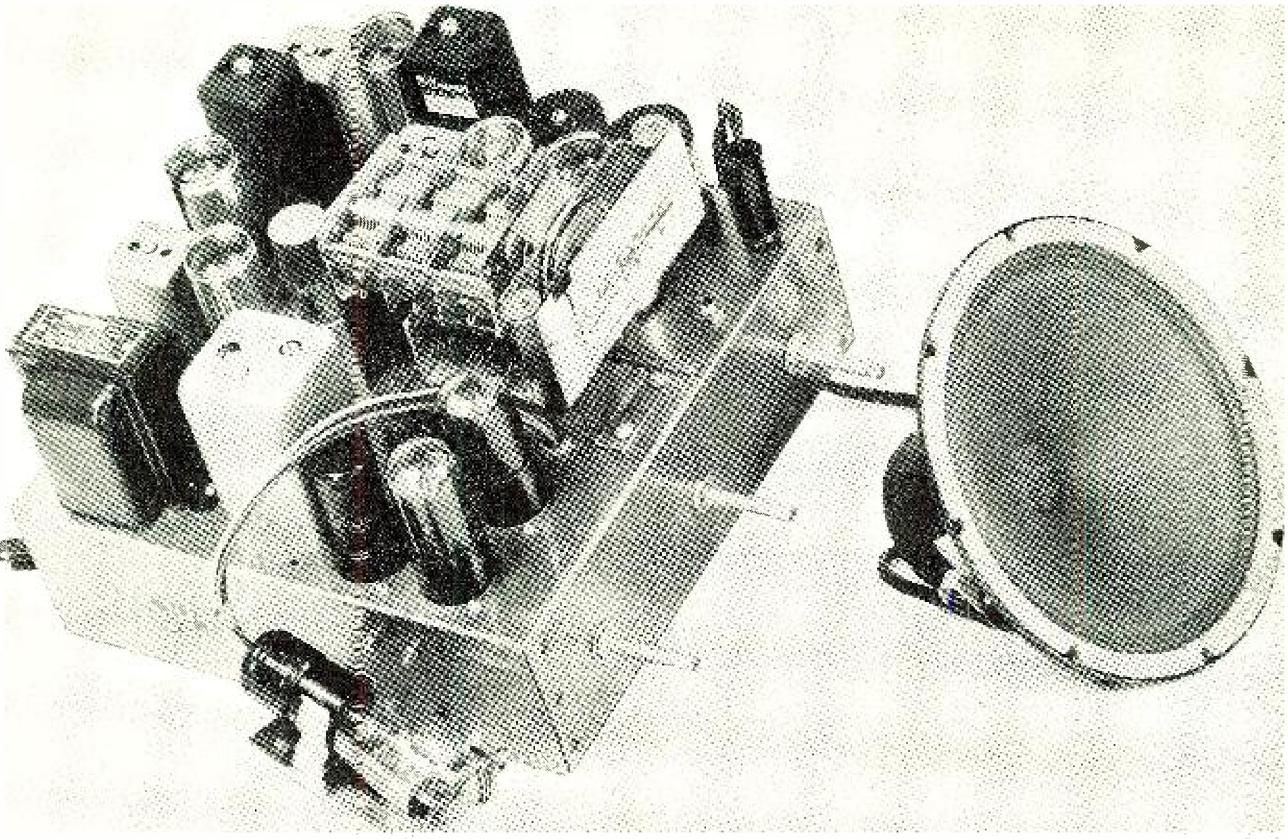
Upon the successful completion of the training course, trainees will be eligible for assignment of Junior Repairmen, *Signal Corps,* at a salary of $1620 a year. Subsequent advancements to positions of higher rank are possible, provided individual efficiency and ability are proven.

So acute is the need for technical personnel in some divisions, that those with nothing more than a mechanical aptitude and suitable fundamental education, can enter a six month mechanic-learner course, during which time the applicant is also paid at the rate of $1020 a year. In this course,

(Continued on page 60)

Engineer adjusting monitoring equipment used for defense.





The tuning eye assembly mounts back of the panel after the set is completed.

Build Your Own FM-AM Receiver

by WILBERT T. PETERSON

It will become increasingly difficult to purchase FM-AM sets so many will want to build their own. This article tells how.

THE combination AM-FM radio receiver presents several obstacles to the average home constructor which must be overcome before such a receiver can be designed and built. The band-switching arrangement, i.f. stages, tuning systems, and antenna system all present their individual problems which must be ironed out before construction is started.

With a little ingenuity, which most home workshop radio enthusiasts possess, and with the experience in building such a unit related in this article, considerable success should be attained in constructing this type of receiver.

Simplicity is the keynote upon which this particular receiver is built, however, none of the circuits which comprise a good superhet were eliminated. An r.f. stage for both FM and AM channels is utilized. together with the usual number of i.f. stages needed in a good receiver.

The tube complement is only 11 tubes, this number being kept small by using dual purpose tubes and combination circuits. The entire receiver is built on a 10-inch square chassis, making a very compact unit.

The tube filaments are in series totaling 118 volts, thereby eliminating any resistance in the filament line.

Circuit Design

By means of an 8-pole 5 position gang switch, of which only 7 poles and 3 positions are used, the various circuits are selected for AM, FM or phono attachment. The receiver contains two antennae, r.f., and oscillator coils, the proper combination selected by the switch for either FM or AM.

The 456 kc. input i.f. and 1st 4300 kc. FM transformers are in series as are the 456 kc. output i.f. and 2nd 4300 kc. FM transformer. The secondary windings of the latter combination are connected to their own respective circuits however. This method of placing the FM and AM i.f. transformers in series eliminates additional tubes and switching arrangements which would be necessary if separate i.f. stages were used. Since each transformer is tuned to its respective intermediate frequency, very little loss is experienced by connecting them in series. The mixer output voltage, whether it be 456 kc. for AM or 4300 kc. for FM naturally places itself across its respective transformer.

Beginning with the antenna circuit, the center tap of the FM antenna coil primary is connected to the antenna terminal of the AM antenna coil. The grid circuit of the 6SK7GT r.f. tube is switched to either the FM or AM coil. In the same manner the plate circuit of this 6SK7GT, the grid circuit of the 6SA7GT mixer, and the plate and grid circuits of the oscillator section of the 6SA7GT are connected to their respective taps on the proper coil forms.

When the switch is placed for AM reception, the 456 kc. output of the mixer tube is applied to the 456 kc. transformers and 6SK7GT i.f. tube and to the 6H6 rectifier. For FM reception, the 4300 kc. output applies itself to the 1st i.f., 6SK7GT tube, 2nd i.f., the second 6SK7GT tube, 3rd i.f., the 6SJ7GT limiter, the discriminator coil and 6H6 rectifier.

The output of both these 6H6 rectifiers are then switched respectively to the volume control. The grid of the 6E5 magic eye tube is also switched to either the grid circuit of the limiter for FM or the load resistor of the 6H6 diode rectifier for AM.

The volume control then places the rectified signal to the one grid of the 6SC7GT tube. The other grid receives an opposite phased signal enabling both plate circuits of this tube to be in push-pull with the grids of two 32L7GT tubes. The plate circuits of the pentode sections on the 32L7GT tubes are connected to a push-pull output transformer to feed the speaker.

The rectifier sections of the 32L7GT tubes are connected in parallel as half wave rectifiers, furnishing a current of 150 MA for the receiver. In this manner a power transformer is eliminated.

For phono operation, a third position of the gang switch connects the volume control to the phono jack.

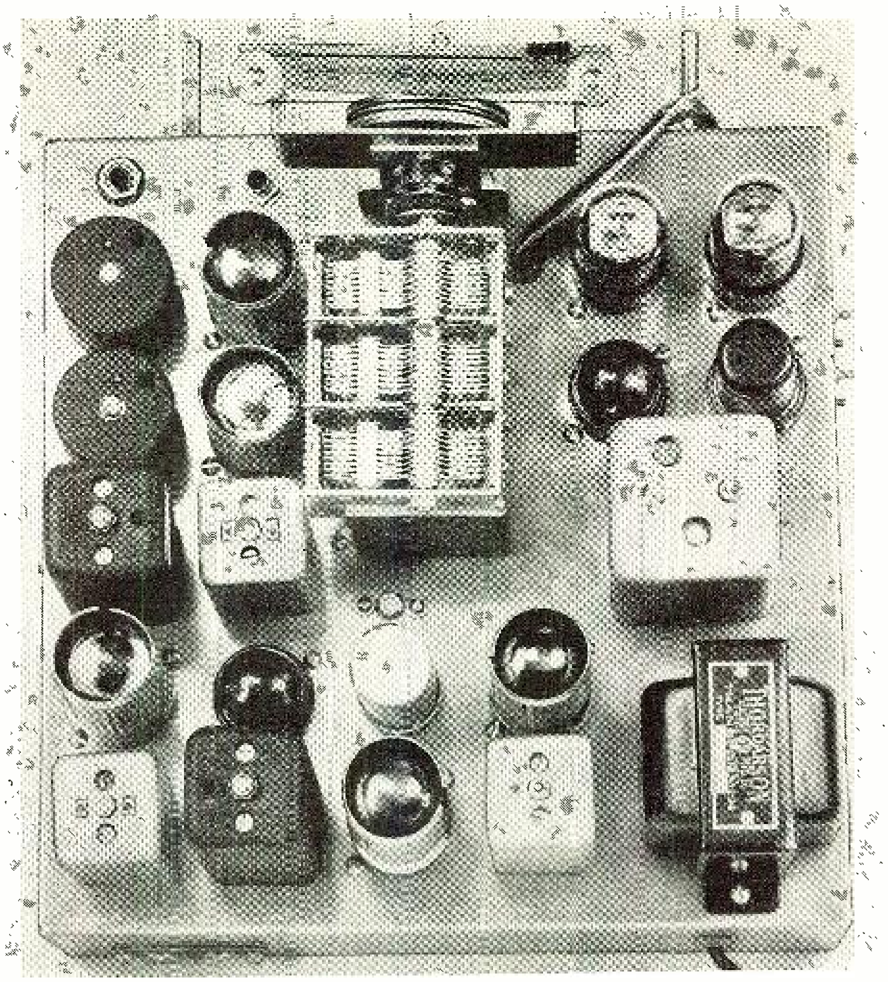
Construction

By following the photographs, the placement of the various components can be determined. After the parts are arranged and marked on the chassis, the socket holes, transformer holes, etc., are punched.

The small FM three-gang condenser is mounted with ¼-inch spacers to the chassis with holes drilled so that its trimmers and leads can be wired from underneath. The trimmer on the back section of the gang is removed, as an air tuned padder will be used in its place. The 365 mmf. 3-gang condenser is mounted *above* the FM gang by means of a bracket made of sheet brass. The dial is now connected to the 365 mmf. gang and a bracket is made to secure it to the chassis. Two pulleys are either purchased or made, if a lathe is available, and placed on the two gang shafts. A *Walsco* universal dial belt is fitted to complete the dial mechanism. This arrangement was used because both gangs are available.

The components are now mounted to the chassis. The stop on the gang switch is set so that it operates on three positions, the other two unused. The FM and AM oscillator padders and AM oscillator coil are mounted under the chassis side by side behind the switch. The shield can is removed from this oscillator coil.

Wiring is begun at the filament circuits. The *hot* side of the filament line is placed on one of the 32L7GT tubes. Since the 6E5 cable is brought through the chassis near the 32L7GTs, its filament is inserted between these two tubes. The filament circuit ends at



There is no crowding of parts in this receiver. Plenty of space is available. The set works from either A.C. or D.C. power lines.

ground potential at the 6SK7GT r.f. tube.

As the side wall of the chassis is three inches high, it is used to mount tie lugs and resistors as illustrated, thus saving room on the underside of the chassis for other components. All audio grid and plate circuits should be wired with shielded wire if possible.

All resistors and condensers are mounted between tie lugs or spare tube contacts or direct to ground. This rigid mounting must be used especially in the r.f. circuits so that circuit constants will not be changed by a movement of the parts or wiring.

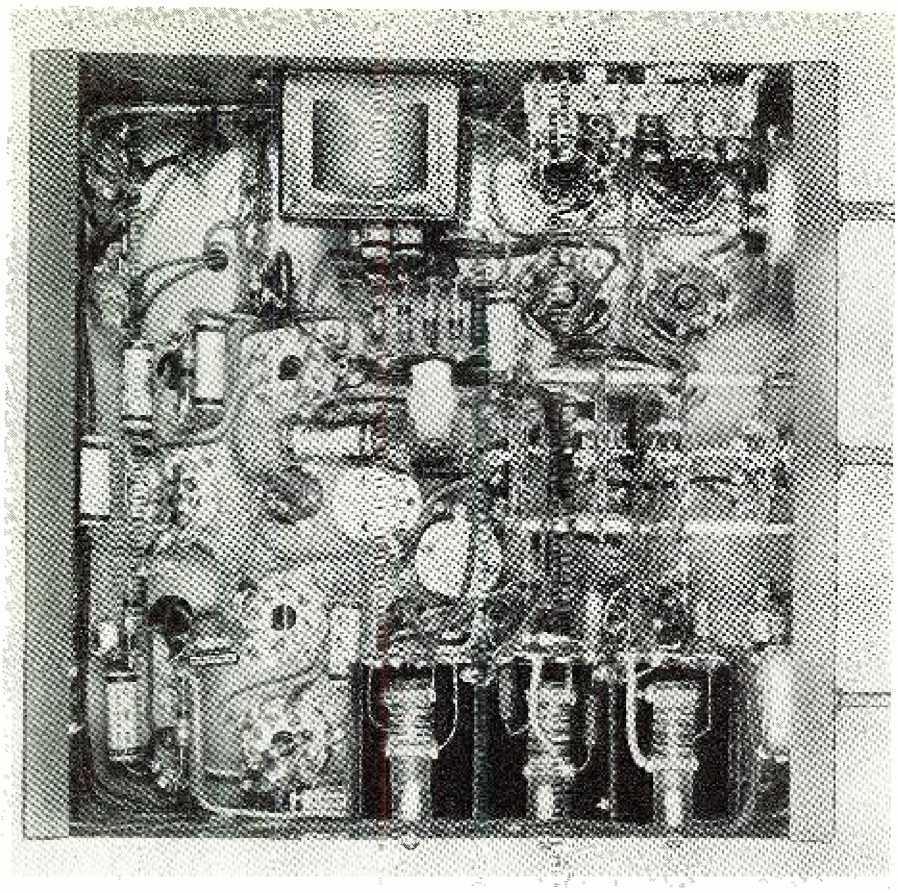
After most of the components are wired in, the FM coil assembly can be built. This is last because the unit is placed above the antenna and r.f. AM coils which must first be wired in.

The FM coil assembly consists of three *amphenol* 912A ½-inch rods 2 inches long. The turns are wound on half of the rod, the other half being used as a stand-off insulator for mounting to the chassis. The antenna and r.f. coil is wound with number 18 enamel wire, 5 turns, spaced to a length on one inch. The oscillator coil is wound with the same wire but has four turns, spaced to ¾ inch. The primary of the antenna coil is wound with No. 20 pushback wire, 2 turns around the grounded end, and tapped in the center. The r.f. coil has only the one winding, with the two .004 mfd. mica condensers mounted alongside. The oscillator coil primary also has two turns of No. 20 pushback wound around the grounded end.

The coil shields are constructed of brass sheet, with two partitions dividing it into three sections. The shield is five inches long 2¼ inches wide and 1¼ inches deep. The end of the coil forms are now drilled and tapped for an 8-32 bolt.

At one end of each partition of the coil shield, tie lugs are mounted to serve as terminals for the coil. The shield is now mounted under the chassis to the side next to the antenna and r.f. AM coils. It should be placed as low as possible without touching the 6SA7GT and 6SK7GT tube contacts. The coils are now placed in their respective partition allowing approximately the same space between the coil and the shield. Holes are drilled into the side of the chassis to accommodate the 8-32 bolts which secure the coil form.

The coils are wired to their tie lugs, and wired into the circuit. No. 18 or heavier pushback wiring should be used for the FM circuits, running the leads to the switch as direct as possible. The terminals of the FM gang condenser, which protrude under the



FM coils are in shielded cans seen in lower right-hand corner.

gang switch are wired direct to the switch, and from there to the coils.

The antenna is a "dipole" with 5 feet per side. Two revamped automobile antennae mounted on a 2x4 mast make a cheap but efficient dipole.

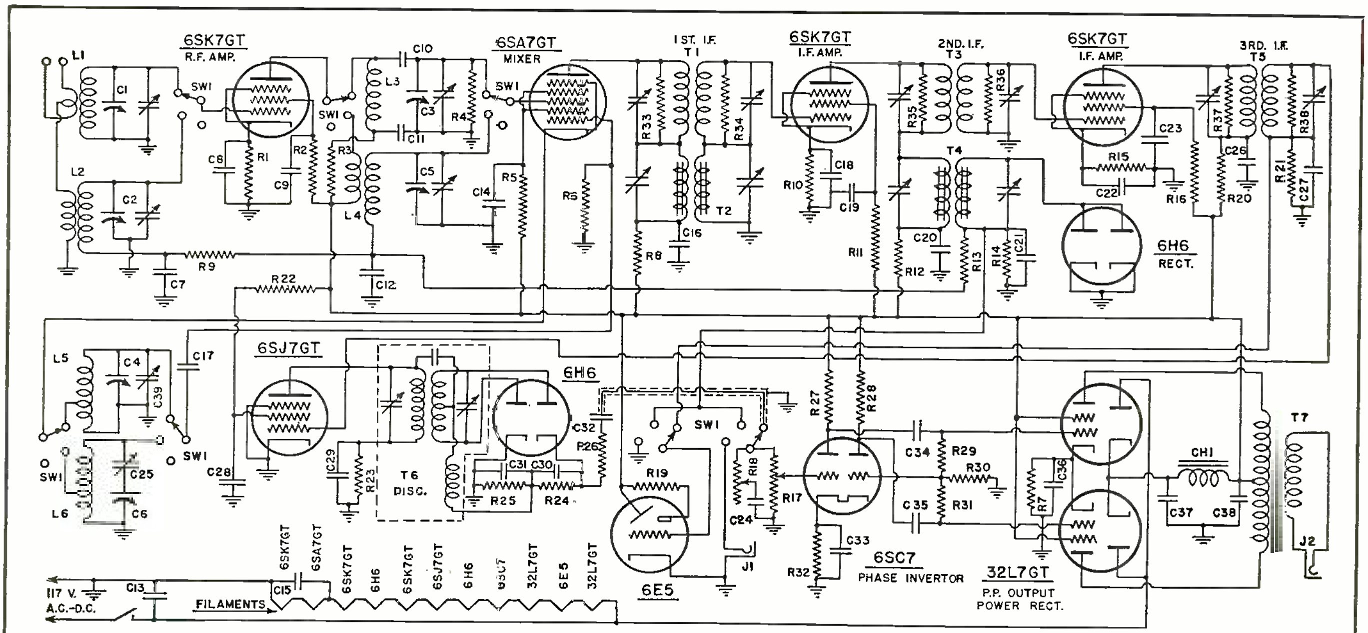
The *Crowe* dial used is revamped to accommodate the FM scale. This type of dial has two broadcast scales running in opposite directions, one above the other. Remove the one that does not follow the rotation of the 365 mmf. condenser by using steel wool. The dial is made of celluloid and the ink rubs off easily. Care should be taken so as not to disturb the broadcast scale to be used. A logarithmic FM scale from 42 to 50 is then printed with a printing guide if possible. Since the dial is small, very little error in calibration will be noted as long as the scale is a logarithmic value.

Alignment

Alignment of the receiver requires a test oscillator and an electronic voltmeter. Before proceeding with the alignment however, the audio system and magic eye circuits should be checked to see if they are working properly. An audio signal from an audio oscillator or record player, etc., can be used to check the audio circuit. The magic eye should be open, and by pressing the finger on the grid circuit, a slight fuzzy closure should be seen.

The test oscillator is set to 456 kc. and placed on the grid on the 2nd

(*Continued on page* 58)



C_1, C_3, C_4—3-30 mmfd. variable, Meissner #21-5201
C_2, C_5, C_6—365 mmfd. variable, Meissner
C_8, C_{15}—.001 mfd. @ 400 v., Sprague
C_7 C_9, C_{12}, C_{13}, C_{14}, C_{16}, C_{18}, C_{19}, C_{20}, C_{22}, C_{23}, C_{24}, C_{26}, C_{28}, C_{29}, C_{32}, C_{34}, C_{35}—.01 mfd. 400 v.,
C_{10}, C_{11}—.004 mfd. @ 400 v., Sprague
C_{17}, C_{27}, C_{21}—.0001 mfd. mica, Aerovox
C_{30}, C_{31}—50 mmfd. mica, Aerovox
C_{33}, C_{36}—10 mfd. @ 50 v., Mallory
C_{37}, C_{38}—30 mfd. @ 150 v., Mallory FPC
C_{25}—150 mmfd. mica, Aerovox
C_{39}—50 mmfd. (variable air padder), Millon
R_1, R_{10}, R_{15}—200 ohm ½ w., IRC
R_2, R_3, R_5, R_8, R_{11}, R_{12}, R_{16}, R_{20}—1,000 ohm ½ w.,
R_4, R_9, R_{24}, R_{25}, R_{21}—100,000 ohm ½ w., IRC
R_6—25,000 ohm ½ w., IRC
R_7—200 ohm 1 w., IRC
R_{13}—1 megohm ½ w., IRC
R_{14}—500,000 ohm ½ w., IRC
R_{17}—500,000 ohm V.C. with switch, Mallory
R_{18}—50,000 ohm tone control, Mallory
R_{19}—1 meg ¼ w., IRC
R_{22}, R_{23}, R_{26}, R_{33}, R_{34}, R_{35}, R_{36}, R_{37}, R_{38}—50,000 ohm
R_{27}, R_{28}—250M ohm 1 w., IRC
R_{29}, R_{30}, R_{31}—250M ohm ½ w., IRC
R_{32}—2M ohm ½ w., IRC
T_1—1st FM IF transf., Carron (#S-411)
T_2—456 K.C. 1st IF transf., Meissner (#5740)
T_3—2nd FM IF transf., Carron (#S412)
T_4—456 K.C. 2nd IF transf., Meissner (#5742)
T_5—3rd FM IF transf., Carron (#S-413)
T_6—Disc. Transf., Carron (#S-415)
T_7—Output transf., Thordarson (#T67551)
Ch_1—Filter Choke 120 ma, Stancor (#C2303)
L_1—FM ant. coil, see text
L_2—Ant. coil, Meissner (#14-1024)
L_3—FM RF coil, see text
L_4—RF coil, Meissner (#14-1025)
L_5—FM osc. coil, see text
L_6—Osc. coil, Meissner (#14-1033)
J_1—Phono Jack, Utah
J_2—Speaker Jack, Utah
Sw_1—Switch 8 pole 5 position, Mallory
Sw_2—Switch on volume control
Dial—Crowe (#3062)
Tubes—3—6SK7GT; 1—6SA7GT; 1—6SJ7GT; 2—6H6; 1—6SC7; 2—32L7GT; 1—6E5 — Sylvania
Speaker—Jensen (#PM8-CT)
Chassis—10"x10"x3", Bud

WAR!
STIMULUS FOR INVENTIONS

by ALFRED TOOMBS

Our recently announced contest is designed to aid in the success of this undertaking.

WAR acts as a powerful stimulus for invention. This is particularly true in a field such as radio, where more is unknown than is known. Radio is playing such an important part in actual military operations it is obvious that, in our effort to keep our armed forces ahead of our enemies, we must concentrate much of our research talent in this field. In addition, the minds of many individuals, not connected with any research organizations, are filled with ideas for improvements which might contribute to the efficiency of the armed forces.

The impetus of the war has already been felt in the field of radio. Certainly in no other field have we seen such startling developments during the war as we have in radio. The things which are being done now in the application of radio principles to warfare almost defy the imagination. The public knows nothing of these developments, but they will before the war is over. And there is reason to believe that the inventions which have come forth so far will be eclipsed by even more amazing developments before many months have passed.

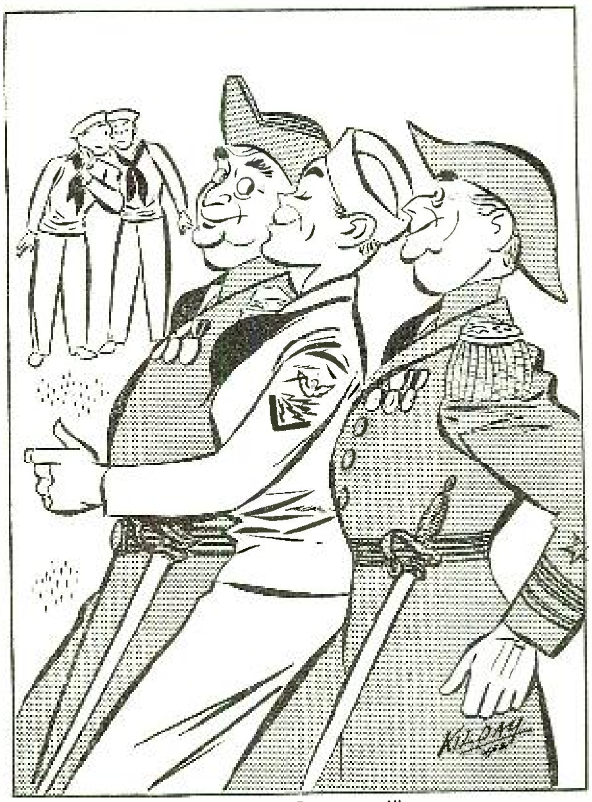
The details of these new developments must, necessarily, remain secret at this time. However, the fact that such progress is being made certainly indicates what great opportunity there is in the field.

This is total war and that belabored term implies not only complete mobilization of manpower and resources, but of ideas as well. The trained minds of the country must concentrate on the war effort. To aid in this mobilization of the nation's inventive talents, the Government has established in Washington an organization known as the *National Inventors' Council.*

All inventions which come into the Government are cleared through this agency. Some 50,000 inventions have been studied by the engineers of this organization and several thousand of those suggestions have been in the field of radio. It is possible to say that a number of these have been very promising. Many of the inventions which the *Council* has received are now under development and some day soon these may be heard from in tones not pleasant to the Axis powers.

The success of Americans so far in making discoveries which are of value in the war effort has prompted the *Council* to seek to encourage others to forward their ideas to Washington. Particularly, is the *Council* anxious to get inventions and suggestions from men who have training, experience and knowledge in such a field as radio. The ideas which come from radio operators, from radio engineers, from servicemen and men who work in the factories which are manufacturing radio equipment will always have their basis in knowledge. It is obvious that the ideas originating in trained minds will have the greatest practical value.

There are many men in the radio field who have already come forth with inventions which show promise. All of these inventors have not been trained research men. Many good ideas have come from individuals who have little formal training and who had limited laboratory facilities. There was the West Coast amateur operator who developed special silencers which reduced the intensity of all sort of interference to an astounding degree. The *Army* has made extensive tests on this equipment. A soldier, undergoing training at one of the *Army's* centers, invented a device which the *Air Forces* promptly took an interest in. A couple of youngsters with an idea developed the instrument which is called the *Klystron* and which has revolutionary implications.



"He's a RADAR man!"

So it can be readily shown that the talent for useful invention may belong to any American.

There has probably never been a time in the history of radio when the men who work in the field were presented with such an opportunity for great service to the country. There is constant demand for improvement in the art.

We know that our enemies are alert and that they are doing everything in their power to press ahead of us in utilizing radio. Because so little is known about radio, it is possible that at any time some discovery may be made which will revolutionize the conduct of the war. There is no way of telling from what source or sources such a discovery might come. Therefore, every new idea is carefully studied. There is no chance that an inventor who sends in a worthwhile new idea today will get a brushoff. This is the time when a man can be sure that this invention will receive a fair trial and will be put to the best use.

The question which is most frequently asked of the *Council* is "What kind of inventions do you want?" It is not possible to answer that question in detail. For if the *Council* told exactly what type of inventions it needed, the enemy would not find it hard to figure out what we have and what we have not in the way of radio equipment. It is possible, however, to make certain suggestions.

There are, in general terms, two types of inventions. The first is the concept which is so revolutionary that military requirements and strategy may have to be changed in order to utilize it. Such an invention was the (*Continued on page* 53)

Analysis of Feedback and Prevention of Oscillation in HF Amplifiers

by THORNTON CHEW
Television Engineer

The author has made a careful study of these subjects in his work with Television and FM on frequencies from 50mc to 325mc

PREVENTION of oscillation has always been one of the first concerns in designing a radio frequency amplifier. In the wide-band amplifiers of television and frequency-modulation systems, even regenerative action must be avoided to secure optimum wide-band response.

With the advent of high gain tubes, such as the type 1851 and 1231 series, and the trend toward more general use of the ultra-high frequencies, the usual steps toward prevention of oscillation or regeneration are not sufficient and must necessarily be supplemented. A review of pertinent principles and diligent extension of their applications provide methods of meeting the new requirements.

The following conclusions are based upon study of the dynamic characteristics of vacuum tube amplifier circuits, coordinated with experimental observations. The formulae developed observe only parameters of major significance, and are merely intended to show qualitative relationships.

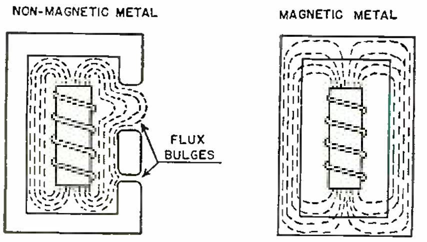


Fig. 1. Electromagnetic Fields.

The prime requisite for self-sustained oscillation is that more energy be fed back from amplifier plate circuit to grid circuit than is dissipated in the grid circuit through resistive, absorption, and insulation losses. With the use of high-gain tubes, hitherto inefficient coupling points between plate and grid circuits become capable of maintaining this necessary power transfer. Also, at high frequencies, the efficiency of inductive coupling points, as well as of capacitive coupling points, is greater, due to their increased and decreased reactances respectively.

Thus we see that the increased tube amplification factor and the increased frequency of amplified currents have combined to enlarge feedback problems. These problems are not new; they are only magnified. Neither are the remedial measures new. But they must be carried to greater heights of efficacy.

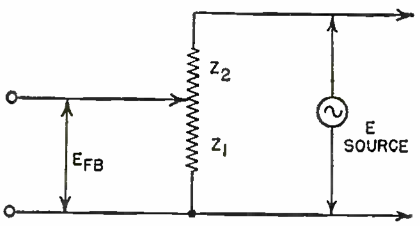


Fig. 3. Voltage divider condition.

The most important requirement for solution of feedback problems is that we be able to recognize the existence and magnitude of the coupling points. Let us first consider coupling accomplished through magnetic fields surrounding the plate and grid inductances.

Immediately, isolation of the two magnetic fields by means of shielding is suggested. At high frequencies, however, shielding must be especially complete. At the highest frequencies, completely encompassing individual stage shields of highly conductive non-magnetic metal will be found necessary. Openings in the shield should be avoided and those necessary for lead wires should be small to prevent "bulging" of the magnetic flux outside the shield, where it may be intercepted by sections of other circuits. Experiment has shown that his "bulging" of r.f. fields from shielded spaces is proportional to the size of the hole.

Non-magnetic metals such as copper and aluminum are used for two reasons. First: magnetic flux lines in attempting passage set up eddy-currents in opposition which in effect reject the magnetic field and confine it within the shielded air-space as shown in Figure I. Individual stage shields prevent coupling due to mutual effects between eddy-currents in the shields.

Second: their high conductivity provides a low-impedance ground termination of electrostatic flux lines.

To prevent capacitive coupling, i.e., coupling by means of mutual action between these electrostatic flux lines, points of high r.f. potential of successive stages should not be close to a common shield plate as shown in Figure 2a.

To more easily visualize this type of feedback, let us view it as taking place through voltage divider networks formed by impedances which may have predominant inductively reactive, capacitively reactive, or resistive components. Thus in Figure 3 the feedback voltage will be essentially in the same ratio to the source voltage as Z1 is to Z1 + Z2.

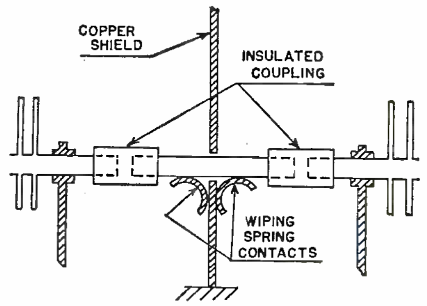


Fig. 4. Reducing feedback through shafts.

It is important to note that the feedback is reduced by decreasing Z1, increasing Z2, or both. Z1 decreases with increase in frequency as $\frac{1}{wc}$ when Z1 is essentially capacitive reactance. Z2 increases with frequency as wL when Z2 is effectively inductive reactance. When it is chiefly the resistance in a shield or chassis, Z1 increases with frequency due to the "skin effect."

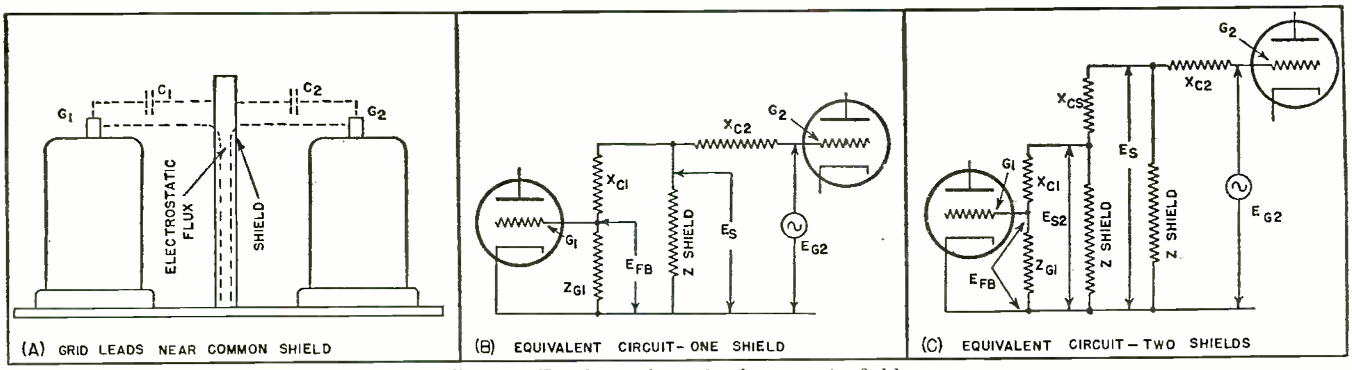


Fig. 2. Feedback through electrostatic fields.

Added impedances may form several stages of this voltage division successively decreasing the feedback voltage as in Figure 2b and Figure 2c. In this case, the capacities between the two grids and the shield, and the inductive reactance along with pure resistance in the shield plate form an impedance voltage divider. The voltage Es appearing across the shield will be $Es = \frac{Eg2\,Z}{Z + Xc2}$ where Eg2 is the grid voltage source, Z is the shield to ground impedance, and Xc2 is the second grid to shield capacitive reactance.

By moving grid No. 2 further away from the shield, the capacitive reactance Xc2 is increased, and the coupling voltages Es will be reduced. Now again looking at Figure 2b, we see that the actual feedback voltage Efb applied to the 1st grid will be

$$Efb = \frac{Es\,Zg_1}{Zg_1 + Xc1}$$

where Zg_1 is the first grid's impedance to ground, and Xc1 is the first grid's capacitive reactance to the shield.

By placing grid No. 1 farther away from the shield, the capacitive reactance Xc1 is increased, and the feedback voltage Efb is decreased. Figure 2c shows how the feedback through this path is reduced by adding another shield, with space between, to provide still more voltage division. The reduction in feedback voltage gained thereby will be in the ratio $\frac{Xcs + Z}{Z}$ where Xcs is the capacitive reactance between the two shields. This is of special advantage when the amplifier must be compact.

Ganged tuning-condenser rotor shafts may provide considerable coupling at ultra-high frequencies, and therefore good shaft grounding contacts and insulated shaft couplings should be provided between each rotor section. Figure 4 shows a shaft coupling method which has proved very effective in preventing feedback through this point.

This may be likened to inserting a "T" network attenuator pad between the rotor shafts. The greatest reduction of feedback depends upon obtaining maximum impedance in the two insulated couplings and minimum impedance in the shield. While it may appear ridiculously extreme, even the capacity between the ends of the shafts inside the insulated couplings is worthy of consideration at ultra-high frequencies.

Another means of feedback transfer in cascade amplifiers is through the impedance of common portions of plate to cathode return circuits as obtained when plate current for two or three successive stages is supplied through a common wire. Figure 5 shows such a circuit condition. Even assuming the plate return is well by-passed at the plate voltage source, such a common wire carrying ultra-high frequency currents presents a relatively large impedance. This impedance will form part of the load of each plate circuit and therefore a part of the signal voltage will appear across it.

This too may be viewed as an impedance voltage divider and the extent of feedback will be $Efb = \frac{Z\,wire\,Ep}{Z\,wire + Zt}$.

In alternate stages where currents are in phase, feedback will result from superimposition of the feedback voltage upon the original signal voltage. In adjacent stages, the feedback voltage will be capacitively transferred through the r.f. transformer windings to the grid.

The remedy, of course, is to provide a separate signal return path by means of decoupling filters for each plate-cathode return circuit. The returning signal will divide between the bypass capacitor path and the plate supply path in inverse proportion to their respective impedances. Usually a good rule to follow in designing the decoupling filter is that the reactance of the capacitor at the lowest frequency to be passed shall not be more than about one-tenth the value of the decoupling resistance or choke reactance.

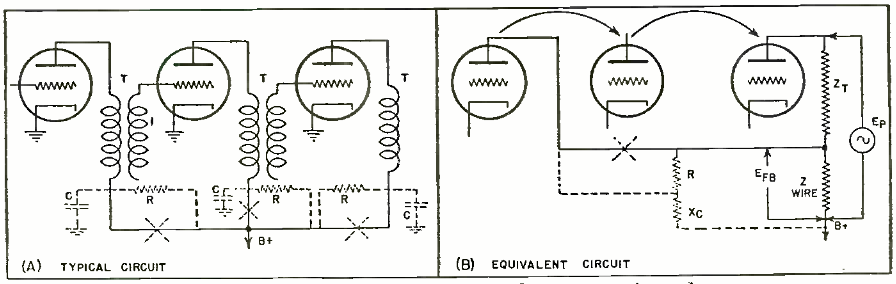


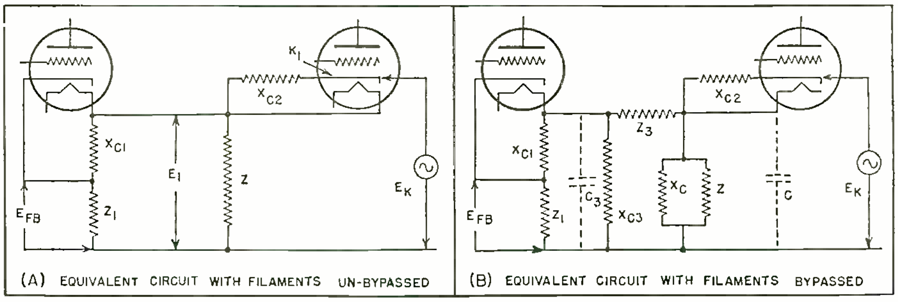
Fig. 5. Feedback through common plate circuit impedance.

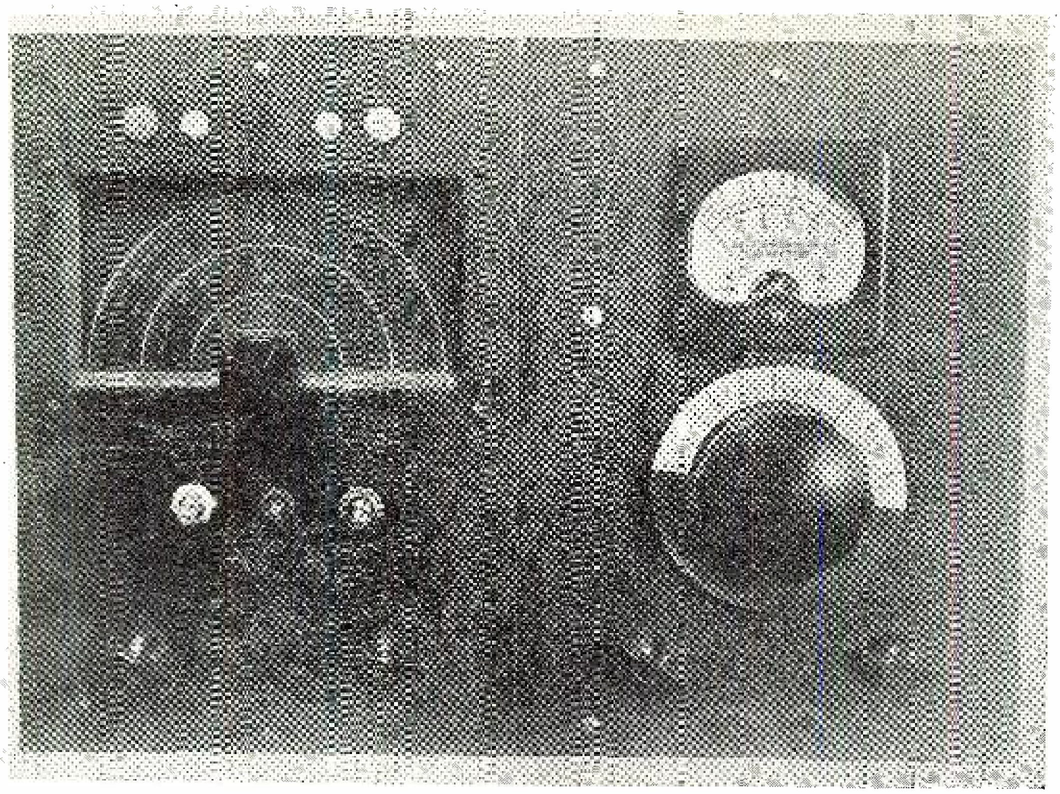
A capacitive type of feedback occurs when common filament supply circuits have sufficient impedance with respect to ground. Due to the close proximity of filament and cathode, signal voltage appearing on the cathode will be capacitively transferred to the filament. If the filament of a preceding stage is supplied by this same wire, the voltage will be transferred capacitively to the preceding cathode. Again let's consider it as an impedance voltage divider as in Figure 6a.

The voltage first transferred from K1 to the filament wiring at E1 will be $E1 = \frac{Z\,Ek}{Z + X_{c2}}$ where Ek is the cathode signal voltage, Xc2 is the cathode to filament capacitive re-

(*Continued on page* 44)

Fig. 6. Feedback through filament circuits.





This professional looking unit is easy to build and will find much service.

R.F. COIL ANALYZER

by HARRY L. POLING

Most of the parts needed for this tester may be found in the service shop. It can solve many circuit problems.

THIS instrument was built to meet a pressing need for a complete R.F. coil analyzer in one unit. It has proven so successful that we believed that others in our profession would be interested in its circuit, construction and method of application.

This analyzer may be used to measure the resonant frequency or tuning range of R.F. coils or circuits; to determine the inductance, resistance and distributed capacity of a coil winding; to check for leakage between windings and to measure the resistance of the windings; and to roughly estimate the "Q" of a coil or circuit.

Circuit Description

These tests are made possible by the use of a circuit comprising a variable R.F. signal source which applies an R.F. voltage across the circuit or coil under test. The step-up in voltage across the tested circuit when it is at resonance causes a deflection on the meter used in the plate circuit of the detector tube. There is also provision for connecting a calibrated variable condenser across the circuit under test for making tuning range and distributed capacity tests. The plate circuit meter has two ohmmeter ranges.

Referring to the diagram, it will be seen that the R.F. oscillator is a five range *Hartley* circuit covering the range of about 100 kc. to about 20 mc. A resistor, connected in series with the plate, provides an R.F. voltage drop which is used for the R.F. testing. This voltage is coupled into the circuit under test and also into the detector circuit by means of a very small coupling condenser. This condenser must be so small that no detuning of the circuit under test will occur. We used two pieces of cambric insulated hookup wire twisted together. The gridleak type detector is made extremely sensitive by using a 15 megohm gridleak. The meter in series with the plate circuit is adjusted to full-scale reading by means of the screen-grid potentiometer i.e. "voltage" control.

The input circuit is connected to a specially-constructed switch for connecting a calibrated variable condenser across the circuit to be tested. This switch was revamped from an old radio band-switch and is connected so that the grid connects to one of the contacts instead of to the arm. This greatly reduced the distributed capacity of the input circuit. The stator plates of the variable condenser are connected to another contact, so that when the switch is in the "on" position, the stator plates of the condenser will be connected to the grid circuit of the detector tube. At this point it is very important to keep all wiring in the detector circuit as short as possible and kept as far away from the chassis as possible. Otherwise, the distributed capacity of the wiring will cause serious errors. Also, the test leads used in the R.F. tip jacks must, for the same reason, be very short.

The analyzer "function" switch is a

three deck, four position unit. In the "Resonance" position, the meter is connected in series with the plate of the detector tube. When the switch is rotated to one of the ohms positions, the meter is connected to an ohmmeter circuit consisting of a battery and zero-adjuster and a pair of tip jacks marked "Resistance." When the function switch is turned to "Leakage" position, the meter is out of the circuit and the "leakage" jacks connect to a neon lamp circuit. This neon circuit incorporates a 25,000 ohm resistor for protection to the circuits under test.

The power supply is a conventional a.c.-d.c. circuit, using a 25Z6G rectifier tube, with the two sections connected in parallel. A resistor-condenser type filter is used. The filament voltage for the series connected tubes is obtained through a dropping resistor.

Construction

The accompanying photos show the layout we used. Our panel is 10″ by 14″, but the layout used is not greatly important, as long as the components are fairly close together, so that connecting leads will be comparatively short.

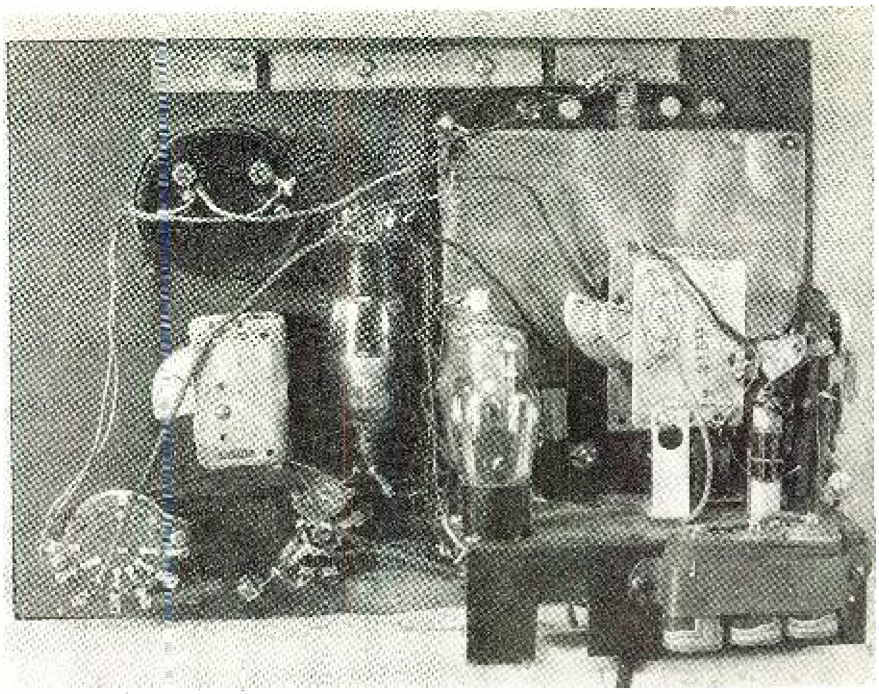
The inductances for the oscillator circuit are made by winding the specified number of turns on ½″ diameter dowel. When winding the coils for the lower frequencies, we glued sides to the form so that we could get many layers on in a small space.

	Turns	Size wire	Cathode tap
Band "A"	8	18 E.	3
Band "B"	50	18 E.	20
Band "C"	160	28 E.	50
Band "D"	260	28 E.	100
Band "E"	550	28 E.	200

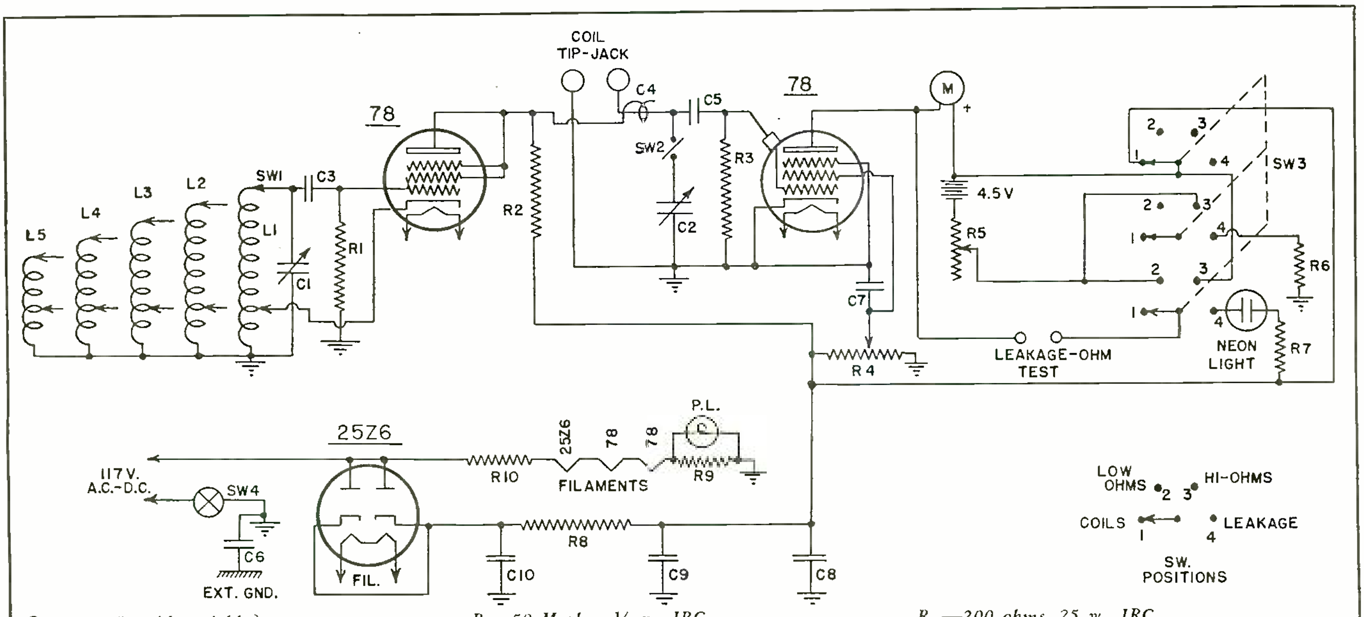
We calibrated the dial of the R.F. oscillator by beating the signal and its harmonics against broadcast signals of known frequency, tuned in on a radio receiver. For example: on a 700 kc. station, we got beats at 700 kc., 350 kc., 175 kc. On a 1600 kc. station, we got beats at 1600 kc., 800 kc., 400 kc., 200 kc. and 100 kc. This system was carried out with different stations in order to fully calibrate the oscillator dial. At this point it is well to mention that a TRF type receiver is better than a superhet for this calibration, as it eliminates errors due to images and beats with receiver oscillator harmonics.

We calibrated the variable condenser in the detector circuit as follows: After gluing a semi-circle of cardboard over the dial calibration already on the dial, we turned the capacity switch to "on" position, thus connecting the condenser across the R.F. jacks. Then, with very short wires, we connected the R.F. jacks to the input circuit of a capacity bridge whose dial setting had been carefully examined previously. We then set the condenser dial to various positions and marked its dial with the readings on the capacity bridge. By calibrating in this way, we included the distributed

(*Continued on page* 50)



This illustration shows how the input tube is inverted to gain short leads.



C_1—.00035 ufd. variable } Meissner
C_2—.000465 ufd. variable }
C_3—.0001 ufd. mica, Mallory
C_4—Coupling Cap. (see text)
C_5—.00025 ufd. mica, Mallory
C_6—.02 @ 400 w.v., Mallory
C_7 C_8—.25 ufd. @ 200 w.v., Mallory
C_9, C_{10}—10 ufd. @ 150 w.v. Elec., Mallory

R_1—50 M ohm, ¼ w., IRC
R_2—100 ohm, ½ w., IRC
R_3—15 megohms, ¼ w., IRC
R_4—100M ohm Pot. 1 w., IRC
R_5—5M ohm Pot. 5 w., IRC
R_6, R_7—25M ohm, ½ w., IRC
R_8—3000 ohms, 2 w., IRC
R_9—40 ohms, 1 w., IRC

R_{10}—200 ohms. 25 w., IRC
Sw_1—2 P. 5 pos. switch, Mallory
Sw_2—Cap. Sw. (see text), Mallory
Sw_3—3P4P Sw., Mallory
Sw_4—SPST Off-On Switch, Mallory
L_1, L_2, L_3, L_4, L_5—R. F. osc. coils (see text)
m—O-1 m.a. 3″ meter, Lafayette
P.L.—#44 Pilot light

Any metal or wood box may be used to house the instrument.

Build this VT OUTPUT METER

by BEN E. LONG

This meter is far less costly to build than conventional VTVM's and will take care of many measurements in radio work.

DUE to the high cost of commercial output meters and the frequent breakdown of the copper-oxide rectifier, this simple vacuum-tube rectifier type output meter is presented for construction by the service man and the experimenter.

The question will surely arise in the mind of the constructor as to whether it is more practical to build a vacuum-tube voltmeter or to build the output meter described. To answer this question properly, two important points must be considered. First, the use for which each is intended, and second, the economy of operation and simplicity of construction. The accuracy of their calibration should also be considered.

The advantages and disadvantages of each instrument will now be considered. First, both instruments may be used equally well in certain kinds of tests where the circuit under test is not disturbed by their use. On the other hand, the output meter cannot be connected directly to any circuit which will be disturbed by its connection and cannot be used in circuits carrying radio frequency currents. The vacuum-tube voltmeter can be used to measure any voltage at any frequency.

It takes a good man to properly construct and calibrate a vacuum-tube voltmeter. The output meter is far more simple to construct and calibrate. The home-constructed vacuum-tube voltmeter requires a calibration chart giving a separate multiplying factor for each voltage range. No calibration chart is required for the use of the output meter. With line operation of vacuum-tube voltmeters, economy of operation of both instruments is about equal.

Because of the simplicity of construction and calibration, the vacuum-tube type output meter has been chosen. If the constructor later desires to build a vacuum-tube voltmeter, he may do so. Most of the parts used in the construction of the output meter may be used for the vacuum-tube voltmeter with the addition of a few extra parts.

Construction

The complete instrument is constructed on a panel 6"x9". The meter is located near the top edge of the panel, with the remainder of the parts arranged in proportion. Looking toward the front of the panel, the filament rheostat is mounted on the left side, with the meter calibration control located at the right. The tipjacks for the various meter ranges are placed evenly around the meter. A kinkless flexible lead with a tip at the end is brought out through a hole in the panel. Each meter range is selected by plugging the tip into the proper jack. Starting at the left side of the panel and moving in a clockwise direction, the ranges are, 0-1, 5, 10, 50, 150 volts.

A five-point non-shorting tap switch may be used in place of the tip-jacks. The two terminals at the bottom are used for connecting the instrument to the receiver under test. A toggle switch mounted directly below the meter is used to connect the meter through the proper multiplying resistor to the filament of the tube. With this connection, the filament rheostat may be adjusted correctly so that the tube receives the correct filament voltage. It also serves to indicate when the rheostat is in the "off" position.

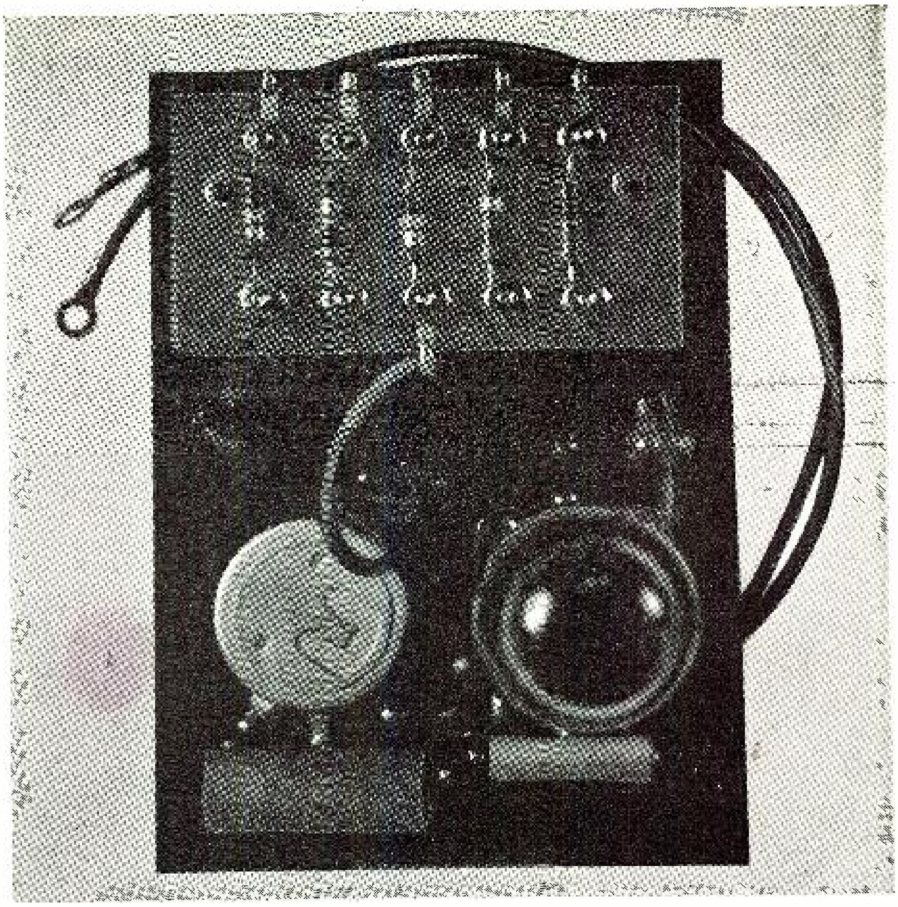
The instrument was originally constructed on a panel 5"x7", and placed in a wooden case as these were on hand at the time. However, the constructor is advised to use a steel cabinet measuring 5"x6"x9". If the constructor is not experienced in drilling metal panels, the following procedure is recommended. Cut a masonite panel to the exact size of the metal panel. Fasten the two panels together with small C clamps. Be sure that the edges of the panels are evenly lined up. If they do not line up, place the masonite panel with a portion of the edges extending beyond the metal panel.

Drill two holes at the ends of the masonite panel, using the original mounting holes in the metal panel as a guide. Screw the panels together with small screws, and remove the clamps. True up the edges of the masonite with a flat file. Check your work with a square. The masonite panel which you have just completed will serve as a drilling template.

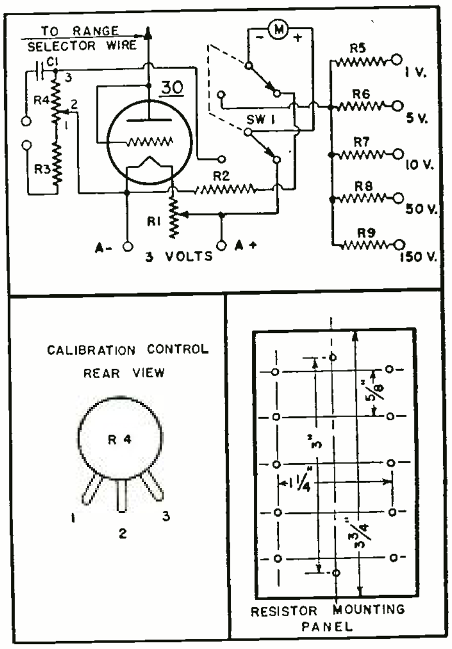
It is very important that the edges of the masonite panel be exactly square, as all holes will be laid out from these edges in pencil and center-punched. All holes should first be drilled with a 1/16" drill and enlarged to their correct sizes.

The meter hole should first be drilled in a piece of scrap masonite in order to obtain the correct setting of the hole cutter. Several test holes may have to be cut before arriving at the correct setting. Once the cutter is set, be sure to tighten the adjusting screw firmly, so that it will not deviate when drilling the panel hole. Drill the holes for the filament rheostat, calibration control, and toggle switch in the order named. This should be followed by drilling the tip-jack and binding post holes. If a tap switch is used in place of the tip-jacks, it can be mounted midway between, and below the filament and calibration controls.

The mounting strip for the multiplying resistors may be cut from a piece of scrap masonite 2"x3¾"x⅛". The strip is mounted behind the meter in a horizontal position. Two mounting collars 2¾" long, and tapped for a 6-32 machine screw serve to hold it in place. Prepare the strip for drilling by first laying out the horizontal and vertical center lines. The horizontal line corresponds to the length, while the vertical line corresponds to the width. Set the dividers to 1½", and mark off this distance on the horizontal line each side of the center.



Rear view shows the bakelite strip designed for mounting resistors.



R1—Rheostat 30 ohms, ½ w., Mallory
R2—4,000 ohms, ½ w. wire wound, Ohmite
R3—2,000 ohms, 3 w. wire wound, Ohmite
R4—2,000 ohms, variable wire wound 3 w., Mallory No. A2MP
R5—1,000 ohms, ½ w., IRC
R6—5,000 ohms, ½ w., IRC
R7—10,000 ohms, ½ w., IRC
R8—50,000 ohms, ½ w., IRC
R9—150,000 ohms, ½ w., IRC
C1—.25 mfd. cond. 200 V DC, Mallory
Sw1—D.P.D.T. toggle switch, H&H
3 Binding posts
1 steel cabinet 5"x6"x9", Bud
1 0-1 milliammeter (Model 221), Triplett
1 Type '30 tube, Sylvania
1 4½ volt C battery, Burgess No. 2370
1 UX tube socket
5 Tip Jacks No. 16, Mallory

The mounting holes will now be 3" apart. With the dividers still set to 1½", lay off this distance from each vertical edge of the panel on the same horizontal line that was used to lay out the meter hole. If this line has been rubbed out, take a new measurement and square another line across the panel. Set the dividers to 3", and check your measurements before drilling. If the measurements are accurate, the marks on the resistor strip will coincide with those on the panel, and will also agree with the 3" setting of the dividers.

It is a good plan to mount the multiplying resistors with screws and nuts for easy replacement without disturbing the rest of the wiring. The resistors should be spaced ⅝" apart. Lay off two horizontal parallel lines equidistant from the center, and spaced 1¼" apart. The vertical center line will now bisect each parallel line. From these points, mark off two points ⅝" apart each side of the center line. The bisection points should also be marked very carefully for drilling.

All holes are drilled for 6-32 machine screws. After drilling the holes, insert the screws in one side of the strip. Place a soldering lug and one nut on each. Insert the remainder of the screws in the other side, and place a nut on each. One lug should be placed on the center screw of this series. Wire them together with a short length of bare wire. Start the wire at one end of the strip, and loop it once around each screw on the bottom side of the strip. The resistors should be mounted with a second set of nuts.

The tube socket is mounted on a piece of masonite directly over the filament rheostat by two 1¼" collars. The collars should be tapped at each end for 6-32 machine screws. The size of the socket mounting will depend upon the type of socket used by the constructor. In preparing the socket mounting, allow a space for mounting the 4,000 ohm multiplying resistor. Mount the tube socket with the filament prongs near this resistor.

This is very important! Leave the meter off of the panel until all wiring is completed. Wire the filament circuit first. Follow this by wiring in the toggle switch, calibration control, and binding posts. The tip-jacks and range multipliers are wired last. Red and black kinkless wire should be used for the connections to the meter and the filament battery. After the meter is

(Continued on page 48)

112 MC Mobile Co-Ax Antenna

by
S. GORDON TAYLOR

There is no reason why the amateur should not take the time to improve on his radio equipment. This radiator works very well.

Note how the radiating parts are kept at a level above that of the car roof. Top rod is detachable for clearing doorway.

ANTENNAE for ultra-high frequency mobile operation have always represented somewhat of a problem both for the amateur portable-mobile enthusiast and for the various technical services which utilize car-mounted transmitting and receiving equipment. In fact a combination of problems exists because, if reasonably good efficiency is to be obtained it is necessary to elevate the radiator above the car body, to maintain minimum losses in the feeder line and to employ a half-wave rather than quarter-wave radiator.

Where the car employed is the family car it is impractical to mount the antenna on the roof. But even if the XYL doesn't object there are mechanical problems and the problems of feeding and insulating the base of such an antenna.

Feeder lines usually have to be brought out through the car body, if the installation is to be a ship-shape and a permanent one. This makes the use of spaced feeders impractical, and the use of twisted-pair feed means loss of power. Concentric (coaxial) cable offers a nice solution from the standpoint of minimum power loss but to feed the center of a conventional vertical half-wave antenna, as is necessary with such low-impedance line (unless a matching section is employed at the antenna base, which means more wires or rods to mount on the exterior of the car), introduces additional problems of its own because this necessitates bringing the feed line away from the antenna at or near right angles.

A mobile installation designed and installed on his car by W2CNS, Fred Holbrook of White Plains, N. Y., for 2½-meter operation represents a very effective solution of just about all the problems that have been enumerated. The accompanying illustration conveys a good idea of the appearance of this antenna system. It will be noted (1) that all extraneous wires and leads are eliminated, (2) that the entire half-wave radiator is above the car roof, and (3) that the entire antenna and its support constitutes a sturdy structure. Further advantages are that with the upper quarter-wave section slipped out of its socket, the overall height of the remaining portion is such as to be easily cleared by garage doorways, etc.

The antenna is one of the coaxial type, in which the concentric feeder line is brought up through the center of the 1" brass tubing which constitutes the lower half of the radiator. Thus the line itself is effectively shielded from the antenna's field of radiation and, moreover, cannot influence the radiation pattern. Such an antenna is recognized in commercial fields as an excellent one for u.h.f. use because of its resulting low angle of radiation. Despite this recognition, this type of installation is rarely encountered outside of commercial fields because of the mechanical and electrical details involved in its construction.

The schematic arrangement of the antenna is shown in Figure 3. Here it will be noted that the upper quarter-wave rod is in effect simply an extension of the center conductor of the transmission line, while the lower quarter-wave is a shield which surrounds the outer conductor of the line. This shield and the outer conductor are connected together at their tops but are otherwise insulated from one another. It is apparent then, that this set-up constitutes a center-fed half-wave in which the impedance of the concentric feeder (about 72 ohms) provides an effective match.

The details of physical construction and mounting are shown in Figures 1 and 2. The "mast" in this case is of the same 1" brass tubing as the lower half of the radiator but is insulated therefrom by a length of *Amphenol Polystyrene* rod which separates the two pieces of tubing by about 1½ inches. This insulating rod extends into each tube a distance of about 2 inches. The extensions are turned down to a diameter which provides a force fit inside the tubing and the joint is further strengthened by the application of *Polystyrene* coil dope during assembly.

The length of the "mast" is just sufficient to extend from the car step to the level of the roof. It is seated in a pipe flange securely bolted to the car step and with set screws which firmly grip the base of the tube. Additional support is provided about half way up by a standard bracket such as those used in mounting glass towel bars. The base of this support is attached to a wood block which in turn is bolted to the car body. The "mast" need not be of metal but inasmuch as the feeder line runs up through its center it is mechanically simplest to employ metal tubing. Then only the insulating rod need be drilled to pass the cable.

Figure 2 shows the details of construction and connections at the center of the half-wave radiator. The insulator (3) is again a piece of 1" *Polystyrene* rod, drilled and turned down as shown in the cut-away sectional view. This is force-fitted into the top of the lower ¼-wave radiator sleeve (8), and into its upper part is force-fitted and cemented with coil dope a piece of brass tubing (2), the bottom of which is closed by soldering on a metal disc through which has been drilled a hole of sufficient size to pass the inner conductor (6) of the feed line. This serves as the socket into which the removable top ¼-wave radiator (1) fits tightly.

The concentric feed line is prepared by stripping away the shield (7) and insulating beads from an inch or so of the inner conductor, then folding the end of the shield back down over a brass ring (4) to which it is then soldered for added rigidity to withstand the moderate pressure of the four set-screws (5), holes for which are drilled and tapped in the radiator sleeve and insulator. These screws not only support the line within the tube, but also provide the necessary connection between the outer conductor of the line and the ¼-wave sleeve.

The concentric line used by W2CNS is the *Amphenol* No. 72-12 which consists of an inner conductor of #12 wire centered in a ⅜" copper-braid outer conductor by fish-scale (flexibly interlocking) insulating beads of Polystyrene. Over the outer conductor is a double covering of lacquered fabric.

In assembling the antenna the insulator of Figure 2, after being prepared as described above, is slipped over the end of the cable with the center conductor of the latter extending up into the metal thimble (2). This conductor should be cut to such length that it projects into the thimble about ½ inch and is there bent over and curled around inside the bottom of the thimble. Here it can be secured by pouring in a little molten solder. (Heat should not be applied by means of a soldering iron as prolonged heating will soften this insulating material.) An alternative method of connecting the inner conductor electrically to the thimble is by soldering its end to a nut, then threading into this nut a screw extending down through the bottom of the thimble and the insulator. This is the method actually employed by W2CNS to avoid any possibility of damaging the insulating material due to the heat of the molten solder.

With this connection completed, the lower radiator is slipped up over the cable and insulator until its set-screw

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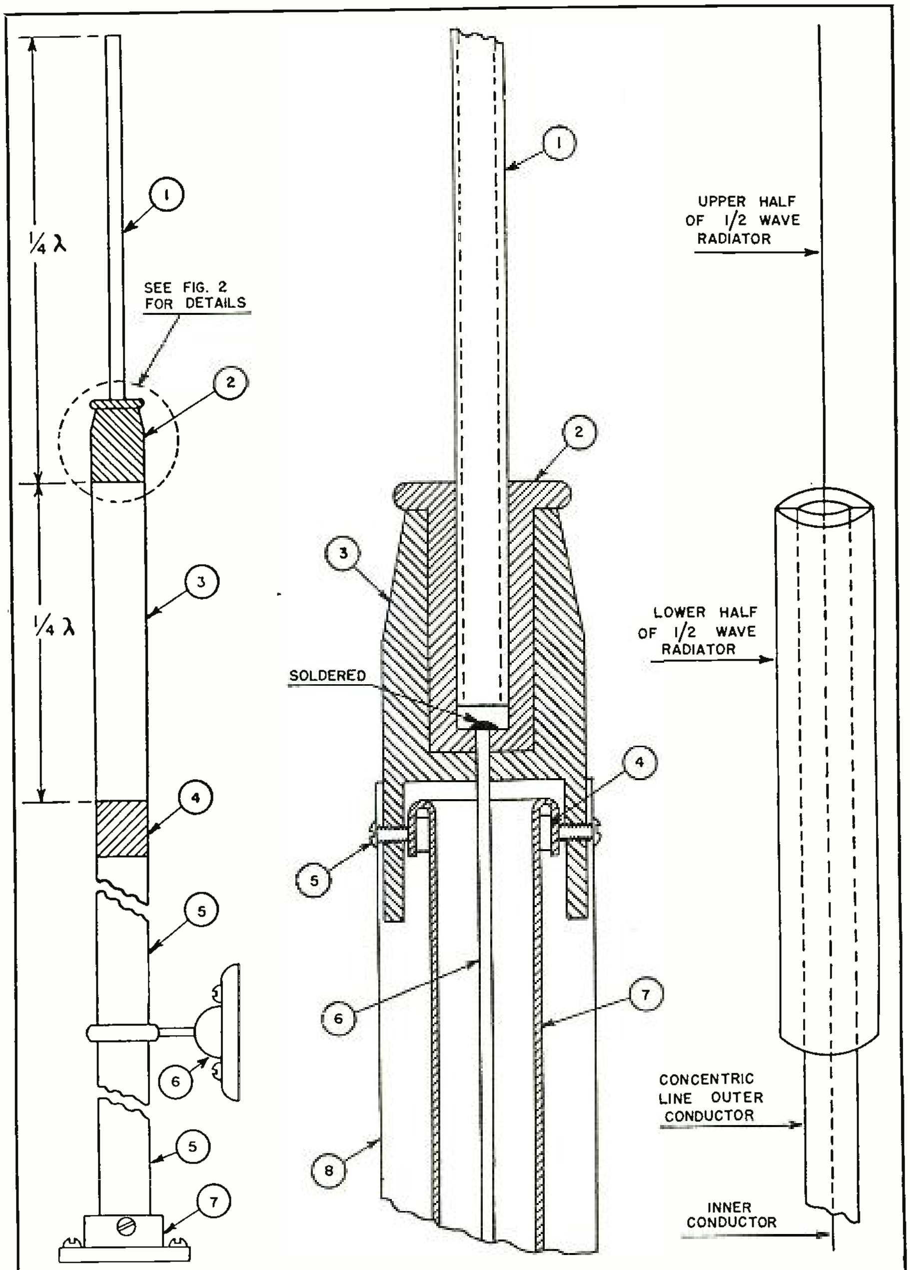


Fig. 1. Fig. 2. Fig. 3.

Electronic Gadgets for Amateur Experimenters

by RUFUS P. TURNER
Consulting Engineer, RADIO NEWS

Many amateurs and experimenters are getting in on the ground floor of this fascinating art.

WITH the cessation of amateur transmitting activity, more and more hams are turning their attention to "electronics" in an effort to further their radio knowledge and whet their "experimenter's hand."

The science of electronics beckons to the ingenious experimenter who will turn its principles to the performance of common tasks. The radio ham is, by the very nature of his past studies and electrical apparatus, uniquely equipped to embark upon an exciting electronic adventure.

Aside from being entertaining and enlightening from a personal standpoint, the science of electronics is making noteworthy industrial contributions. During the present war emergency and before, electronic devices have found their way into busy factories, offices, public places, and homes. Electronics is the bright science of the future, pointing the way to myriad future applications of electricity in our daily life.

The ham has the interest, learning, and often the apparatus, to explore the fascinating field of electronics. Electronic gadgets are interesting in their operation, and we have yet to find the ham who did not learn a number of new facts when investigating their operation. Electronic gadgeteering, like ham radio, need not necessarily be made an expensive proposition, although the sky is the limit. Some ham junk boxes will furnish all of the apparatus and devices for a six-month round of experimentation, while other hobbyists will be compelled to build or buy special parts not already owned. An exciting feature of electronic gadgeteering is the challenge it offers to individual inventiveness—the slogan of the electronic gadgeteer is *do nothing mechanically that may be accomplished electronically.*

What Is Electronics?

As the name implies, *electronics* is based upon the electron, its motion, and the capabilities of electron emission. However, some of the tubes employed in electronic devices might be more appropriately termed *ionic* devices. Electronic devices are *tube* devices. It is well known to radio amateurs that the electron stream may be utilized to accomplish a number of operations previously possible only with electromechanical gear. For example, a relay, switch, or signal device may be switched on and off by the passage of tube plate current controlled in turn by a grid voltage.

Photocell applications, time-delay devices, capacity-controlled relays and alarms, tube-operated counting devices, and sound-controlled locks and alarms are only a few of the gadgets that are merely combinations of simple electronic circuits.

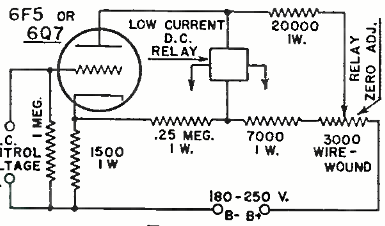


Fig. 1.

The amateur will, after he has looked over several simple electronic circuits, immediately visualize embodiments of these hookups in apparatus of his own design. Several of these simple circuits are shown in this article. They are presented as "building blocks" much as were the hundred mechanical movements in the old patent-attorney pamphlets. Some readers will desire to hook up the equipment, just as it is shown, in order to study its operation; others, already familiar with the simple units, will prefer to combine several simple circuits for some more complex application of their own designing.

Electronic Movements

Figure 1 shows one of the simplest d.c. control circuits. The tube may be a 6F5, 6SF5, 6Q7, or 6SQ7 when the resistor values shown in the circuit diagram are employed. Any other triode might be used if the resistances are altered to suit the tube characteristics. With this circuit, a relatively small d.c. grid voltage may be employed to control large voltages or currents through the relay which is normally placed in the plate circuit.

The plate circuit relay operates on a few milliamperes or on as little as 1 milliampere. It is a direct-current operated device, such as a *Sigma* milliampere relay. Such relays may be obtained to close at small current levels ranging over a selection of several mils.

It will be observed that the low-current relay is connected into a bridge circuit in the tube plate circuit. This is in order that the initial steady d.c. plate current may be balanced out to bring the relay contacts to the "full open" position in the absence of a grid-voltage signal.

Before the circuit is placed into operation, the heater and plate supplies are switched on; and, without applying an exciting voltage to the grid input terminals, the zero-set potentiometer is slowly adjusted until the relay contacts swing wide open. The plate-circuit bridge is then balanced, and the control circuit is ready for operation.

A small voltage applied to the grid-input terminals will then unbalance the plate-circuit bridge, causing current to flow through the relay, closing its contacts. The external contacts of the relay may then be connected to the circuit, machine, or device which is to be controlled. If the controlled device requires more power than the low-current relay can safely handle, a second relay may be used after the former to handle the large values.

The applied grid voltage signal may be a rectified radio signal, amplified voltage from a photocell, small battery voltage, or any similar potential sufficiently intense to unbalance the plate-circuit bridge. The actual amount of this voltage will depend upon the characteristics of the tube and the sensitivity of the plate-circuit relay. If the relay, used in the circuit of Figure 1 has a sensitivity of 0.2 milliampere, approximately 1½ volts will be required to close it. If, on the other hand, the relay sensitivity is 1 mil, the grid signal will need be approximately 6 volts.

Figure 2 shows a similar circuit adapted for a.c. signal operation. The triode may be any convenient tube, preferably a power amplifier type, and the cathode resistor, Rk, and the plate resistor, Rp, are the values specified for that tube. The control tube might likewise be a tetrode, pentode, or beam power amplifier. The 6H6 diode rec-

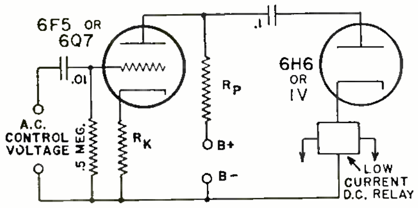


Fig. 2.

tifies the amplified a.f. output signal and delivers d.c. to the low-current relay.

The a.c. signal applied to the grid-input circuit may be the output signal from a radio detector, a line voltage pulse, audio tone signal, or similar signal voltage. The actual value of the signal voltage will depend upon the amplification characteristic of the tube. For high-gain tubes, this signal may be quite small. If the normal signal voltage is large enough to cause an overswing of the low-current relay, it may be reduced by increasing the value of the cathode resistor, installing a resistor in the 6H6 cathode lead, or altering the value of the plate coupling condenser.

Figure 3 illustrates an interesting gaseous-tube circuit designed to operate specifically on d.c. signal pulses or a.c. signals superimposed on d.c. In the former case, the d.c. pulse sets up a pulse in the input transformer secondary; and, if this pulse is of the proper polarity with respect to the grid, the gaseous tube is fired, causing it to pass plate current and close the relay.

The tube may be a triode such as type 884 or 885 or a gaseous tetrode such as type 2051. The plate supply is a.c., this voltage corresponding to rated plate voltage for the tube. If the signal consists of an a.c. superimposed on d.c., a pulse is not delivered to the gas-tube grid until the a.c. component exceeds the d.c.

The gaseous tube is not similar in operation to the better-known vacuum types. It is in reality a high plate cur-

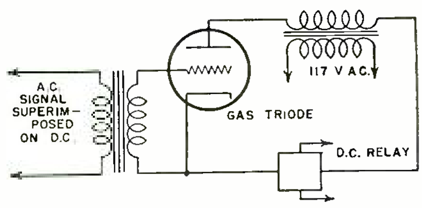


Fig. 3.

rent controlled rectifier. The flow of plate current is not controlled over a wide range by the grid voltage, as in the vacuum tube, but merely set off by a certain value of grid voltage, whereupon it continues to flow, maintaining a constant value until interrupted. Some gaseous triodes and tetrodes pass such enormous plate currents that the special plate-circuit relay is not necessary to control external devices.

Figure 4 shows a quick-acting circuit embodying a cold-cathode rectifier tube. The outstanding advantage of this circuit is its ability to remain on the alert without requiring filament and plate power. The circuit shown may be operated by a "wired-wireless" carrier transmitted over the a.c. power line and will control either an a.c. or d.c. relay.

Low frequencies, generally of the order of 50 to 400 kc., are used for carrier control operations, and the coil, L, and the .002-mfd. mica condenser are arranged to form a series resonant circuit tuned to the carrier frequency. The inductance of L will be governed by the frequency of the carrier.

When the circuit is placed in service, the line voltage is continuously ap-

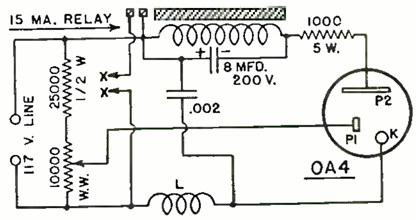


Fig. 4.

plied to the anode, Pl. The carrier voltage drop across the inductor, L, is applied in series with the cathode and Pl in addition to the line voltage. The starter-anode discharge is initiated, in turn initiating the main discharge in the tube and closing the relay.

The adjustment of the 10,000-ohm

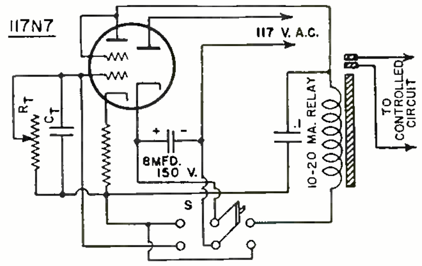


Fig. 5.

potentiometer is very important. This resistor is set at the point where the OA4-G tube just "fires," and then the setting reduced until the discharge is just extinguished. The latter point is correct for operation.

A practical time-delay circuit is shown in Figure 5. This device is capable of operating a relay at predetermined time intervals set by the time constant of the resistance-capacitance network, Rt-Ct, in the grid circuit of the tube. A 117N7-GT tube is employed to provide both tetrode and rectifier in the same envelope and to afford 117-volt heater operation. These features make the device extremely simple and reduce the number of parts required.

In operation, the double-pole, double-throw switch, S, is first thrown to the left-hand position. This removes the d.c. voltage from the plate and screen of the tube and applies it across the grid network, Rt-Ct, charging the condenser, Ct. The switch is then thrown to the right-hand position, applying

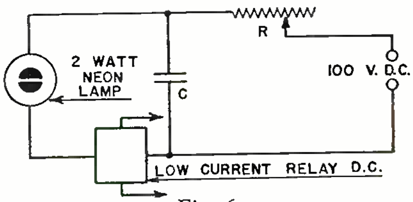


Fig. 6.

the plate and screen voltage. The control grid of the tube then receives the drop across the resistor, Rt, due to the discharge of the condenser. Because of the negative polarity of this grid voltage, the tube plate current will be cut off as long as the grid voltage is present, and the relay in the plate circuit will accordingly remain open. The condenser will eventually discharge completely through the resistor, however; and at this time the grid voltage will be lost, plate current will flow, and the relay will be closed.

The time delay of the circuit depends entirely upon the time constant of the Rt-Ct combination. The larger the resistor, the longer will be the time required for the condenser completely to discharge. The time interval may be predetermined, therefore, by setting the value of Rt, according to prior calibration.

Figure 6 shows a circuit capable of intermittent operation at any frequency between one cycle every hour or so to high audio frequencies. Between those limits any desired rate of repetition may be obtained. The circuit is exceedingly simple in that it employs a neon lamp, rather than a tube, and requires little current for operation. This device is the familiar *relaxation oscillator.*

Operation of the circuit is explained as follows: The condenser, C, is charged by the 100-volt d.c. source. This condenser charges at a rate determined by its capacitance and the resistance of R. When the voltage across the condenser, due to the charg-

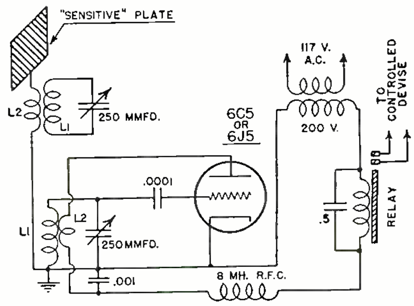


Fig. 7.

ing current, reaches the ignition potential of the neon lamp, the latter is fired and the condenser charge sharply reduced until the extinction potential of the lamp is reached, whereupon the

(*Continued on page* 66)

Theory and Practice of DISC RECORDING

by OLIVER READ

Managing Editor
RADIO NEWS

The subject of Bouncing is discussed this month. NAB proposed standards are listed.

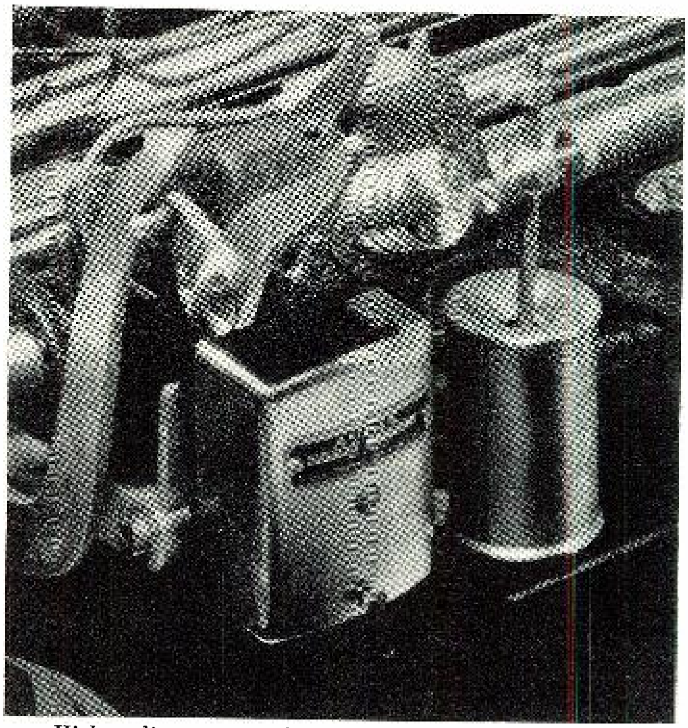
PART 7

Several causes of *distortion* were discussed in our last installment. This month we will consider "bouncing" as it applies to our recording technique. This problem was rather serious until recently and many a disc has been ruined by failure to consider the need for making accurate adjustments to the mechanism. No disc, while undergoing the process of cutting, is completely free from unwanted vertical or lateral vibration. The usual home recording instrument is manufactured on a "production" basis and is, therefore, subject to the imperfections that are not present on the more elaborate machines.

The term "bouncing" refers to the *vertical* motion of the cutter when cutting is taking place in a lateral direction. It is caused by several conditions. The most common is a slight rise on the disc surface which lifts the cutter and stylus off the disc surface and then drops back into place on the record. This was a common fault in the early days of instantaneous recording but manufacturers have perfected their disc to a high degree and seldom do we encounter this difficulty any more.

The mechanism itself, particularly the motor, is another cause of "bouncing." Small shocks may be transmitted to the cutter assembly if the adjustments have been made improperly. Careful design will eliminate this condition or at least reduce the hazard to a minimum. It is important that the turntable be absolutely level. A small carpenter's level is a handy accessory for the home recordist to have on hand. The rubber drive and idler wheels should be given special attention more now than at any other time. Chances are that they will become more and more difficult to buy until after the war. Some provision should be made so that the wheels are left free from contact with the table rim when they are not in use. They may be "dressed" on a small lathe or drillpress with very fine sandpaper if they develop "flats" from continuous contact with the rim.

A major improvement was the introduction of the "dash pot" assembly. Several types are illustrated. Their purpose is to damp out the *vertical* vibrations. The action is similar to that of an automatic door closer. The better assemblies use the type shown mounted next to the *Audak* magnetic cutter used on the writer's equipment. This dash pot is filled with glycerin to within about a quarter inch from the top. A round plunger is attached to the vertical rod as shown. The dash pot moves with the cutter and acts to suppress any vertical motion after the stylus is placed onto the disc. The upper rod remains stationary and the plunger disc, immersed in the glycerin, serves to damp out the unwanted vertical vibrations.



High-quality cutter and glycerin-filled dash-pot damper.

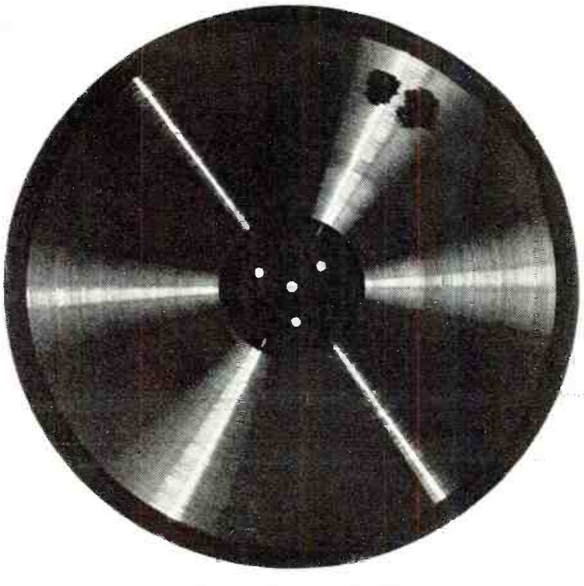
Other types are illustrated which have been designed for use on other types of cutter feed mechanisms. The action is the same in all cases. Not all of the various dash pots employ the pot filled with glycerin. Some make use of counter-balancing weights or springs to get the same results. It matters little which one is used, but their use on the recorder is highly recommended. The handyman will find one of these gadgets to be a good subject for home construction.

A word of caution: Do not permit the plunger to rub on the inner wall of the dash pot or serious trouble will be encountered from the friction.

Recording and Reproducing Standards

Many of our advanced readers have requested information on the technique and standards employed by the broadcast companies in their effort to arrive at a better overall characteristic in the art of transcription reproduction. The following data supplied by the publishers of *The Broadcast Engineers Journal* describes the latest decisions by the *Recording and Reproducing Standards Committee of the National Association of Broadcasters.*

"As broadcasting has developed, the problem of reproducing transcriptions with uniform results has become of much concern to broadcasting stations. Quite a number of different characteristics have been used by the various manufacturers of transcriptions, recording equipment and reproducing equipment. Most of these characteristics produce good results by themselves with the proper playback equalization. The NAB Engineering Committee early last year sent a questionnaire on recording to all stations. Among other interesting data obtained was the fact that some stations use as high as ten different equalizers. The NAB Engineering Committee recommended to its Board of Directors that NAB coordinate the work of a Committee to be formed for the purpose of establishing recording and reproducing standards. The Board of Directors approved of this procedure and early in June, 1940, Neville Miller, President of the NAB, invited all companies interested in recording to a meeting to be held on June 26, 1941, in Detroit. Some twenty companies responded by sending representatives to the meeting. The Recording and Reproducing Standards Committee was formed at that time. The Committee drew up a set of rules and regulations for conduct of the work. The Committee also at that time formulated a list of the items that should be considered for standardization. In order to supervise and expedite the work, an Executive Committee of five members was appointed.



Effect of "bouncing."

The Executive Committee was instructed to recommend standards on items that require little or no special study. It also was instructed to recommend a line of procedure for standardization on all other items.

The Executive Committee reported to the main Committee at a meeting held in New York City on October 23, 1941. The main Committee with minor changes adopted as standards or recommended good engineering practice sixteen of the items proposed by the Executive Committee. The Committee decided to divide the remaining items between four Subcommittees for further study. The several committees have made good progress to date. However, the war effort has seriously curtailed the speed of the work and it is not expected that enough additional work will be finished for two or three months more so as to warrant another meeting of the main Committee. The Committee felt that application of the sixteen standards already adopted should not be delayed and they are therefore being submitted to the industry at this time. Although NAB has not as yet officially placed its stamp of approval on these standards, it is believed that this is merely a formality and there is no reason why the industry cannot proceed with the use of the standards already adopted. At any rate, progress has been made in the solution of the problem.

Following are the sixteen standards as already adopted by the RRSC. (The main Committee consists of 77

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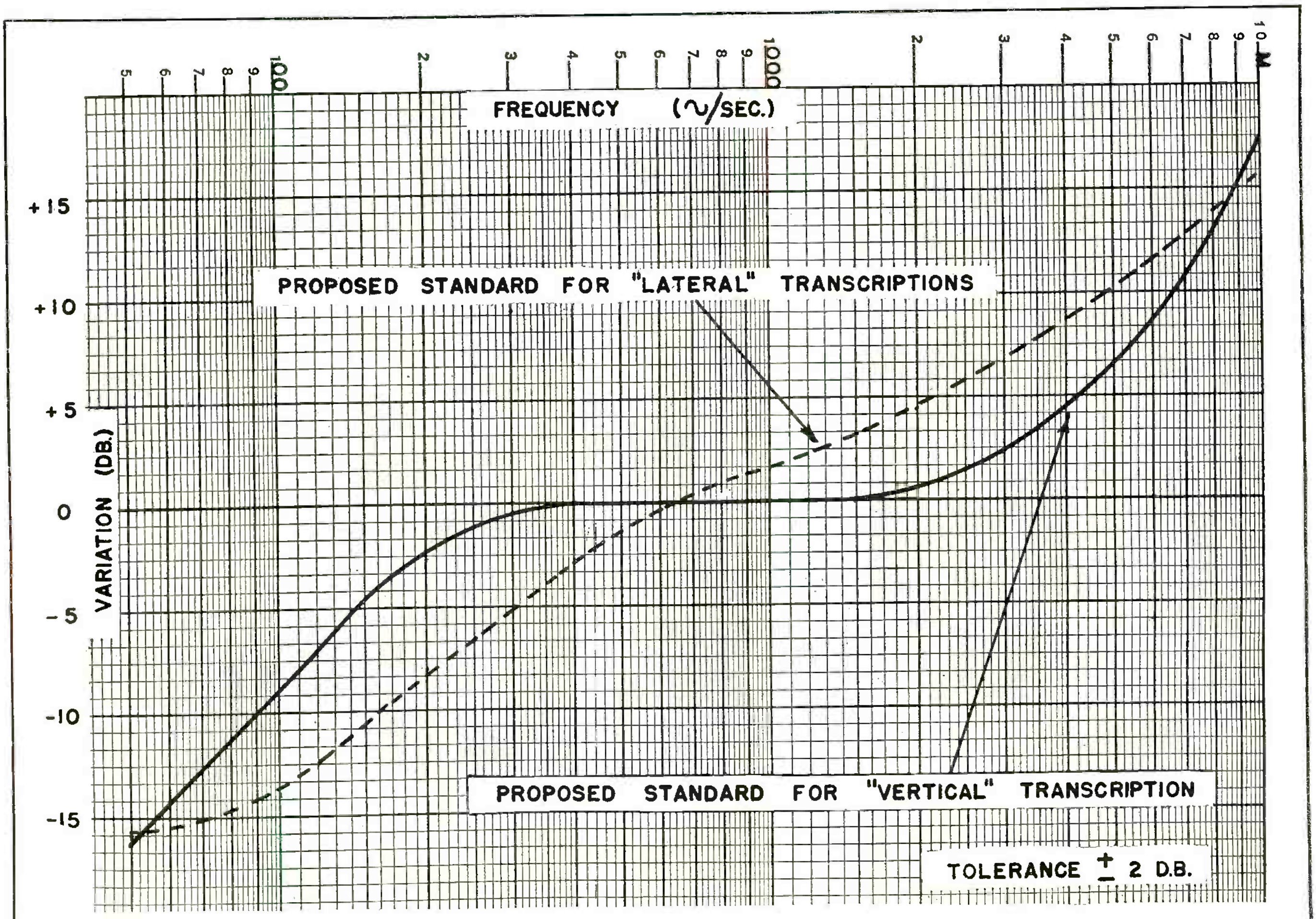
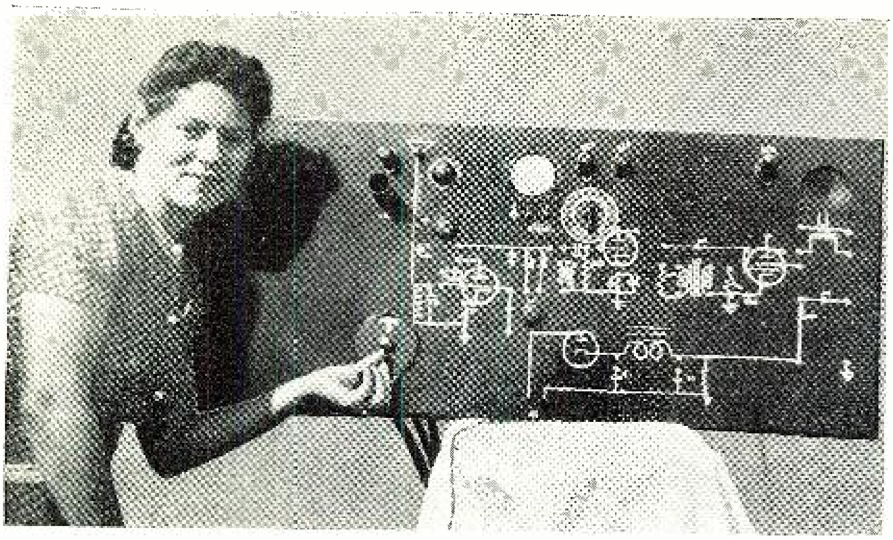




The complete circuit is marked in white on a black background.

Beginner's Dynamic Demonstrator

by DAVID GNESSIN

Many circuits are possible with this unit. The author shows how many of them can be had with only a few hastily-made jumpers.

(Part Two)

WELL, the demonstrator should be finished and dry by now, so let's put it to work. The first **circuit** we're going to build is the speech amplifier. We have Fig. 1 for the diagram and a full length photograph showing the young lady actually using the unit as a speech amplifier.

Connect the solderless phone tips to pieces of hook-up wire of different lengths. You can determine the length by measuring the distance between the jacks which will receive them.

If you have a good d.c. voltmeter in the 150 volt range, hook it up with the positive lead at the rectifier cathode, just before CH2 and the negative lead anywhere you find a ground jack. If you've built the meter into the board, use it. If no meter is available, follow the steps anyway. We can use very simple tests to show the results.

With the demonstrator plugged into the outlet and no wires plugged in, the meter should read 50v. (All these readings will vary with different meters, but the readings should be comparable.) If there is no reading at all, trace the circuit to the rectifier. You'll probably find an open circuit there.

Now hook in connection "1" shown in Fig. 1. Hooking this condenser into the circuit (make certain of the polarity . . . the red + wire goes to the choke) should raise the voltage to 150v. Hook in connection "2." This other condenser should bring the voltage down to 145v. Connection "3" hooks B + to the 6F6 screen. Voltage at the rectifier cathode is now 106v., since we now have a load. (If you're using a 6C5 for the output the connection will be made direct to the primary of T_3, combining with connection "4." Otherwise there is no change.) Connection "5" hooks plate into circuit, pulling voltage to 102v. At this point, a slight hum should be heard in the speaker.

Touch the grid of the 6F6 with your finger. You should hear a click and a louder hum in the speaker. Connection "6" gives the grid a return to ground and brings the voltage up to 114v. The hum should almost disappear. Touching the grid with the finger or a screwdriver should bring the hum back. This is the test for the last stage. If you get a hum when you touch the grid, you know that both the rectifier circuit and the output tube circuit as well as the speaker are operating. From now on, different connections in the other circuits will not vary the rectifier voltage much, so we can disregard the meter.

For those without meters, observe the use of the filter condensers C_9 and C_{10}. Remove them carefully, one at a time, and notice that the hum becomes louder. Bring them back into the circuit and the hum disappears. Thus the condensers filter the rectified d.c. Caution here is advisable. *You can touch any terminal in the circuits with impunity except those connected to B +.* The B + leads will give you a slight shock if you touch them. This is because your capacity to ground sometimes lets you accept the charge. It's not much of a shock, and is not fatal. Either shut off the power when you change the connections or use an insulated pair of pliers.

Connections "7" to "10" bring in an additional audio stage. Now touching the grid of the 6C5 will give a fairly loud hum. While you're touching this grid, vary the knob of R_5. Note the volume decreases from maximum to zero.

Connections "11" and "12" bring in the microphone transformer. Plug in the microphone leads "13" and "14." If you have a 15 m.a. meter, hook it in series with either mike lead. Then you can measure the microphone current. If your mike draws too much current, better remove the meter or put a low resistance (2 to 20 ohms) in series to avoid damaging the meter and the mike.

Now speak. Your speech amplifier is complete.

Adjust the volume control to the proper level. Feedback howl may be heard if the mike is too close to the speaker or the volume is too loud. For practical amplification the mike and speaker should be in different rooms, or at least 50 feet apart.

Look at the schematic diagram. Note that C_5 is connected to R_5, which goes to grid of first audio stage. Use the free terminal of C_5 as one connection and any ground connection as the other and we have the two jacks to plug in for any type of amplification. You can hook a crystal microphone directly to these jacks, i.e., the condenser to grid and the jack to ground. Then the microphone will be connected properly in the amplifier. The same leads will act as input for phonograph amplification, etc. With the carbon microphone removed we have a general purpose transformer-coupled amplifier.

Figure two shows a resistance-coupled amplifier. The most remarkable change here is in the method of coupling the first audio stage 6C5 to the second or power stage. Remove the wires connected to T_2. Plug in the wires to connect R_7, R_8 and C_7 into the circuit. Now the two stages are resistance-coupled. Test by touching grid of 6C5 and listen for hum. Next is the change in the output. Suppose we want to utilize phones instead of the speaker. The double arrow shows the wires which need to be connected. Note that now the 6F6 acts as a *triode,* since the plate and screen are tied together. If you're using a 6C5, just connect the plate to R_{10} and C_8. Now we have phone output instead of speaker.

At this point we can use the speaker as a microphone. Connect the jacks of the primary of T_3 which is now unused to the input shown in Fig. 2. You now have a telephone. You may extend the lines to go from one part of the house to another as a long line circuit. Of course the input will serve for a phonograph, radio or anything the other amplifier did.

We're now ready for the audio oscillator circuit. This produces a note of about 1000 cycles which can serve as a signal generator or may be keyed for code practice. This is shown schematically in Figure 3. Since the rectifier circuit has been explained thoroughly before, it will not be shown again. Where the arrow points to B + connect to the jack in the B + circuit.

The output tube is shown as a triode. A 6F6 can also be used, connected as a pentode or triode, as shown in Figure

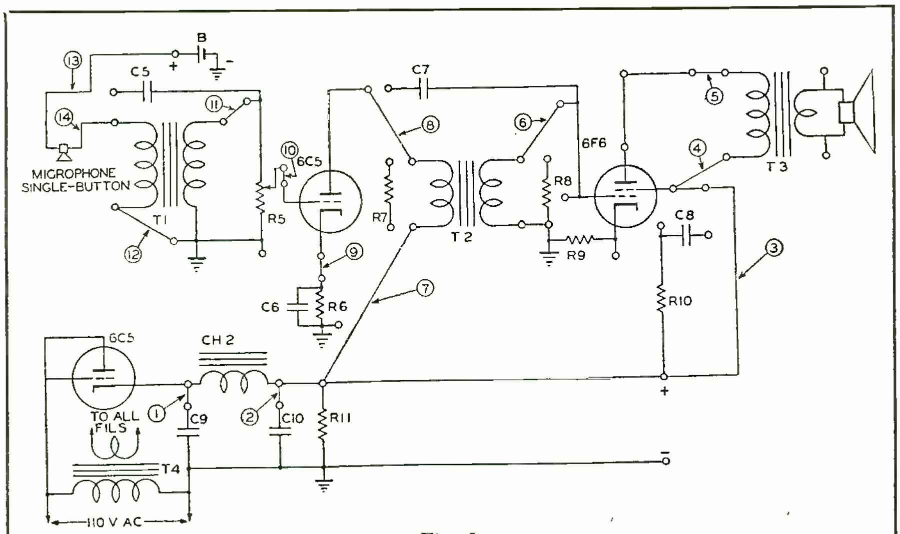


Fig. 1.

C, C_3—100 mmf. variable, Bud
C_1—15 mmf. variable, Bud
C_2—.00015 mfd. midget mica, Mallory
C_5, C_7—.004 mfd. midget mica, Mallory
C_6—.5 mfd., 200 v., Mallory
C_8—.05 mfd., 400 v., Mallory
C_9, C_{10}—8 mfd., 450 v. electro, Mallory
R_1—2 megohms, 1 w., IRC
R_2—2,000 ohms, 1 w., IRC
R_4, R_7—250,000 ohm, 1 w., IRC
R_5—500,000 ohm pot., Yaxley
R_6—15,000 ohm, 1 w., IRC
R_8—1 megohm, 1 w., IRC
R_9—600 ohm, 1 w., IRC
R_{10}, R_{11}—100,000 ohm, 1 w., IRC
Ch_1—2.5 M. H. R. F. choke, National R100
Ch_2—10 hy @ 40 M. A. filter choke, Thordarson T13C27
T_1—Microphone to grid, Thordarson, T86A02
T_2—Interstage transformer, Thordarson, T13A34
T_3—Universal voice coil to spkr, Thordarson
T_4—6.3. v. filament transformer, Thordarson
L_1, L_2—(See text)
B—1.5. v. flashlight cell
Spkr—Utah P.M.
Tip jacks and plugs—Yaxley
Tubes—Hytron

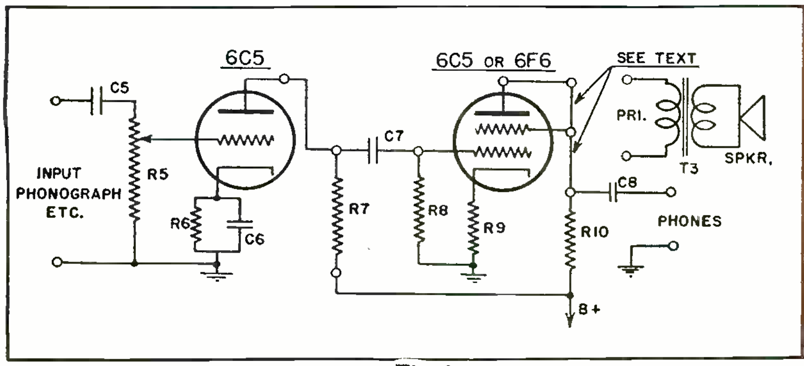


Fig. 2.

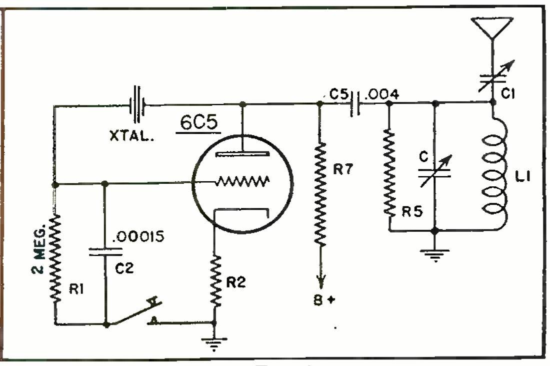


Fig. 5.

1. There will be a slight difference in audio tone. By the way, since different components provide a different audio tone, you may experiment with different components till you obtain a final tone most desirable. For instance, the microphone transformer may be hooked in instead of T_2. This will give a different tone, with less volume. Also, since different cathode resistances *vary* tone, changing the resistance might bring the tone to a frequency you prefer. In any case, hooking up the circuit, as shown in Fig. 3, will give you an oscillating note.

If, after the circuit is hooked up correctly, there is no oscillation, then reverse the leads to the primary of T_2. This will surely start it squealing. Note the key in the cathode circuit of the first stage (by the way, this is the very first tube on the left of the demonstrator board). This is the telegraph key which is plugged in to the jacks of the input transformer and ground. As the key is operated, the circuit is completed, and an audio oscillating note is generated.

Of course the circuit may be operated to feed into headphones. See Fig. 2 for this. Or the output terminals in Fig. 2 can be plugged into an amplifier for further amplification. This, then, is the audio oscillator.

Next comes what may prove to be the most popular circuit of them all—the four-tube regenerative receiver. Since one tube is used for rectification, actually there are only three tubes active in the receiver proper. The first tube is the detector, the second is the audio and the last tube is for the power stage. Let's look at Fig. 4 for the schematic diagram and at the front view photograph. Your demonstrator should look exactly like the photograph when you've hooked up the cir-

(*Continued on page* 46)

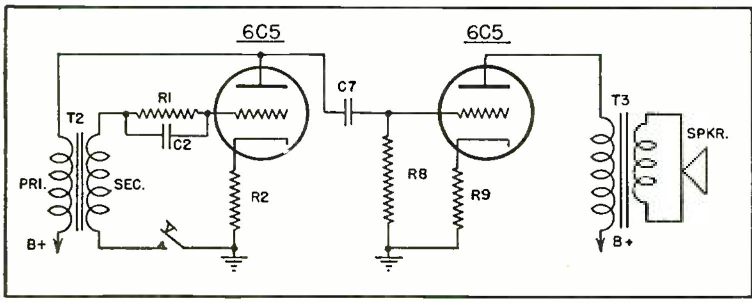


Fig. 3.

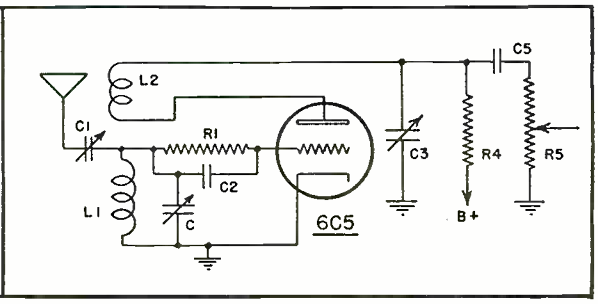


Fig. 4.

AVIATION RADIO COURSE

by PAUL W. KARROL

Part 2 in this exclusive series tells of more opportunities for radio men in the aviation field. Equipment is discussed.

To many men who desire to keep abreast with all new developments, a job with the CAA provides all essentials. The CAA Communications Systems employ radio operators, maintenance and installation technicians, trained weathermen, special equipment operators, radio engineers (found usually on research staffs) and other personnel who administrate the many affairs of the *Administration.*

Aeronautical radio engineering and research is performed by those having college degrees, preferably electrical engineering with a radio major. Nearly all large enterprises utilizing aviation radio equipment will have one or more engineers in their employ. These engineers may or may not be pilots. But the engineer who understands the theory of flight, aerodynamics, etc., is preferred. In order to ascertain probable "flight effects" on aircraft radio equipment, it is nearly always mandatory that a radio engineer accompany the radio equipment and make tests while the aircraft is in the air. "Flying Laboratories," aircraft equipped with universal mountings for radio equipment, special generators, some permanently installed testing equipment, and in some cases recording apparatus are used by our Government, Airlines, and radio manufacturers to facilitate testing new equipment. This may be classified as the radio engineer's "workshop."

The radio engineer who has studied the many aspects of aviation radio is in demand. His knowledge may command as high as $5500.00 a year, and if employed as an instructor his services command up to $3500.00 a year.

In order to supply the demand for trained personnel many instructors are now needed. The qualifications of these must be high.

Radio engineers who specialize in receiver, transmitter, tube, or small parts design are employed by aviation radio manufacturers. Mass production has accelerated employment. Capable radio engineers are needed in nearly every branch of the radio industry.

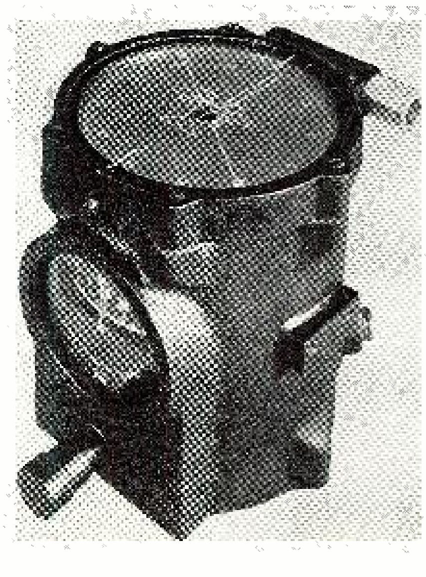
In discussing aviation radio employment it would be well at this time to bring into being a discussion involving our armed forces. There is no need to reiterate the necessity for employing trained radiomen in our *Army, Navy, Marine Corps, Coast Guard,* etc. When combat efficiency must be realized, trained personnel must be available at the right time and at the right places to effectively deal with the enemy. Communications, viz., radio, telephone, teletype, telegraph, facsimile, etc., are all bridges to the vast beyond wherein subordinate commanders receive their orders from their superiors. If communications facilities are operating efficiently (and in our armed forces they do) the enemy is usually baffled by sudden moves for which he wasn't prepared resulting in surprise, an element all important in modern day warfare.

With thousands of aircraft used for coordinated defense and offense it is necessary that mass movement be instantly controlled.

When a four-engine bomber takes off on a mission, an experienced well trained radio operator is at his station, in some cases he has an assistant. The operator must know what to do under variable circumstances. Co-operating with a navigator, the pilot, co-pilot, etc., he renders assistance that can not be taken too lightly. On the ground there are other trained operators who are in constant contact with aircraft in the air. They have been trained to dispatch necessary flight information quickly and accurately to the crew of any aircraft. Whether it be blind landing instructions or weather information that is required by the pilot they know what should be done without too much thought.

Gigantic increases in Military and Naval air strength is inevitable. More radio operators, maintenance technicians, weathermen, and instructors are needed. For the man who feels that he should be able to do more for his country, aviation radio is a large bet!

Directional gyro indicator is one of many instruments to be described.

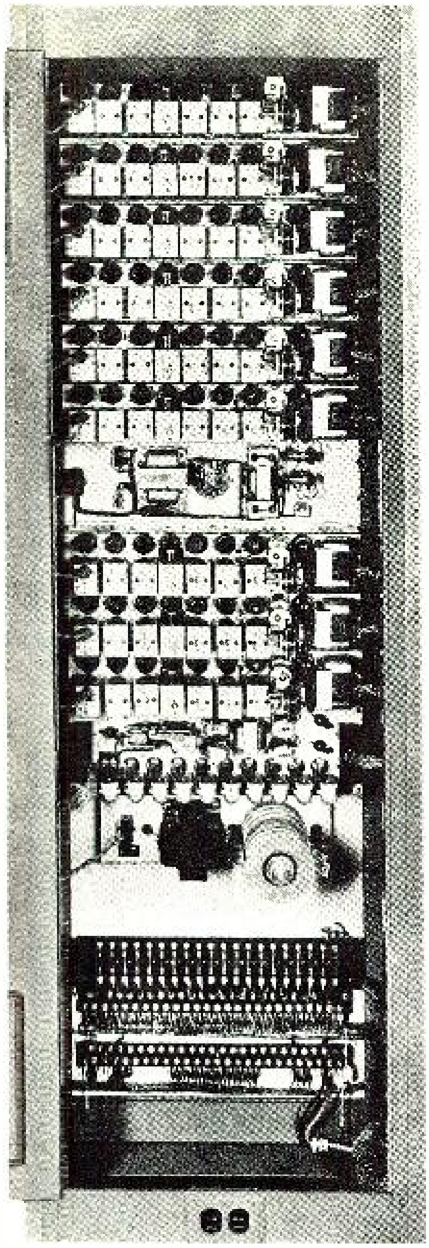


The radioman who understands aircraft radio maintenance and installation can easily learn the technicalities involved in aircraft electrical installation and maintenance. In fact he must know an immense amount about the electrical "end" of an aircraft before he is able to efficiently work as an aircraft radio technician. To stress the importance of electrical installations and maintenance, all one need do is to visit any one of a number of Government schools. Special courses are taught in this subject to thousands of pupils each year. Those who have had no experience in radio but who desire to take it up later should study aircraft electrical systems and the mechanics involved. In this way they are laying a firm foundation for a more technical endeavor.

Every position in the aviation radio industry requires a given amount of experience and training. It would take nearly three times as long to train an inexperienced group to become airlines radio operators as it would to train a group of amateur radio operators who have had licenses for a year or more. Each position requires unswerving attention to its specialized aspects.

The writer is acquainted with a few men trained by the army who can operate both in the air and on the ground; install, operate, and maintain teletype equipment; install and maintain aircraft radio equipment; and are highly proficient in telephone installation and maintenance. These are few and far between, however. A man who is not a specialist is handicapped unless it is possible for him to work at one or more jobs closely allied to each other. In the aviation radio field a man may be a capable radio operator and also a capable maintenance and installation technician. Too, he may have some knowledge of teletype work; this will help him secure good employment. For, if a man knows enough of each subject to "get by" it is always possible for him to specialize later. And the small amount he knows after he specializes will still hold him in good stead.

After a man has decided what he would like to do and after weighing his qualifications for the various positions available he makes application for employment. Most concerns have personnel departments who take care



Doolittle receiving system as seen from the rear. Note neat wiring!

of the applications received daily. They consider each applicant's qualifications and assign a time for interview with the personnel manager or technical supervisor. At this interview each man must "toot his own horn" figuratively speaking. Those who interview you want to know (and should know) all about your qualifications; no point is too small.

It should be remembered though, that overburdening talk gets one nowhere. All facts must be concrete. References should be taken with you. If you find that you will be given an examination at your interview be prepared for it. By consulting various employees of the concern with whom you wish employment, it will be possible for you to obtain many fine tips on what you should know. Above all, at your interview be yourself. If you are pretentious, it will be noticed; much to your detriment.

In the study of aviation radio this one thought must prevail: All available material should be conscientiously studied. When in doubt about a term or an explanation an immediate investigation should be conducted in order to clear up your misunderstanding.

Understanding Electrical and Radio Theory

The foundation upon which the study of aviation radio or any other branch of radio is founded must necessarily consist of those subjects all essential to a progressive study of the subject under consideration. A study of electrical and radio theory must of course precede studies in equipment application, installation, operation and maintenance. Mathematics should occupy a great part of one's study pursuits, because the subject is often needed throughout any scientific course to properly treat the exact relations existing between quantities or magnitudes and operations.

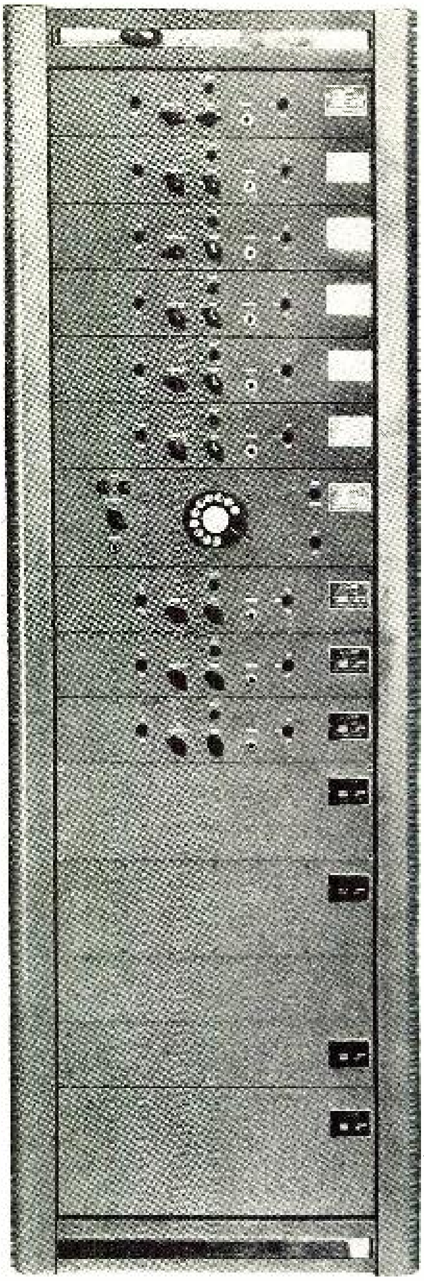
Before endeavoring specialization in any specific work in the aviation radio field it is necessary that one have a thorough understanding of the rudiments of that work. The many reasons are quite obvious.

In order to fully comprehend all radio and electrical theories promulgated during the past forty years one would have to spend his whole life in study. It is entirely possible for a student, however, to obtain most essentials in the first lessons; then proceed to the advanced, later retracing avenues of previous studies until a greater understanding of the subjects is acquired.

Yes, it is possible to install radio equipment in an aircraft by utilizing pictorial diagrams without having knowledge of electrical and radio theory or even experience. But how efficient will the installation be, and how long will it operate before it needs expert attention? It is known that any one of a large number of mis-steps will reduce over-all efficiency. If the installation is haphazardly performed and installation rules (learned from experience and expert instruction) violated, it may operate only a few hours; if the so-called "installation technician" is lucky, a few days.

Those not having proper qualifications are not usually found attempting ground radio installations. But it is known where unqualified personnel have attempted aircraft radio installations, re-installation had to be effected in order that the equipment would operate efficiently. Where inexperienced hands have found their way into various pieces of equipment, results both costly and disastrous have occurred.

The man, who has taken time to properly train himself, realizes that his work must be beyond reproach. He trusts his knowledge and is aware of his grave responsibilities connected with aviation radio in any one of its



Front view of the system shows main telephone dial for selector units.

many phases. Therefore it is mandatory for those who are desirous of aspiring to top-paying positions, to begin with radio and electrical theory and proceed methodically to specialized study.

Before proceeding with this course it is assumed that those who study it are grounded in electrical and radio theory. The novice, who has yet to begin his study of electronics, should remember that it is all important that he learn those fundamentals which govern the advanced aspects of his study. Theoretical studies should be supplemented if practicable, with practical work.

It is suggested to those who have no knowledge of electrical and radio theory that they study *Ghirardi's* "Radio Physics Course" and supple-

(*Continued on page* 65)

PRACTICAL RADIO COURSE

by ALFRED A. GHIRARDI

Part 4 in a radio course prepared especially for students

Electrical Circuits

OUR study to date has discussed all the essential elements of a complete electrical circuit and it is therefore now time to investigate more closely the voltage and current distribution in typical circuits. This is something which the radio service man, the engineer and the experimenter has to do continually and the ability to thus analyze circuits is one of the most fundamental requirements for everyone who is to become familiar with the theory and practice of radio.

In Figure 1(a) is shown the simplest form of electric circuit, consisting of a battery, a resistance and connecting wires. Actually, the connecting wires offer some resistance to current flow. For practical purposes, however, this can be neglected because of its extremely low value. We then have in effect a 10,000-ohm resistor connected across a 90-volt battery. Suppose we want to determine the current flow through the resistor, the voltage drop across it and the power dissipated by it.

The voltage drop across the resistor is obviously equal to the voltage supplied by the battery, inasmuch as it is connected directly across the battery terminals. It is therefore 90 volts.

The current flow through the resistor, according to Ohm's Law, is $I = \frac{E}{R}$. Substituting the known values for E and R, we have $I = \frac{90}{10000} =$ 0.009 ampere (9 milliamperes).

Next to determine the power dissipated in the resistor we apply another of the Ohm's Law formulas: $W = E \times I$. Substituting the values already obtained, the equation becomes $W = 90 \times 0.009 = 0.81$ watt.

As a further step in the analysis of this circuit, it would be interesting to divide the resistance into two parts of 2500 and 7500 ohms each as in Figure 1(b). Obviously the voltage, current and power dissipation remain as before, so far as the total resistance is concerned. However, we now have a new condition in that in addition to the original voltage value we have made two others available as indicated by E2 and E3.

Because the current flow through the entire resistance R2, R3 is still 0.009 ampere, this is the value flowing through each of the resistors. The voltage drop across each is easily determined. If $E = I \times R$, then the voltage drop across R2 will be $0.009 \times 2500 = 22.5$ volts. The drop across R3 will be $0.009 \times 7500 = 67.5$ volts. The sum of these two is 90 volts, thus checking with that applied by the battery.

Examination of the figures just obtained demonstrates two important basic principles. The first of these is that when a voltage is impressed across a circuit in which resistors are connected in series, the voltage drop across each of the resistors will be proportionate to their resistance. The second is that the current flowing in such a circuit will be equal at every point in the circuit. These are, of course, simply confirmation of Ohm's Law.

To examine the effect of inserting parallel resistance, the circuit of Figure 1(c) shows another 2500-ohm resistor, R4, connected in parallel with R2. Here again an entirely new condition is established, as we shall see by figuring out the new constants. First of all, by the rule of parallel resistors given previously, we find that the combined resistance of R2 and R4 is now $2500 \div 2 = 1250$ ohms. The total resistance through which the 90-volt e.m.f. of the battery is to send current is, therefore, 1250 plus 7500, or 8750 (instead of the original 10,000 ohms). This permits a total current of 0.0103 ampere to flow. The voltage drop across R3, therefore, becomes approximately 77 volts and that across the combination of R2 and R4 is slightly less than 13 volts.

If current measuring instruments were inserted at the three points marked "X" in Figure 1(c) they would all read alike. However, this would not be true of additional meters placed at the points "Y" because here the current divides between the two branches of the parallel circuit. Because R2 and R4 are of equal resistance value, the division of current will be equal and each resistor will carry one-half of the total current, or 0.00515 ampere each.

In the matter of power dissipation in the various resistors, calculation will now show that R2 and R3 in Figure 1(b) will be called upon to dissipate 0.2025 watt and 0.6075 watt respectively and that in combination the dissipation will total that of R1 in Figure 1(b).

In the circuit of Figure 1(c), however, R3, carrying heavier current than before, will have to dissipate nearly 0.80 watt while R2 and R4 will each dissipate about 0.067 watt, making a total of about 0.93 watts to be dissipated in all.

In Figure 1(d) another resistor R5 is added directly across the circuit of Figure 1(c) and therefore in parallel with the entire resistance network consisting of R2, R3 and R4. The effect of this is simply to decrease the overall resistance of the circuit so that the current from the battery is increased by the current flowing through R5. If the battery voltage remains unchanged this additional current will be the same as that drawn by R1 in Figure 1(a), or 0.009 ampere. So far as the R2, R3, R4 branch network is concerned, conditions will remain identical with those of Figure 1(c).

The four circuits just analyzed deal with assumed resistors and a battery. The method of analysis would be precisely the same, however, were we to substitute any other source of power for the battery, and radio tubes or other devices for some of the resistors. Thus, in Figure 2, for instance, are

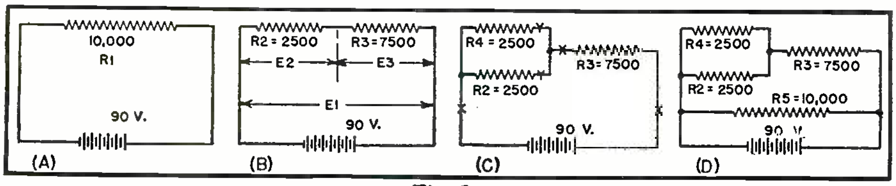
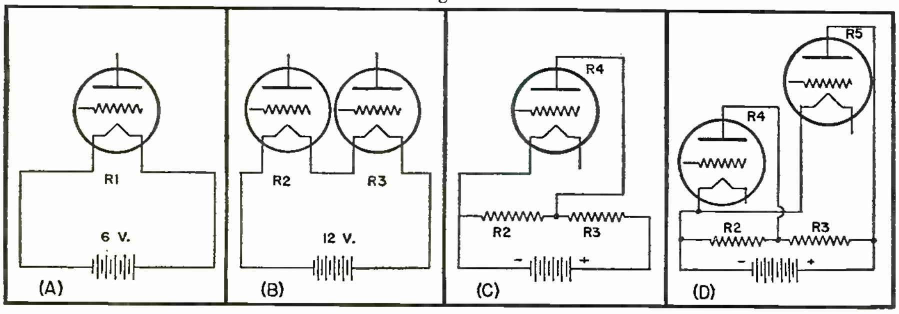


Fig. 1.

Fig. 2.



shown four practical circuits which are equivalent to the correspondingly lettered circuits of Figure 1 in all but the values. In Figure 2(a), we substitute a 6-volt battery and the resistance of a 6-volt tube filament for the 90-volt battery and 10,000 ohm resistor of Figure 1(a). In Figure 4(d), the plate circuits of the two tubes represent R4 and R5 of Figure 1(d) and the resistors R2 and R3 form a conventional voltage divider which provides the lower plate voltage required for the tube which represents R4.

In actually analyzing voltage and current distribution, etc., of the circuits of Figure 2, it is more than likely that the radio man would think of them (or even draw them) in the form shown in Figure 1. In this way, all extraneous factors are eliminated and the circuit under study is reduced to its most fundamental terms. In the more complicated radio circuits, it is practically impossible to make any kind of detailed analysis of voltage, current and resistance relationships without resorting to simplified circuit diagrams in which the various components such as tubes, transformers, etc., are represented simply by resistors of equivalent values.

Various types of electrolytic capacitors.

To illustrate this point, Figure 3(a) shows the filament circuits of a radio receiver employing two different types of 2-volt filament tubes and operated from a 3-volt filament battery. Assume that the problem is to determine the necessary resistance values of the filament-voltage control rheostats (variable resistors), R4 and R7; also the power that they will be called upon to dissipate.

Examination of the circuit shows that the filaments R1, R2 and R3 are in parallel and that the rheostat R4 is in series with the group. Filaments R5 and R6 are also in parallel with each other and rheostat R7 is in series with the pair. The first step in simplification is, therefore, to redraw the circuit as at (b). But we can go further than this. We can lump R1, R2 and R3 as a single equivalent resistor. Suppose the required current through each of these filaments is 0.06 ampere. Then the three will draw 0.18 amp. and this is the amount that will have to be supplied through R4. Suppose R5 and R6 each require 0.12 amp. Then, combined and represented as a single resistance, they will draw 0.24 amp. through R7. The absolute basic circuit is, therefore, that of (c).

The functions of R4 and R7 are to reduce the 3-volt supply voltage to the 2-volt value required by the tubes. Thus a drop of 1 volt must be developed across each. In the case of R4, the current to be passed is 0.18 amp. Its resistance will, therefore, have to be capable of adjustment to $R = E/I = 1/0.18 = 5.55$ ohms. The power to be dissipated will be $W = E \times I = 1 \times 0.18$, or 0.18 watt.

R7 must develop a drop of 1 volt at 0.24 amp. Its resistance must, therefore, be 4.16 ohms. The power to be dissipated figures out to be 0.24 watt.

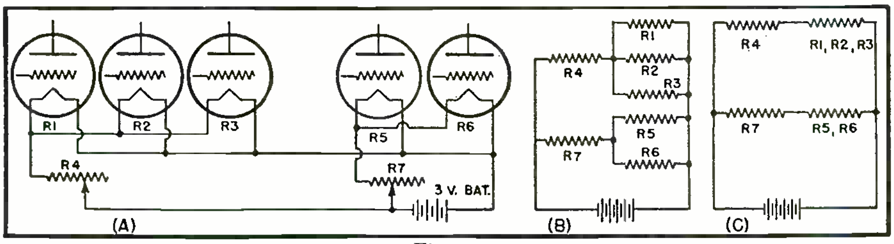


Fig. 3.

From this analysis it becomes apparent that standard 6-ohm variable rheostats can be used for R4 and R7 and that the power to be handled is well within the rating of the smallest and most inexpensive wire-wound rheostats available from parts jobbers.

A 6-ohm control is advisable but larger resistance controls up to 12 ohms may be used.

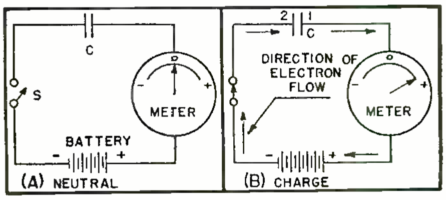


Fig. 4.

Capacity and Capacitors

"Capacity" is a technical term applied to a property inherent in all electrical circuits. This is the ability to store electrical energy. It is as fundamental in both electricity and radio as is "resistance" and because of the extremely important part it plays in radio circuits it is essential that the student gain a clear conception of this property at the very outset of his study.

"Capacity" or "capacitance" are the terms employed to designate the ability to store electrical energy. The electrical devices which we frequently insert in a circuit to increase its capacity are known as "condensers," or more correctly as "capacitors."

A pair of metal plates (or other conductors), separated by air or other insulating material, constitute a capacitor. If this capacitor is connected to a source of e.m.f. as shown in Figure 4(b) it is apparent that there is no complete conducting circuit (since the metal plates of the capacitor are separated by insulating material), yet it is a fact that a momentary current will flow when the switch S is closed. A sensitive current meter, connected as shown in this circuit, will give a definite indication of such current flow. Moreover, it can be demonstrated that the current which flows during this momentary surge is not lost or dissipated but is actually stored in the capacitor. Evidence of this is obtained by opening the switch, removing the battery from the circuit, then again closing the switch, as in Figure 5. The result will be another momentary surge of current, this time in the opposite direction to that of the original

(*Continued on page* 55)

Manufacturer's Literature

Our readers are asked to write directly to the manufacturer for this literature. By mentioning RADIO NEWS and the issue and page, we are sure the reader will get fine service. Enclose the proper sum requested when it is indicated. This will prevent delay.

1942 Edition of Sprague Interference Elimination Manual Now Out

A new 1942 edition of the *Sprague Manual of Radio Interference Elimination* has just been announced by *Sprague Products Company,* North Adams, Mass., makers of *Sprague* Condensers, Koolohm Resistors, and various items of test equipment. The booklet is available either direct or through *Sprague* jobbers at a net price of 25c.

The new edition has been revised and brought fully up to date. From a study of noise-reducing antennas, to the work of locating and remedying all types of man-made radio noises, the Manual is a complete guide. Throughout, it is based on practical experience as gained by *Sprague* engineers in many years of intensive field research —both separately and in conjunction with public utility specialists, radio servicemen and engineers.

Of utmost importance is the fact that the Manual tells the reader how to locate noise-making devices, then how to determine exactly what filters are required, before any units are purchased or any permanent installation made. Described and illustrated are the correct filter circuits and parts required to reduce noise from electrical devices such as fluorescent fixtures, single or polyphase motors, d.c. generators, alternators, switches, thermostats, sign flashers, arcing devices, oil burners, gas engines, vibrating contacts, mercury vapor lamps and many others. In addition, the *Manual* tells radio servicemen how to go about building profitable interference elimination business.

New Booklet Describes Electrical Instruments

For industrial, central station, laboratory, and general use, portable switchboard and miniature panel instruments are described in a new 34-page booklet announced by *Westinghouse Electric and Manufacturing Company.*

Somewhat the same in format as the popular and well-known quick-selector catalog, the new publication lists all instrument types for specific applications on an instrument selector chart. Special features, specification data, and full-scale range of standard ratings are included.

Design features and physical char-

(*Continued on page* 61)

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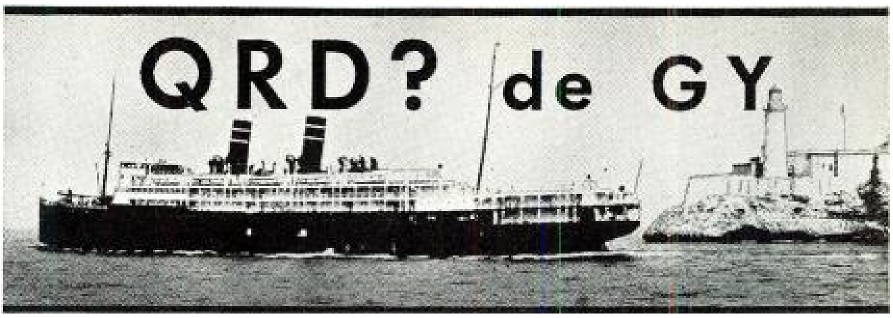


by JERRY COLBY

ONE of the many things which this war will prove to misinformed foreigners and to some Americans themselves is the ability of the supposedly smug, self-centered, egotistical, boisterous, blundering Americans to take it—smiling and standing upright. We hear of many cases of self-sacrifice, like the man who sold his farm, put up his wife and kids with relatives and then proceeded to enlist in the Army; and the former $50,000 a year president of the New York Stock Exchange who traded his glass-topped desk for a service cot.

And guys like Don Rietske, former Chief of Police Communications, City of Los Angeles, trading that high billet for a 2nd class radioman's crow in Uncle Sammy's Navy. And Ye Ed's old shipmate, Leo Meiers, who was also hooked up with Police Communications and is now somewhere on the broad Pacific on one of the Navy's cruisers trying to find those Japs.

SPEAKING of Brother Meiers reminds us of the time back in '29 when Los Banos, Philippine Islands, wasn't just a name on the road 75 miles outside of Manila, but a billet to suit the heart of the most unsuitable radiop that ever held down a key. Chow to fit a king's taste served by Filipino mess attendants, duty which allowed for plenty of liberty and the hot natural baths wherein one could steam out the beer after an evening's debauchery. And plenty of roads on which one could wheel a high-powered motorcycle.

Well, Brother Meiers whilst barreling his Harley-Davidson down the road one sunny afternoon, came a-cropper all because he forgot that in this land which was different from his native heath, people drove on the wrong side of the road, or rather on the right side or rather when they were on the left hand side of the road, you'd be on the right side, or rather . . . well, dear readers, you get what is meant . . . or do you? Be that as it may Brother Meiers saw an automobile coming towards him on his side of the road and being Brother Meiers, he wouldn't yield an inch. No sir, and neither did the other hombre who happened to be on the right side of the road. So when the smoke cleared away there was the motorcycle, or rather what was left of it, and there was Leo Meiers lying in a prone position on his back trying to figure out how come. That's what it took to make Meiers see the light, slide-rule or no. But as a radiop, technical man, beer-guzzler and tennis player, he's top man and ye Ed wishes him plenty of good luck and good hunting.

THIS war has encroached upon the vacation activities of our old friend Matt Murray, former shipside radiop, former movie radiop and now Police Communications radio technician. Sad is Brother Murray who has a gold mine, literally, back in the hills of Los Angeles with no powder to blow out the rocks. Patriotically, sez Murray to Uncle Sam, throw my dynamite to the Japs and don't miss 'em. But from a financial view Matt would like to dig into that mountainside hole just "another coupla feet" where he's sure to turn over some real pay-dirt. Gold mining is not a novelty for radiomen as many of the boys often went into that business before the unions came to their rescue and brought decent wages into their pay envelopes. So Brother Matt is doing nothing new or novel except digging hardrock out with a pick instead of with a dynamite stick. Matt's an old friend of ye Ed's so we're settin' up here cheering him on. One never can tell what the morrow may bring to him, and if it's good, we might make a touch. So good luck, OM!

BROTHER HAROLD CRAIG is back into port again with the news that Brother Karl Baarslag made full Lieutenancy in the last bunch selected. Three cheers for Baarslag. There's one chap who goes after what he wants and gets it. Just like that! And we're betting on him if he decides he wants to become a full-fledged Admiral. Yessir, Karl decided one day to become a writer and bango . . . he sits himself down and pounds out five books in one, two, three order.

He decided that unless his union would throw out the Commies and all subversives, he would form a union of his own and open it up for fellows who were all-Americans, first, last and always. So Karl hits the ball again and it wasn't long before the ROU was stepping into the big league with many hits, no strikes and few errors. This was quite a plugging job but Brother Baarslag had what it takes

(*Continued on page* 49)

HIGH PRESSURE

by E. H. LEFTWICH

The experiences of Lee and Al at Salutary Sales and Service are replaced this month by Bink and Red. You see— our former friends have gone to war. Good luck to them.

AT eight o'clock on a Saturday morning, this dame walked into my radio shop carrying a midget radio under her arm. She was fat, about forty, peroxide-blonde and looked like she was in a hurry.

"You the Radio-man?" she asked, and put the radio down on the work-bench.

"You bet," I answered, jumping up and producing my best grin. "Having a little trouble?"

"Yeah," she confided. "This is the little radio I keep in my bedroom. We got a big one in the sun-parlor. This one's got so it's kind of hoarse. It sounds like a two-bit politician after a hard speaking campaign. What's wrong with it?"

"Well, lady," I tried to explain, "I can't tell until I go into it. Offhand, though, I'd say it needed a couple of condensers and maybe a tube or so. If you wait a few minutes I'll . . ."

"Haven't time," she broke in. "Got some shopping to do. You go ahead and fix it . . . and deliver it to Mrs. P. D. Mossbeck, 2411 Somerset Place. Can you get it there by ten A. M.?"

"Sure," I said. "But hadn't I better call you first and let you know what it'll cost?"

"No," she answered. "I don't care what it costs. It's got to be fixed anyway, and besides . . . you look like an honest lad to me."

"Thanks, lady," I smiled, and felt a warm glow stealing over me at her compliment. She'd actually called me, "lad." When you're thirty-five and someone calls you, "lad," you feel like there may be a few miles left in the old chassis, after all.

"I'll fix it, and get it there by ten," I said, and she waddled off.

Well, I was in a jam . . . no fooling. Here was a job to do, and I didn't see how I was going to do it. The way it used to be, was when boys finished High School they started selling insurance. Now, they started fixing radios . . . and that's one reason why my business is no good.

Believe you me, I needed every job I could get. I'd promised to fix the radio and deliver it by ten . . . and I *had* to do it!

In the first place, my car was in the shop, and I couldn't get it out until I paid the repair bill on it. In the second place, I was dead broke and my credit was no good at the wholesale houses where I bought my parts. I was certain to need some parts to fix the radio and I didn't know how I could get them without money. Even if I did get the parts, I had no way to deliver the radio.

Somerset Place was three miles off. I couldn't afford to be gone from the shop long enough to walk, because some of my customers might come in to pay their bills. I couldn't ride the bus, because I didn't have a nickel for fare.

Then . . . I thought of Sedgewick East. Good old Sedge. He had often helped me out of jams before, and I needed help now, as bad or worse than I ever needed it. Unless I raised some cash, quick, Maizie (the Missus) and I would spend a hungry week-end.

Thank goodness . . . the 'phone was still there. They wouldn't come and take it out until Monday.

I grabbed the 'phone and called Sedge's number. Sedge is tall, lean and cotton-headed. He's a swell guy, and always ready to lend a helping hand to those who need it. He's a natural-born salesman, and has plenty of brains back of his dumb-looking pan.

Luckily, Sedge was home. He lives about two miles out, on Marshall Lane. He answered the 'phone himself.

"Sure, I'll help you, Red," he said. "I'll wind up the model A and be there in a minute."

While I was waiting for him, I checked the little radio. It had one shot condenser and needed a tube. I called Mann Electric Company and asked for Cecil Binkley.

"Listen, Bink," I said. "Remember the time I rode you all over town at three A.M., got you some black coffee, took you home and put you to bed?

"Sure, Red," he came back. "You really did take care of me that night."

"And," I continued, "There was the little incident at the Camp party on the River, when you gulped down a glass full of white-corn whisky and fell down the hill into the river. Remember who pulled you out?"

"You did, Red," he said, kind of meek and fearful-like. "What you *want,* Red?"

"I need a 43 tube and an 8 mike condenser."

"But, Red," he argued, "Your credit is no good here. I'd loan you the money, myself, if I had it . . . but I'm broke."

"Listen, Bink," I pleaded, "I've got to have those parts to fix a radio that's here . . . or I don't eat tomorrow. Can't you do *something* to let me have them?"

"Is that a cash job you're working on?"

"You bet."

"Well, then . . . I'll tell you what I'll do. I'll send you the parts and you get the money and bring it down here *before* one o'clock, when we close. I'll hold the ticket until then . . . and you'd better have it here, or it'll be just too bad . . . for me."

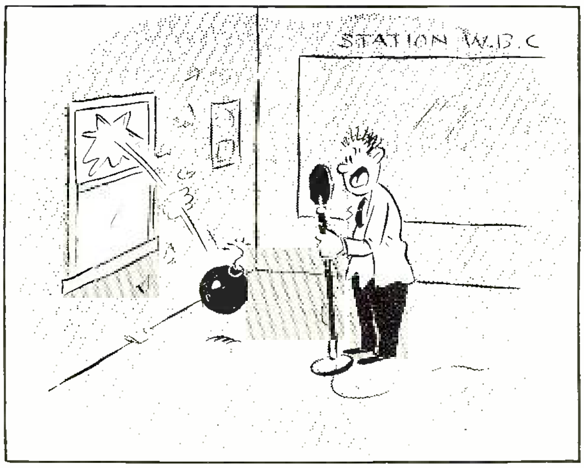
"Thanks, Bink . . . and don't worry. The money'll be there all right!"

The parts arrived on the motorcycle delivery. My iron was hot. It only took a couple of minutes to solder in the new condenser, stick in the new tube and get the radio playing. Just about nine-thirty, the job was finished. I was making out the bill when Sedge pulled up in front of the shop in his model A.

"Had a little trouble, Red," he explained. "Float was stuck in the carburetor and practically all the gas ran out before I could fix it . . . but here I am."

"Yeah," I sneered. "Here you are . . . and with no gas. I wanted you to deliver this radio before ten o'clock. That's what I called you in for."

Red thought for a moment before replying.



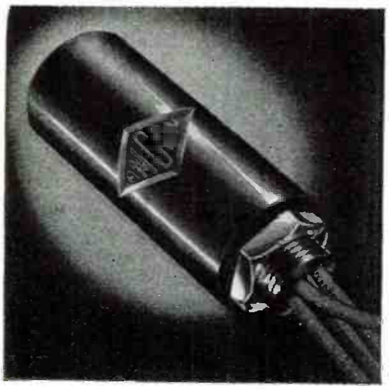
"The next sound you hear will be WBC leaving the air!"

(*Continued on page* 50)

WHAT'S NEW IN RADIO

New Capacitors Announced

Specially designed, inverted type tubular capacitors with lock-nut, now available in modern plastics for chassis top installation. Available in single or multiple units over a wide range of capacities and working voltages in both electrolytic and paper by-pass types, to meet rigid government specifications. The recognized dielectric properties of plastics—tensile strength—imperviousness to moisture—immunity to temperature and climatic changes—to say nothing of its inherent



beauty, assure wide acceptance for these new units. They improve the appearance of any top chassis assembly. They are jar and vibration proof with effective insulation from chassis to container—providing an ample safety factor for voltage surges. Specially developed insulated leads cannot ground. Additional information may be had by writing *American Condenser Corp.*, 2508 S. Michigan Ave., Chicago, Ill.

Electronic Air Raid Siren

A new electronic type air raid siren, designed to give both great volume for alarms as well as a simple method of crowd control, is announced by Audiograph Division of *John Meck Industries*, 1313 West Randolph Street, Chicago. Called the "Electro-Siren," this unit makes use of a vacuum-tube tone generator which can either duplicate the rising and falling tone of a mechanical siren, or can be set at any pitch for best audibility over traffic

or manufacturing noises. It can also be used to send code messages to air raid officials by dots and dashes. Special circuit design allows 50% more power than is possible from an ordinary sound system.

A feature of this new unit is an arrangement so that a microphone can be used for voice announcements over the same system, which takes the place of a public address system. This is important in avoiding confusion and panic in crowded places. A reassuring voice following an air raid signal may save countless lives.

The *Audiograph* "Electro-Siren" normally operates from any 110 volt source, but in the case of current failure can be instantly switched to 6 volt storage battery operation. It can also be used in police cars or other vehicles, operating from the car battery. The largest system can be operated continuously for four hours from a fully charged battery.

Sonora Lightweight Portable

This handsome, lightweight portable radio made by *Sonora Radio & Television Corporation*, Chicago, is designed for America-at-home, on-the-go, or on-the-march. It is a 5 tube, 3-way radio, sturdy and compact, that can be carried and played anywhere—from self-contained batteries or from 110 volts a.c. outlet or 110 volts d.c. out-

let. It tunes 535-1720 kc. and has the built-in "Sonorascope" loop—no aerial or ground needed. 5" Dynamic Speaker, Slide-Rule Dial, on-off Battery, a.c.-d.c. indicator, and attractive grille-effect are other features of this smart-looking brown luggage-type model with its durable carrying handle. Size: 12⅛" high, 14¼" deep, 17" wide.

UHF Transmitting Capacitors

Engineered and especially recommended for use in ultra-high-frequency radio transmitters, television and FM transmitters, as well as in miscellaneous applications in the ultra-high-frequency range, the new Type 1860 transmitting capacitor is now made available by *Aerovox Corporation* of New Bedford, Mass. In such applications this capacitor is readily adapt-

able for use as a fixed tuning capacitor, for by-passing, blocking, coupling and neutralizing, and as an antenna series capacitor. Losses are extremely low because of the highly refined sulphur compound utilized as the dielectric, the elimination of corona as well as the unique design and construction. The case is grounded and a single high-tension mica-insulated brass terminal is used. The aluminum case is 2" in diameter by 2" or 2½" high, and is provided with a mounting base with 2 holes for 10-32 screws. These units are available in .00001 and .000025 mfd. in 10,000 volts and .00005 mfd. in 5,000 volts.

New Changer Replacement

Detrola Corporation of Detroit, Michigan has announced a remarkable new product in its automatic record changer replacement unit. There are two models, one of which plays twelve ten-inch records and ten twelve-inch records and the deluxe model which plays fifteen ten-inch records and ten

twelve-inch records.

This *Detrola* replacement unit fills the needs of service men to meet the demands for an efficient placement unit to replace unsatisfactory or obsolete automatic record changers as well as to convert almost any type of record playing instrument to a modern automatic phonograph.

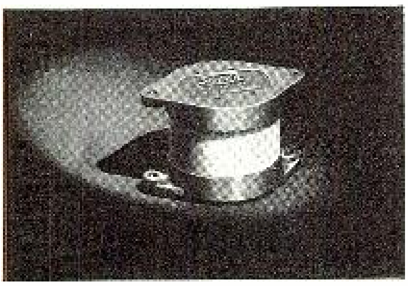
This automatic record changer was designed, engineered and produced by *Detrola* and has many exclusive features. Among its many features are gearless, noiseless operation, oilite, permanently lubricated bearings, a device for permitting the playing of home recordings, free floating ton arm, manual or automatic record selection.

This particular unit finds a new field in public address installations where continuous music is desired. It is one of the simplest mechanisms imaginable and probably the simplest ever produced in an automatic record changer. It is therefore very efficient and trouble free. Easy to install and very easy to operate. It is mounted on an attractive baseboard ready for installation.

Solar XP Capacitor

Type XP mica capacitor series includes four sizes, housed in ceramic shells with cast aluminum end bell terminals. These capacitors are designed for heavy-duty service involving high voltage and high current requirements as demanded by high-power transmitting equipment.

These designs afford the necessary terminal separation for high voltage ratings and the ample area of the ter-



minals provides a low resistance positive contact where multiple stack assemblies are required.

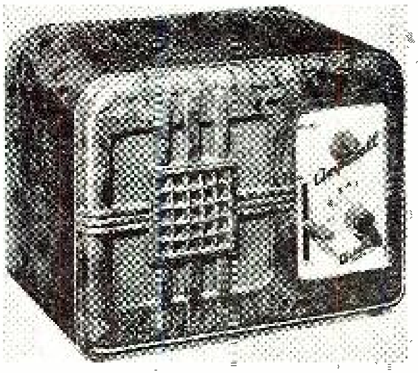
The best of available materials are combined with careful processing to produce a design capable of long life expectancy under the most exacting operating conditions. The capacitor stack assembly consists of a number of series sections which are pre-tested before assembly to provide capacitors with an ample margin of safety to guarantee reliable service.

The four types are designated as XPN, XPV, XPX and XPY. All are of the same general construction, but of increasing size as dictated by voltage and current specifications. Capacitors are serially numbered and production testing data is available on request.

Every phase in the manufacture of these capacitors is controlled by test. Every capacitor is subjected to a radio frequency heat run at one of its current ratings. A normal ambient temperature of 60° C. is recommended. Higher temperature ratings are available on request. *Solar Mfg. Corp.*, Bayonne, N. J.

Multiple Station System

The W-105 is an excellent low cost communicating system for office and industrial application. Warehouses, service stations, small factories, whole-



sale distributors, professional and business offices will find this system saves time and money far beyond its cost.

This system consists of a Master, or central control unit, the only amplifier in the entire system. Up to five Remote, or outlying sub-stations can be used. The Master or central unit can call and converse with any one of the five Remote stations as selected.

A new and special feature of this system is that the Master unit can call and "listen-in" or converse with all five Remote stations at one time. This is done by means of the sixth, or "all" position on the selector switch.

Manufactured by *The Rauland Corporation*, 4245 No. Knox Avenue, Chicago, Illinois.

New Blackout Bulb Unit

Important changes in Blackout bulb specifications are announced by the *Wabash Appliance Corporation*, Brook-

lyn, N. Y., whose silver-lined Blackout bulb placed on the market in early January was put through exhaustive blackout tests in actual city-wide blackouts in practically every State. Specification changes are based on the results of these tests, as well as on various official recommendations.

The most important specification change is in color of light from blue and red to the deep orange recommended by the *Office of Civilian Defense*. Other changes are in size which is smaller, in reduced current consumption to 15 watts, in elimination of the former built-in reflector, and in the improved type of heavy black silicate coating to prevent light leakage.

The deep orange light that the new unit provides, is said to be ample to permit room occupants to see each other plainly, as well as furniture, doors and windows. The bulb will fit any household socket.

Blackout Control

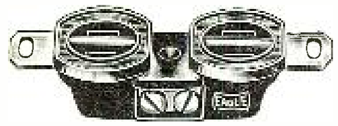
United Cinephone's blackout control offers the most practical answer to the important problem of maintaining lights without the risk of infringing on local blackout rulings. The Model No. 77 Control is focused at a street light thus using it as a light source. When the street light is extinguished at the power station due to an alarm, automatically the control will become operative and will extinguish any lighting circuit which it controls.

The control will operate on 1/200 part of a foot candle, which makes it highly sensitive to light. The collector lens on the cover receives the light

from a fixed point which can be a street light of ordinary intensity 100 feet away. The lens converges the light on a small aperture thus allowing it to fall on the photocell behind the aperture. The aperture itself shields the photocell from ambient light and increases the sensitivity of the control. A relay in the control is held energized when light is on the photocell, and when the light is interrupted or extinguished the relay de-energizes and breaks the circuit.

New Eagle Receptacle

The Engineering Department of the *Eagle Electric Mfg. Co., Inc.* have just completed their periodical test on the durability of their Cat. No. 733 All Bakelite Duplex Flush Receptacle.



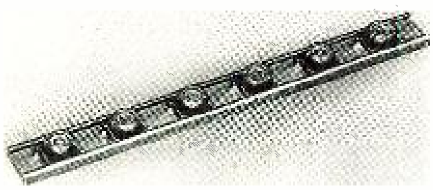
After 15,000 insertions, the contacts still hold an ordinary attachment cap as firmly as it did after the first insertion.

The actual receptacle is on exhibit at the *Eagle Electric Mfg. Co., Inc.* in Brooklyn, N. Y.

Elastic Channel Nuts Available

Elastic Stop gang channel nuts, widely applied in the aircraft industry, are now offered by the *Elastic Stop Nut Corporation,* 2332 Vauxhall Road, Union, New Jersey, for testing on the many applications in general industry where a multiple, self-locking, bolted fastening is required. These strips of self-locking nuts have the approval of the military and civil air authorities and are used on all American-built military and transport aircraft, on fuselage and wing structures, engine cowlings, cover and inspection plates, around windows and doors, and at other points where a series of fastenings is required.

The strips are factory-assembled, and it is necessary only to rivet or otherwise fasten them to the structure where they are to be used. They consist of specially designed *Elastic Stop Nuts,* with four lugs at the base and installed at specified intervals in a metal channel strip which is preformed to accommodate the nut lugs under longitudinal flanges. The channel strip is pierced for the required nut size and spacing, and the nuts are held



in place by dimples in the channel, tolerances permitting them to be virtually self-centering.

In application, the assembled gang channel is permanently attached to the structure with bolt holes aligned with those in the structure. As in all *Elastic Stop Nuts,* the locking action is obtained with a vulcanized red fiber collar which resists the entry of the bolt. This action forces the nut outward, creating a constant metal-to-metal pressure-contact throughout the threads of nut and bolt, taking up all axial play, and creating a cushion against vibration stresses, and impact. The fiber locking element retains its resiliency permanently and is not subject to fatigue under the most severe conditions of vibration.

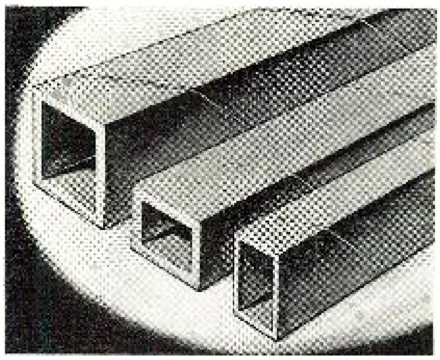
New Process Precision Tubes

Another important improvement in tubes for electric coils is announced by *Precision Paper Tube Co.,* manufacturers of dielectric paper tubes spirally wrapped, round, square or rectangular, 2033 W. Charleston St., Chicago, Ill.

This latest advance is affected by the use of a specially adapted heat die machine.

Heavy compression insuring a new degree of strength, and resistance to collapse—clean perfect formation—finer accuracy in sizing to specifications, superior dielectric properties, lower moisture absorption rate, space-saving on "light jobs," absolutely square corners and straight side walls are among the advantages claimed for tubes treated by this added process, and demonstrated by users. Thus "Precision" adds new significance to its name.

The improved tubes are preliminarily formed as heretofore, of dielectric kraft, or fish paper, or a combination of both. The paper is spirally



wound on a steel die in an automatic machine. The tube is then pushed pneumatically through the new heated compression die which effects an added compression of about 10% and finishes the operation to its remarkable degrees of superiority.

Precision Tubes made by this process can be supplied in round, oval, square or rectangular cross section and in continuous lengths of any wall thickness with any inside or outside diameter.

The advance in the approach to absolute accuracy is especially worthy of note. It has been shown that *Precision* Tubes made by this process can be held to a tolerance of .002 inches.

The result of the extra compression and heat-treatment in the strength of coil tubing is astonishing. For all practicable purposes of its use it is non-collapsible.

Greater winding area is provided. This means greater efficiency without increase of size. The contribution of the new process to the solution of the space and heat factor problems is greeted with satisfaction by electrical manufacturers.

Complete information on the new tubing can be had by addressing *Precision Paper Tube Co.* at address above.

New GE Dynamotor Contactor

A new contactor specially designed to start and stop dynamotors used with aircraft equipment has been announced by the industrial control division of the *General Electric Company,* Schenectady, N. Y. It is available for either 12- or 24-volt direct-current circuits, and conforms to the general requirements set up for aircraft control devices. The contactor is also applicable to tank installations.

The dynamotor contactor is approximately 2½ in. wide and 4 in. high, weighs only 2.3 pounds, and can be mounted in any position. It is totally enclosed, with the contacts in the upper compartment and the coil and plunger in the lower compartment. Copper-lead-alloy contact tips are used to assure the best high-current inrush performance.

The contactor meets Signal Corps vibration requirements, being good for mechanical frequencies of 5 to 55 cycles per second at a maximum of 1/32-inch amplitude (1/16-inch total travel) applied in any direction. The single-pole, normally open contacts are designed to stay open when the coil is not energized, and closed when the coil is energized even when the contactor is subjected to a linear acceleration of 10 times gravity (10G) applied in any direction, or to the vibration conditions outlined above.

Sylvania Newspaper Mat Service

Sylvania announces a series of 1 and 2 column newspaper mats, available free to *Sylvania* radio servicemen. "Radios Need Inspection Too" is one of the themes that is illustrated several ways with a delightful touch of humor. Others are handled in radio quiz form, telephone dial, dramatization of late news bulletin reception and that old folksy saying, "One Rotten Apple Will Spoil a Whole Barrel."

Sylvania urges radio servicemen to promote their expert abilities aggressively, right now when new sets are disappearing from the market and the public can keep up their "radio contacts" *only* by having a serviceman repair broken down sets. *Hygrade Sylvania, Corp.*

Lighted Radio Service Sign

It's a "Go Light" that brings in business, according to the bulletin to *Sylvania* jobbers announcing the new electric lighted "Complete Radio Service" sign. The new sign has a snow white glass panel with "Complete Radio Service" lettered prominently across the face. To the right of the lettering is a modernistic sketch of a radio chassis with the new *Sylvania* Lock-In Tube superimposed. Snappy colors of the lettering and illustrations are orange, green and black.

The sign hangs or stands. Strong chains are provided for hanging and a sturdy metal rod easel is mounted on the back for standing. A sliding panel in the back permits easy installation and replacing of a 60 watt lamp for illumination.

The back of the sign is mounted apart from the front glass panel and beveled back gunmetal sides. As the light rays shoot out around the edges, the red painted rim is illuminated, giving a neon glow effect. It is 11" high, 19" long, 3¼" thick and weighs 4 pounds. It is available to servicemen at $1.50 each.

According to the *Sylvania* advertising department, "War emergency is making the public more radio conscious than ever before, and radio store identification signs, such as this one, can become as important as direction signs to the nearest air raid shelter.

New 4,000 Play Needle

"LIFETONE" is the appropriate name given to the new 4,000 play needle just developed by *Duotone Company*, of 799 Broadway, New York City. Retailing at $1.50 the newly released "Lifetone" needle adds to the widely varied *Duotone* line a super playback needle that is guaranteed to give at least 4,000 perfect playings. Quality has not been sacrificed to longevity here for the "Lifetone" needle maintains brilliant highs while holding surface noise to a new low. "Lifetone" comes packaged in an unusual, attractive plastic container. Further information available by direct communication with the manufacturer.

Low-Frequency Generator

For those oscillographic studies requiring sweep frequencies as low as one cycle every few seconds, a Low-Frequency Linear-Time-Base Generator is now announced by *Allen B. Du Mont Laboratories, Inc.*, of Passaic, N. J. Used in conjunction with an oscillograph provided with a long persistence cathode-ray tube, or with photographic recording methods, this accessory instrument opens up new fields of investigation of low-frequency transient and recurrent phenomena. Vibration studies, stress and strain measurements, low-frequency electrical observation, electrocardiography and electroencephalography, are all facilitated by this new unit. The frequency range of the instrument corresponds to rotating speeds of 12 to 7500 r.p.m., thus permitting the use of an oscillograph for the visual study of certain characteristics of rotating machinery at low and medium speeds. Transient observation is provided for by a single-stroke sweep circuit.

The *Du Mont* Type 215 Low-Frequency Linear-Time-Base Generator provides a sweep frequency range of 0.2 to 125 cycles per second. The maximum undistorted output signal is approximately 450 volts peak-to-peak, balance to ground. The single sweep is initiated either manually or by observed signal. Excellent linearity is assured by a compensating circuit.

Thoroughly portable, the instrument measures 14¼" h., 8 13/16" w., 19½" d., and weighs 41 lbs. Steel cabinet, black wrinkle finish, with carrying handle. Etched metal black panel. 115 or 230 v. a.c. r.m.s. 40-60 cycle. Power consumption, 50 watts. 1 amp. fuse protection. The primary voltage is selected by a switch in the instrument.

New Sectional Resistor

For use in railway service, radio circuits, power rectifiers and laboratories, for measuring any high voltage a.c. or d.c. circuit of 250 to 30,000 volts, a new sectional resistor is announced by the *Westinghouse Meter Division*, Newark, N. J. The unit is designed to replace, in certain cases, the old box type resistor which had a high power consumption and was inconvenient to install or replace.

Made up of individual, hermetically sealed units wire wound around a ceramic resistor spool, the resistor units have values of from 0.25 to one megohm and a rated current of one milliampere. Dimensions are 1⅜ inches by 1¼ inches in diameter per section. The ceramic resistor spool is sectionalized, and adjacent sections are wound in opposite directions to obtain a noninductive resistance.

Two nickel-plated brass shield cups are slipped over the spool before the outer cover is molded on. The cups, together with a phenolic retainer ring, prevent the molded material from coming in contact with the spool during the molding process and also provide electrostatic shielding. Ends of the shield cup are tapped with a 10-32 thread. Units are connected electrically and mechanically by a 10-32 stud and mounting ferrules are held in place with a 10-32 screw.

Resistance is held within close tolerances permitting interchangeability of units having the same voltage rating. When a number of sections are mounted on one shaft, permanent taps may be taken off between any two sections, permitting a multiplicity of resistance combinations on one complete unit. For switchboard mounting, insulators are available in 7.5, 15 and 30-kv. sizes.

6 Tube Sonoracorder

For Complete Home Entertainment *Sonora Radio & Television Corporation,* Chicago, offers the *Sonoracorder*—a 6 tube table model Phono-Radio-Recorder. It records all blank discs up to 10″ size; plays back 10″ and 12″ records. Radio tunes 535-1720 kc. The 5-position Selector switch makes it simple to operate. Features the "Sonorascope" loop; big Clock-type Dial; Dynamic Speaker, 3 Watts Output; AVC; rim-drive motor; magnetic cutting head; new feather-weight crystal pickup with lifetime needle. This "three-in-one" model is encased in an attractive cabinet, fashioned of choice walnut veneers, with gracefully designed grille, and hinged lid which closes over 10″ and 12″ records. Size: 17¼″ wide, 10½″ high, 14½″ deep. For operation from 110 volts, 60 cycles a.c.

Chemical Kit Available

A complete kit of samples and detailed description of chemicals and adhesives, such as used by the radio and electronic trades, is available free to manufacturers of radio and allied products, laboratories, government agencies, etc.

Described and sampled are chemicals to prevent contact oxidation and noisy operation, adhesives for many purposes, such as Speaker Cement, Thermo-Plastic Cement, cement for fabrics and plastics, etc.; also coil dopes and special chemicals to increase friction, such as used for dial drives, etc.

Requests should be mailed on company or official stationery to *Walter L. Schott Co.,* Department 26, 5270 W. Pico Boulevard, Los Angeles, California.

Sonora 5-Tube Phono-Radio

Sonora Radio & Television Corporation, Chicago, presents a handsome new version of the convenient table model Phonograph-Radio. This model includes a 5 Tube Superhet AC Radio tuning 535-1720 KC; features include: built-in "Sonorascope" loop—

no aerial or ground required; large square Clock-type Gemloid Dial; Dynamic Speaker; Automatic Volume Control. Phonograph includes: latest 78 RPM self-starting motor; new featherweight crystal pickup with lifetime needle; pickup arm-rest; push-button on-off phono switch; plays both 10″ and 12″ records with cabinet lid closed.

—30—

NEXT MONTH
AUDIO INNOVATIONS
Don't Miss It!

Spot Radio News IN DEFENSE AND INDUSTRY

Presenting latest information on the Radio situation.

by **LEWIS WINNER**
RADIO NEWS WASHINGTON CORRESPONDENT

RECEIVER PRODUCTION WILL CONTINUE until probably the first weeks in June where production quotas have not been met. The temporary relaxing of this ban has been prompted by first, enormous stocks of many manufacturers; second, inability to convert plant facilities and arrange for labor readjustment before that time, and third, desire to assure adequate provision of some types of receiver considered essential to civilian-emergency activities.

Although the original order specified complete curtailment, allowances had been made for unusual instances where, for instance, specific parts on hand were without value, except for the particular device designed. A study of this situation proved that there were many such cases and thus the general relaxation is being allowed. It is true that such parts could be and will be set aside for replacement purposes, but the percentage of the available parts was too high to be shelved for replacement purposes only. In addition, such components as stamped chassis, cabinets and dials, have little replacement or conversion value.

Although this relaxation has been predicated on completion of quotas, it is believed that quotas may be extended, up to and including this period, provided sufficient reason can be provided for such extension. In this respect, the export market condition may become an important factor. It was originally believed that a million receivers would be produced for the Latin-American market. Because of shortages and the increased effort to convert and produce for an all-out War effort, this plan was abandoned. However, with the recent ease-order, such planning may be resumed again. Any such production will be based on the stockpile of available parts that has little replacement property and tropical characteristics or conversion properties.

SPECIFIC RULINGS ON REPLACEMENT PARTS will be available and placed into effective operation, as soon as both the Production Requirements Plan and the PD-1X application form ruling is clarified for the parts-makers.

The PD-1X form was designed to assist distributors, wholesalers and jobbers who need priority assistance, so that they can keep sufficient stocks on hand to maintain essential productive and service industries in operation. Distributors who have been hesitant to make deliveries to retailers and other users, who could not furnish priority rating certificates, fearing that they would not be able to replace such material in their inventories can, now, with this form, use preference ratings for essential supplies without receiving or extending a rating on every individual order they fill. Unfortunately though, thus far, radio supplies have not been on the list of those favored by this ruling. Electrical supplies have been designated on this listing, and many have been using this division of approval for a supply of many radio parts that could have been also classified as electrical supplies. However, to effect a distinct delineation, radio supplies will soon be included.

A uniform system for assignment of ratings will be developed in cooperation with the material branches so that all distributors handling the same types of products for the same classes of products will receive similar ratings. In addition, inventory limitation is another consideration and a special order indicating the quantities of items for which priority assistance will be granted will be issued too.

The successful operation of this plan is predicated on the availability, of course, of the basic materials to make the parts. Shortages in this respect have caused delays of weeks and months in the past. Specific allowances for material for this manufacture will thus have to be made and applied only to replacement part manufacture. Emergencies will, of necessity, arise, causing sudden shifts of even these allocated materials. This uncontrollable status must be considered and judged carefully, when delays in delivery are experienced. The shortage of the smallest item, containing some material essential to any one of an endless stream of War components, may hold up production for quite a spell.

The Production Requirements Plan will tend to somewhat alleviate this condition. This plan, which goes into effect July 1, will give the WPB a tighter check on the volume and uses of materials for which preference ratings are assigned and will also require all applicants who need assistance in the regular course of their business to furnish full inventory information to the board. Individual applications from a manufacturer for materials for one month will only be considered instead of the "time-to-time" applications that have been filed previously.

Producers whose annual volume of business amounts to less than $100,000 may file their applications on the simplified form PD-25X.

TUBE TYPE REDUCTION OF OVER 50%, eliminating 349 of the 710 receiving type tubes, recently went into effect with the issuance of limitation order L-76. These discontinued types represent duplicate, obsolete and little-used types, and include such familiar old timers as —00A, —01A, WD11, WD12, WX12, 24, and 6Y5, 12SA7G, 50L6G, 950, 12A5, 35Z5G, 12Z5, etc. In the elimination of duplicate types, one of each group of duplicate types will be kept in production. There are inventories of discontinued tubes that should be sufficient to accommodate civilian needs for at least two years. Obsolete types and little-used types will not be replaced. Incidentally, this latter type of tubes represents 41% of the total number of types produced, or 289 types. And yet sales of these types in 1941 amounted to only .6 of 1% of the total number of tubes sold last year, or 780,000 out of a total of 135,600,000.

Advertising and merchandising plans to familiarize dealers and consumers with this ruling, and also describe the substitutions necessary in some instances, are under way.

This new tube order does not apply to tubes manufactured for the Army, Navy, Maritime Commission, Panama Canal, Coast and Geodetic Survey, Coast Guard, Civil Aeronautics Authority, the National Advisory Commission for Aeronautics, the Office of Scientific Research and Development, and Lend-Lease requirements. Thus, for these agencies, all of the 710 types of tubes will be available. However, it is believed that plans are afoot to effect some form of standardization, so that it will not be necessary to use any but those tubes in the new streamlined category.

SHELLAC . . . THE VITAL PHONOGRAPH RECORD INGREDIENT will no longer be available in usual quantities. For, because of critical conditions in the Far East, particularly India, from where this material in the form of lac is found, it has become impossible to import the usual supply, or recently any supply. It has thus become necessary to affect a reduction in the supply of shellac. Thus far, this reduction has been 30% of last year's production used in the manufacture of records and transcriptions. Fifty percent of all inventories of shellac 10,000 pounds or more have been frozen, and 50% of all future imports.

Aware that such a condition may arise soon, development of a substitute material or a substitute method has been under way for many months. Thus far no suitable substitute for shellac has been found, but methods have been devised to use a greater percentage of scrap records in the record as a filler and binder, thus reducing the overall requirements of shellac. Scrap was always used as a binder, but in comparative small quantities. In view of the necessity now for additional scrap, campaigns are being waged for increased collection of such records from dealers and consumers. One large company has had such an effort under way for several weeks, and has, as a result, created an effective stockpile.

The shortage of shellac does not affect pressed transcriptions as seriously as the instantaneous transcriptions, for they have been using shellac along with the plastic derivative, vinylite. As yet, no order has been issued affecting this material, although it is possible that this may happen, since the ingredients of vinylite are chloride and ethyl cellulose, both essential in gas mask manufacture, among other War products.

According to a survey recently made, broadcasting stations use approximately 60% of all recordings made, with government agencies accounting for an additional 10%. That's quite a ratio.

TO SAVE 1000 TONS OF CRUDE RUBBER and latex a month, consumption of these materials in about 50 products has now been seriously reduced and completely eliminated in some 20 products. Among those akin to radio that are affected by this reduction, are storage battery parts, insulated tools and magneto parts. The reduction in these latter instances has been from 12.5% to 80%.

Although, thus far, the reduction has been small and the components affected few, continued reductions and additional components will be added to the restricted list, until production of substitutes are well under way. Such substitutes will not take the form of rubber, but rather of other insulating materials. It is not possible to divert rubber, in view of the many other more important War projects in which rubber must be used. Hopes of getting rubber from Brazil, which never produced more than a small fraction of our needs, or from the guayule plant in any quantity at present are not too bright. Thus conservation is imperative. Other synthetic means of producing rubber now under way, will be applied to the host of War projects and not to civilian requirements.

A NEW SOURCE OF NICKEL has been found in Cuba, and the WPB is so keen about this new supply area, that it has authorized a production project for a $20,000,000 plant and facilities. This new source will augment the strained facilities of Canada, which produces 85% of the world's nickel.

This new source will primarily be used to supply nickel for armor plate and other tough steels required for warships and the like, and as such will also afford a corresponding release of pressure on other sources of supply. From such a relaxation, the radio industry will eventually benefit. The quantities released as a result of such expanded production may not be large now, but as production schedules are increased, there will be sufficient to take care of many important radio projects.

Since early 1940, research on the recovery of nickel from low grade ore deposits in Cuba has been conducted by the Nicaro Nickel Company, a subsidiary of the Freeport Sulphur Company. The present methods afford a solution to one of the most perplexing problems.

RECLAMATION OF OLD PARTS is being successfully practiced by service men in Long Beach, California, in their effort to aid the War effort. Only when a part is turned in, is a new part supplied. These old parts are either repaired and sold as renovated components, or dissembled and turned over to the proper salvage authorities.

Other communities are rapidly following these procedures, and establishing an effective stockpile of replacement parts and scrap material. It is a wise move and should prove to be an outstanding contribution not only to our War effort, but to future methods of trade practices.

WARTIME IDENTIFICATION SEALS will soon become the property of all Stromberg-Carlson dealers. Specially created for a nationwide plan to keep America's radio operating and available 24 hours a day, this seal will serve to identify all those linked to this program.

Among the data that will be available in this program will be wartime radio bulletins, with last minute technical data, service tips, articles by leading engineers, and exchanges of ideas.

TELEVISION, since its inception, has never received such serious attention and study as that accorded it by the industry and the FCC at a special wartime conference called several weeks ago in Washington.

Analyzing such vital topics as the present use of television in the War effort; number of receivers in areas of each station; number of receivers in hands of manufacturers and dealers; changes in rules if found to be desirable; policy regarding outstanding construction and policy on future operations of stations, members of the industry presented graphic cross-sectional viewpoints on the television situation in this country today. Dr. Jolliffe of RCA, for instance, expressed the opinion that television should be kept alive if it is to have value to our War effort. That, he declared, was an issue which the Government should decide. On this same theme, a CBS representative said that a decision in this respect is important soon, for if television is to be maintained and declared an essential to our War effort, men to operate television stations must be retained in this technical service and be diverted at least temporarily from the selective service call. With the need for men of a technical nature becoming increasingly important, such classification was vital, he declared.

It was generally agreed by the industry that research and development be maintained, with the resultant developments being applied not only to further our War effort, but the very art of television itself. In this respect, **Philco** declared that it was willing to engage in experimental relay work, feeding programs via Philadelphia, Washington and Wilmington, even though there were no receivers in the latter areas. The **Philco** representative declared, incidentally, that it was essential that television be encouraged and programs be maintained, even if on a very limited basis. Community results would be very effective from such operation, particularly in view of the 400 receivers in the Philadelphia area.

The desire not only to proceed with experimental work, but with commercial television as well was expressed by several. Allen B. DuMont of the **DuMont Laboratories** in concurring with this plan explained that he could build several hundred receivers, the necessary stations in both New York and Washington and install receivers in Washington, too, with material now on hand. Representatives of **General Electric** also indicated willingness to maintain the experimental and commercial operation and operate on the full 15 hours weekly schedule required at the present by the FCC.

Post war economy was explained by Lt. Eddy representing **Balaban and Katz,** as an important feature of present television maintenance. He cited the tremendous expenses that would be involved in post war development and design, should television be placed on the full banned for the duration listing.

The importance of television as a training medium was pointed out by many, not only for those just looking-on, but for those in the actual construction and development work. Because of the intricate electronic circuit design of television equipment and its similarity to circuit design of electronic equipment used in many instruments in War service, engineers and technicians trained for television equipment applications can similarly be of service in War work, when and if such men are called into service. In view of this feature, the maintaining of television in some form was declared as essential by several at the conference.

Mr. Sanabria of school fame declared it was important to adhere to this plan so as to keep prospective students interested in television and consequently build a reservoir of electronic talent, that eventually can be diverted to our War effort, if necessary. And certainly our post-war effort would be greatly aided by such talent.

Whether or not television could be effectively maintained is dependent, too, on the materials available. With the situation becoming increasingly difficult, shortages may cause an interruption not only in construction but in station maintenance. Thus plans for material allocation assistance were suggested. As a means of conserving material of those stations now on the air or even about to go on the air, reduction in the number of hours on the air from the present fifteen to perhaps three or four was requested. This minimum would afford sufficient time for testing, program study and general design and development analysis, it was said.

To judge the extent of progress made by those holding construction permits for commercial or experimental uses, the FCC asked for a report with the following information: percent of completion of station construction; dollars spent for construction of station, including equipment and land purchased for station; man-hours spent on construction of station during the past six months; equipment and materials on hand and where located; equipment and materials necessary for completion of station with approximate cost; personnel required for completion of station and an estimate of number of man-hours necessary for completion of construction; date that the construction can be completed, etc. Such data it is believed will serve as an accurate guide as to whether or not construction should be continued.

Whether or not television will be continued, the FCC did not say, at the conclusion of this meeting. There were rays of hope though in view of the impressive facts and figures presented, in view of the recommendations that the present flexible standards of the FCC be maintained, and in view of the fact that it was felt that an effective material-availability program could be devised, that would not hamper other production.

MARINE CORPS COMMISSIONS in the Reserve in aircraft warning service are being offered to those holding a Bachelor of Science degree in electrical, communication or radio engineering. College graduates with special training in physics or mathematics are also eligible.

Men appointed as second lieutenants will receive annual pay and allowances of $2,196, plus an additional uniform allowance. Commissions in higher grades may be awarded to applicants with exceptional qualifications. Physical defects which would normally be disqualifying may be waived in certain cases, and men with dependents will also be commissioned.

After completing a brief indoctrination course in customs of the service, officers selected will attend a three to six months course on aircraft warning equipment at one of the service schools. They will then be assigned to Marine Corps units to supervise the operation and maintenance of aircraft warning and allied radio equipment. They will also be charged with the organization and training of aircraft warning personnel and units for both ground and air forces. Prospective candidates should apply in writing to the Commandant, Headquarters, United States Marine Corps, Washington, D. C.

Experienced radio operators, technicians and repairmen are also urgently needed for service in the United States Marine Corps. Appointments in the Marine Corps Reserve will carry the initial rank of staff sergeant for those from 17 to 35 who are high school graduates, with a class A or B amateur license or a first or second class commercial radiotelephone or radiotelegraph operators license. Also acceptable is three months' professional experience in radio repair or service work. Remuneration will be $72 a month, in addition to food, shelter, clothing and medical care, upward to $121.50, including allowances.

Men accepted for this service will be transferred to a signal battalion for assignment to a special course of training in maintenance of aircraft warning equipment. Those not completing the course will be released from the Marine Corps if they so desire. Men who meet the foregoing requirements, but who are not high school graduates may be enlisted as privates in the regular Marine Corps or Reserve, with the assurance that they will be assigned to general communication duties. They will be assigned to radio schools at Quantico, Virginia or San Diego, California, upon completion of recruit training. Men who fail to finish the course will remain.

During assignments to duty outside the United States, all noncommissioned officers and enlisted men receive a 20 percent increase in their base pay.

Prospective candidates should apply to the nearest Marine Corps recruiting officer or by letter to the Commandant in Washington, D. C.

40,000 MEN WILL BE TRAINED IN RADIO by the Navy, under a program now in progress. These men will be trained in elementary electricity, radio material, visual signalling and receiver-transmitter operation, with schooling to be conducted in 21 privately operated schools.

Seven schools have already started courses in electricity and radio, with total monthly quotas of 713 men or an annual training of 8,556 men. The course requires 12 weeks and graduates then go to secondary schools also operated by the Navy, for a five months' course. In Chicago, the course started some months ago at Balaban & Katz. On March 2, three more schools, Grove City College, Grove City, Penn.; U. of Houston, Houston, and Oklahoma Agricultural and Mechanical College opened courses. Among the others who have already started or to be added are Utah State Agricultural College; Texas Agricultural and Mechanical College; Bliss Electrical School; Texas A. and M.; U. of Chicago; U. of Illinois; Butler U.; Mass. Radio & Telegraph School; RCA Institutes; Keystone School; Alabama Polytechnic Institute; U. of Wisconsin; Northwestern U.; Miami U.; U. of Colorado and U. of Idaho.

A DEFENSE BOND DRIVE AT RCA was recently begun, in which a $4,000,000 objective was set as the goal for all five plants of the company. . . . **CINAUDAGRAPH SPEAKERS, INC.**, has moved to a new factory building at 3911-3929 South Michigan Avenue, Chicago. . . . **A NEW SAN FRANCISCO SW STATION** installation is now under way with O. F. Walker, General Electric engineer supervising the job. The station will have a power of 100,000 watts and will be operated under the call letters KWID. Operators of the station will be Associated Broadcasters, Inc., who are operators of the long wave station KSFO. . . . **DEFENSE BONDS** were given to 91 employees of Davega-City Radio at a recent dinner, in recognition of their faithful service. . . . **100% ENLISTMENT IN NATIONAL DEFENSE SAVINGS PLAN** is the proud boast of the employees of the Sonora Radio and Television Corp. of Chicago. . . . **THE NATIONAL UNION RADIO CORPORATION** of Newark, New Jersey, have moved to new headquarters in the American Insurance Company Building in Newark. . . . **ALLEN B. DUMONT LABS.** are assisting in the training of some 54,000 air wardens in the New York, Philadelphia, and Schenectady-Albany metropolitan areas by television. . . . **A NEW ERROR-PROOF RADIOTELEGRAPH PRINTER** has been developed by RCA and placed into operation on the direct radio circuit between New York and Buenos Aires. The new printer automatically rejects false signals and prints an asterisk in place of the incorrect letter. The printer may operate alone or with others over the same radio transmitter. When more than one printer is used, they are operated in conjunction with RCAC's "time-division" multiplex system, which provides two, three, or four simultaneous message channels over a single radio transmitter. In sending messages, the output of the several transmitter-perforators is brought together in the multiplex equipment, scrambled and delivered to a transmitter, which beams the aggregate radio signal to its destination. At the receiving end, the multiplex equipment unscrambles the signal and delivers the components to the several error-proof printers. The aggregate speed of the four channel system is 248 words a minute. . . . **TO AFFORD GUIDANCE IN BLACKOUTS**, the Formica Insulation Company, Cincinnati, Ohio, has provided laminated plastic plates printed in phosphorescent and fluorescent inks, both of which glow brightly in the absence of visible light. The phosphorescent type is activated by ordinary white visible light and will remain legible for two hours after the light is turned off. The fluorescent type is activated by ultra violet or "black" invisible light and remains legible as long as ultra violet light is thrown upon it. The plates are printed in various colors, and lettering is carefully protected by plastic films, which prevent the lettering from being injured by grease or cleaning solutions. The process is available where identical signs are required in considerable quantities. . . . **HYGRADE SYLVANIA** has recently purchased a new plant at Mill Hall, Pennsylvania. C. A. Haines, who has been superintendent of the Salem tube plant, will be in charge of operations of this plant.

WILLIAM L. BATT, director of the Raw Materials Division of the WPB, was the guest of honor at final production ceremonies at RCA recently, when the last phonograph-radio, that will be made for the duration, came off the line. The instrument was presented to the Georgia Warm Springs Foundation. . . . **WALTER C. EVANS** has been appointed general manager of the three major Westinghouse divisions that include radio, broadcasting and x-ray. Lee B. Wailes is manager of the broadcasting division; the x-ray division will be managed by

Clair V. Aggers and Carrol J. Brunside formerly sales manager of the radio division is now manager. . . . **N. E. CONGDON**, appliance department manager of Prottos & Levitt, Seattle, Washington, will head the Radio and Home Appliance Dealers Association for 1942. Others named as officers were Gene Belcourt, vice-president and Dave L. Allan who was reelected secretary. . . . **GENERAL ELECTRIC'S** television station in Schenectady has been designated by the call letters WRGB, in honor of Dr. W. R. G. Baker, vice-president in charge of the radio and television department of G.E. . . . **C. P. BOGGS** has been appointed director of manufacturing of Hygrade Sylvania. . . . **GODFRED C. GEBHARDT** has been named production supervisor of Universal Microphone Company, Inglewood, Calif. . . . **ALLEN E. BAILEY, JR.**, and William D. Cockrell have been appointed sales manager and engineer respectively of the new industrial control section of General Electric. . . . **JAMES H. CARMINE** has been elected vice-president in charge of merchandising of Philco Corporation.

ONE OF THE MOST INTERESTING wartime radio assignments anywhere in the world is being handled by a radio "ham" in California, who is by profession a dentist.

He is Dr. Charles E. Stuart, who received his first amateur license from the U. S. Department of Commerce when he was 13 years old. His job—to which he was assigned by the Central Chinese Government in Chungking—is that of American listening post to shortwave broadcasts from China.

Dr. Stuart's work is to receive and transcribe daily English voice-broadcasts emanating from XGOY and XGOX, Chinese International Broadcasting Stations in Chungking. These broadcasts consist of military and general news and talks by distinguished Chinese and foreigners, and are made primarily for use by the Chinese News Agency in New York City, and by United China Relief.

The frequency used by XGOY and XGOX for their American broadcasts, and the time of day set for the broadcasts, are determined by Dr. Stuart and vary with the seasons. The programs are recorded on acetate instantaneous discs, and then are transcribed. Dr. Stuart is aided in his unique radio job by Mrs. Alicia Held, who probably is the only secretary in the world who takes dictation from a source 7,000 miles distant, through static and heterodynes, through "fading" and "hash."

Dr. Stuart uses uni-direction antennae (rhombic) which are also reversible. One of the antennae used for the Chungking receptions is a highly directive diamond rhombic with a full mile of wire in the system. This gives great signal strength from Chungking, according to Dr. Stuart, plus reliable consistent reception when poor general reception conditions are confronted. The location of this vital station is ideal, according to Dr. Stuart, being on a flat stretch of beach land underlaid with salt water, which gives maximum reflection and ground conductivity. The low horizon, plus the absence of interfering hills or mountains, shields the incoming signals.

The Chungking broadcasting studio, located in the heart of Free China's much-bombed capital, is constructed of huge blocks of granite four feet thick, and is bomb-proof. The transmission apparatus is set up outside the town in a dug-out blasted from the side of the hill on which Chungking sits. Broadcasts from Chungking are piped through to the transmission station by telephone.

Dr. Stuart became a radio ham in 1914, and has been actively engaged in amateur radio activities since 1932. A few years ago, he was honored by the Century Club—an organization of radio amateurs—for having proof of contact with more than 100 different countries. A few of the remote spots contacted by Dr. Stuart have been Tibet, Franz Josephland, Chagos Archipelago, Mauritius and Reunio Islands, Bahrien Island in the Persian Gulf, Baluchistan, Kenya, Tanganyika, and the Belgian Congo. He also made contact with the two bases and the Snow Cruiser in the recent Antarctic expedition, and with Howard Hughes plane on his round-the-world flight a half hour outside Yakutsk, Siberia.

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Feedback Analysis

(*Continued from page* 15)

actance, and Z is the filament wiring impedance to ground. The feedback voltage Efb applied to the first cathode will be $E_{fb} = \frac{Z_1 E_1}{Z_1 + X_{c1}}$ where Z1 is the second cathode's impedance to ground and Xc1 is the second cathode's capacitive reactance to filament.

The feedback voltage is reduced by shunting the filament to ground impedance Z with the low capacitive reactance of a by-pass condenser (c). Still greater attenuation is obtained by the use of another capacitor Xc3 and the impedance (Z3) of the connecting wire to form another voltage dividing circuit as shown in Figure 6b. Thus for minimum feedback, each filament should be by-passed on both legs at its

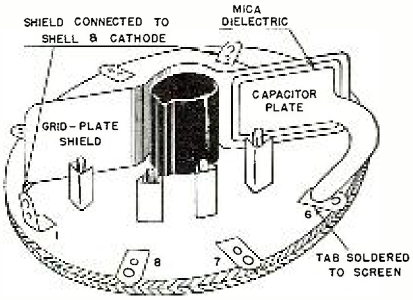


Fig. 7.

socket connection. . . .

Capacity between grid and plate circuits of an amplifier tube is a most difficult point of feedback to control. This capacity may be minimized to a limited degree but the steps to such minimizing are few.

Grid and plate leads, besides being very short, should be of small diameter. As nearly as possible, they should project away from one another on the same axis. A small shield placed between the socket-prong connections and soldered directly to the cathode socket connection is recommended. See Figure 7. Its effect is similar to that shown in Figure 2.

Within the tube, the screen and suppressor grids are very effective in reducing grid-plate capacity provided they are well by-passed to r.f. ground. The importance of thorough by-passing is shown in Figure 8. The electrostatic flux lines between plate and cathode form a signal-voltage gradient which may be viewed as a voltage divider and the grids may be considered as variable taps on the voltage divider.

The feedback voltage will be $E_{fb} = \frac{E_p X_{c3}}{X_{c1} + X_{c2} + X_{c3}}$ where Ep is the plate signal voltage, Xc3 is control-grid capacitive reactance, and Xc2 is plate to screen-grid capacitive reactance.

Now following the voltage-divider-with-taps analogy, sliding Sg tap down the divider will force Cg tap down the divider also, so that if Sg be at zero voltage, Cg must also be at zero voltage. The screen grid by-pass condenser Cs does this "sliding" electrically by placing its capacitive reactance in shunt with Xc3 and Xc1, thereby decreasing the feedback voltage. As Xcs approaches zero, in effect, the screen-grid Sg slides down the signal voltage gradient toward zero, and the signal voltage it may capacitively feedback—or down—to the control grid is accordingly reduced.

From the foregoing discussion, it is apparent that by-pass condensers are of paramount importance to the pre-

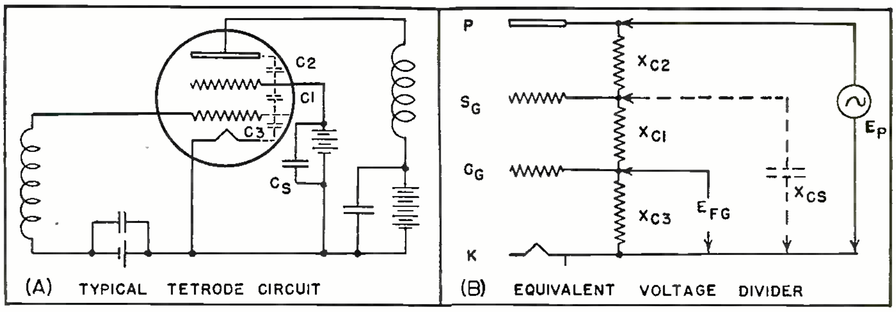
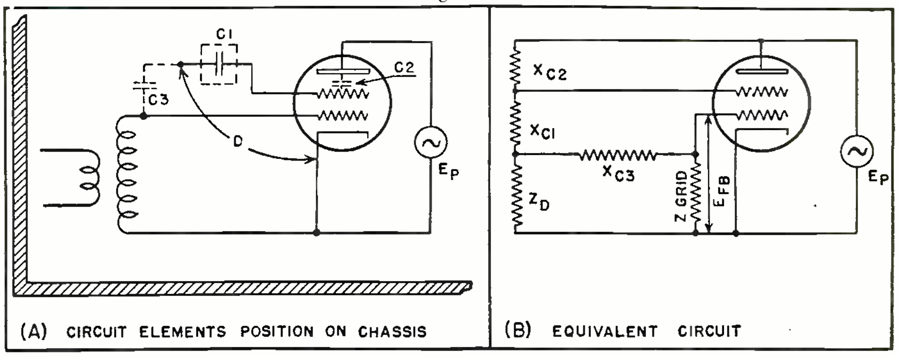


Fig. 8.

Fig. 9.



vention of feedback. However, they are not sufficient within themselves. By-pass condensers must be designed properly and connected properly to be effective.

An ideal by-pass capacitor would be a very small, pure capacitive reactance in effect. Any addition such as resistance and/or inductive reactance causes departure from the ideal in proportion to its relative magnitude. It behooves us, therefore, to reduce to an absolute minimum all series resistance and inductance.

Where a single fixed frequency signal is amplified, by-pass capacitors and the length of their leads may be chosen to form a series-resonant circuit: theoretically zero-reactive at the amplified frequency.

To ultra-high frequencies of current, even short condenser connecting leads will present considerable values of impedance. When the "Acorn" screen-grid type tubes were developed, some socket manufacturers, recognizing this fact, incorporated by-passing capacitors directly between the socket connections. As yet, this commendable feature has not been applied to sockets for other tube types. Figure 7 shows a method of providing screen-grid by-passing capacity, grid-plate shielding and a good ground connection for the tube shell on an octal socket which might hold the 1852, 1853, 6SK7, 6SJ7 types.

The screen-grid side of the capacitor is quite easily formed by varnishing a thin sheet of mica and a thin plate of pure copper foil to the grid-plate shield surface. A tab of the copper foil is carried over to the screen-grid connection.

The purpose of by-pass condensers for applications mentioned in this article is to place the by-passed point of the circuit at r.f. ground potential. The true ground point is that farthest removed in potential from the point of high r.f. potential. This is at the lower end of the signal input source, or cathode as seen by the amplifier tube. Near it, and near all by-passed points, a single point to terminate all by-pass condensers should be chosen.

Such precaution is made necessary by the resistance to high frequencies offered by commercially available chassis metals. Indiscriminate termination of by-pass condensers places widely varying r.f. potentials throughout the chassis surface. The use of a copper plate chassis will reduce the magnitude of these random surface r.f. potentials. Figure 9 shows how by-passing to the wrong point on the chassis may provide excessive feedback.

In this case, the screen-grid by-pass condenser is terminated on the chassis near the grid lead, but at a point inches of relatively high impedance chassis metal removed from the cathode. Returning to our voltage divider conception, the reactance of C2 is low enough to transfer considerable r.f. potential to the screen-grid. The reactance of C1 is negligible. If then Z_D, the chassis impedance, between the condenser ground side and the cathode, be relatively large, a correspondingly large r.f. potential will appear around the condenser ground side.

Capacity between the condenser ground area and the grid lead will couple this r.f. potential to the grid. Even though the condenser ground is not near the grid lead, the series impedance will oppose effective by-passing and may cause excessive feedback through inter-electrode capacity.

This is only one of several possible sources of feedback trouble due to poor placement of by-pass condensers. It serves to show the importance of returning all by-pass condensers to a common, well-chosen ground point.

In constructing various kinds of high frequency amplifiers, varying degrees of diligence in applying the design features mentioned here will be required. Some method of determining just how far to carry these precautions against feedback troubles saves much time and expense. The stage gain and frequencies to be amplified should be carefully considered in first design steps. It is then well to follow a "process of elimination" method of bringing about the necessary reduction of feedback.

The following is such a method: Insert a variable resistance in the amplifier plate voltage supply lead. Then each remedial measure will permit an increase in the plate supply voltage applied without going into oscillation.

Satisfactory reduction of feedback may require several contributory steps. To allow something of a safety factor, the final applied plate voltage should be 25 to 50 volts higher than normal operating voltage.

If a high frequency, high gain amplifier shows no tendency to oscillation when first completed, stage gain should be measured to assure that lack of feedback and not lack of stage gain is to be credited for the happy situation.

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Beginner's Demonstrator

(*Continued from page* 27)

cuit. The schematic Fig. 4 shows only the first stage. The balance of the circuit is that of the transformer-coupled amplifier Fig. 1. You may also use the amplifier in Fig. 2, with resistance-coupling.

Connect the antenna (about 30 ft. of wire will do) to the antenna binding post. Now comes the hardest job of all: winding the coil. Take a lot of time to do this, because if done sloppily tuning will be difficult. If a four-prong coil form isn't available take an old 4-prong tube base and cement in a coil form from an old receiver. Heat the prongs and let the solder flow out. Clean out the solder with a piece of stiff wire. Now our coil form is ready.

The wire can be almost any type. If you have a large coil salvaged from a receiver, carefully unwind that wire and use it. Any wire number 22 to 30, enameled or cotton-covered will be good. For the broadcast band L_1 has 80 turns close wound and L_2, 30 turns close wound ¼ inch space between windings. (They're both on same coil form.)

To start the winding, clean and tin one end of the wire. Then thread one end through a hole in the coil form through the prong desired. Refer to Fig. 4. Note the two coils are on one form. In the actual winding, place the tickler L_2 below L_1, not above, as shown in the diagram. This makes for better electrical characteristics. Wind L_1 first. Start the wire in one of the small prongs, then, while you keep the prong hot with the iron, solder the wire in well. This will be the grid lead. After 80 turns, drill a hole in the form and bring the end through the other small prong. This will be the ground lead. Space ¼ inch and drill a hole for the B+ lead. This should go to one of the large prongs. The tickler winding should be wound in the same direction as the grid winding. Wind the tickler 30 turns and bring the end out of the other large prong.

The coil socket naturally should be wired in the same manner. The circuit wiring of the detector stage should be solid and well fastened. If your coil is perfect and you accidentally move a loose connecting wire in back of the board, the receiver may refuse to function. So use good solid wire, and tie it down!

With your antenna connected and the circuit hooked up, plug in the coil. You have previously ascertained the functions of the audio stages. If the coil has been connected properly you should have voltage at the plate of the tube. Touching the grid with the fingers should make a whale of a noise.

Advance the regeneration control C_3 to maximum. Set tuning condenser C to minimum. Now tune for a signal. A loud squeal will show its location. Then retard C_3 till the squeal just disappears. Then tune C for maximum volume and clarity. The volume control R_3 is self-explanatory.

Now suppose the coil doesn't work. Different electrical characteristics of coils, wire and associated wiring may require some alteration. Before you change the wiring, though, make sure the wiring in the coil isn't open. Use an ohmmeter. Then make certain the cathode is grounded. Then make certain the grid-leak and condenser C_2 and R_1 are connected properly and not shorted or open.

Now for the coil. If no squeal was heard then there are not enough turns on the tickler coil, or the tickler is too far from the grid coil. Push the two coils together with the fingers. Then, if necessary, add a few turns. One of these will give the "squeal," or regeneration. The number of turns in the grid winding determines the tuning frequency. The more turns, the lower the frequency will be. The lower the frequency, the more turns are required on the tickler winding. With these facts known, the builder can wind a coil to almost any frequency. Make certain both windings are in the same direction and that the extreme ends of both coils go to the grid and plate windings respectively and the ends in the middle go to ground and B+ respectively.

Tuning a regenerative receiver is really a two-handed affair. While tuning "C," the tuning condenser, with the left hand, the right hand keeps the regeneration control C_3 just under the point of squealing. This makes for greatest sensitivity. You will find that as "C" reaches maximum it will be difficult to get regeneration even with C_3 at maximum. Then try another setting of the antenna condenser C_1. Generally C_1 needs to be tuned only when using a different antenna. Set for greatest sensitivity and don't change it until you use a different antenna. Changing setting of C_1 requires changing setting of "C."

So you think that's too much work in tuning? Well, maybe that's why they made the regenerative receiver obsolete by inventing the single control superheterodyne. But the regenerative receiver still gives the most sensitivity tube-for-tube. And that's good enough for our little receiver.

After the receiver is perking, wind different coils for different bands. If you don't like to experiment, the winding data is available in any manual showing the triode regenerative receiver, such as the *ARRL Handbook*, etc.

The next circuit on our list is the monitor. That's easy! Disconnect the antenna to avoid blocking the signal and wind a coil for the frequency of the oscillator used and tune to that signal. The same receiver circuit without antenna will be a perfect monitor and will be able to receive a signal emitted by the oscillator anywhere in the same building. When used for CW, advance the regeneration control C_3 right into oscillation. Then tune for best beat note. That's all there is to the monitor.

Circuit number 4 is the R.F. Oscillator. Let's try an experiment. Hook up the circuit for the regenerative receiver Fig. 4 exactly, without connecting the audio stages. Naturally you won't be able to hear anything. Tune in another radio receiver in the broadcast band to the same station the demonstrator was tuned. Hear the music? That's fine! Now advance the regeneration control on the demonstrator C_3. You should hear the squeal in the other radio receiver! Tune "C" in the demonstrator until the beat note is heard in the radio receiver. When it is heard then the demonstrator and the receiver are tuned to the same frequency. At this time the demonstrator is acting as an R.F. Oscillator.

The R.F. Oscillator is a signal generator, since as it *oscillates* it *radiates*, and the receiver picks up the signal, which, beating against the carrier of the broadcast station tuned in, provides an audible beat note. This is the squeal. It's almost a miniature transmitter.

Our last circuit to describe is the Crystal Controlled Oscillator, really an entire low-powered CW transmitter. It is shown in Fig. 5. Essentially it is a Pierce oscillator feeding into a tank circuit composed of L_1 and C, on to which the antenna is tapped. This is a coil tuned to the transmitting frequency. It is plugged into the regular coil socket. If desired, the antenna may be attached directly to C_3, omitting the tank circuit. Or the tank may be kept, but C_1 the antenna condenser may be strapped across or shorted. This will give greater output. (Forget this one until after the war.—*Ed.*)

A milliammeter plugged in the grid circuit will indicate resonance. It must be admitted there is no regular plug for the crystal. If your crystal is in a regular case, it can be plugged into the plate and cathode holes of a five prong socket which can be mounted permanently on the board.

Remember it is necessary to have a license to operate the transmitter. Well, there you are. That should be enough circuits to keep you busy for awhile.

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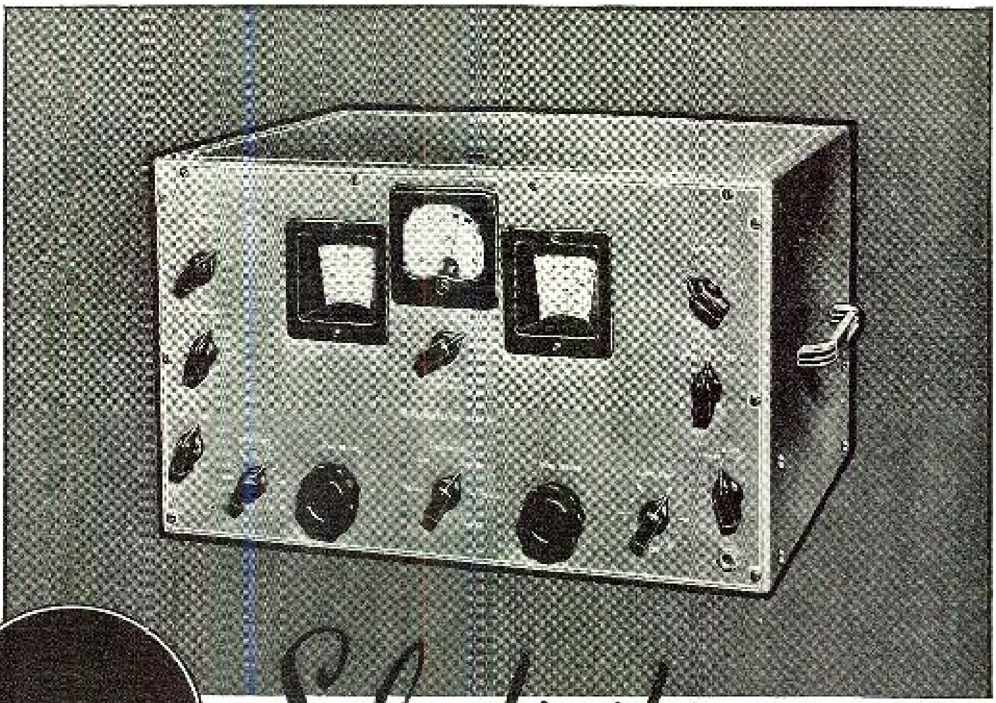
$600 PRIZE CONTEST
See page 64



V T Output Meter
(*Continued from page* 19)

mounted and connected, the instrument will then be ready for testing.

All wiring should be checked thoroughly before making any tests. The connections to the toggle switch should receive special attention to see that the proper polarity is observed with respect to the meter. The tube used should be checked in a radio set and not in a tube checker! If the tube elements are partly or completely shorted, damage to the meter will result. A d.c. filament voltmeter should be on hand when making these preliminary tests.

Proceed with the testing as follows: Turn the filament rheostat to the "off" position. Connect the external filament voltmeter directly to the filament terminals of the tube socket. Set the toggle switch in the "filament" position. This places the panel meter in series with the 4,000 ohm resistor directly across the filament terminals of the socket.

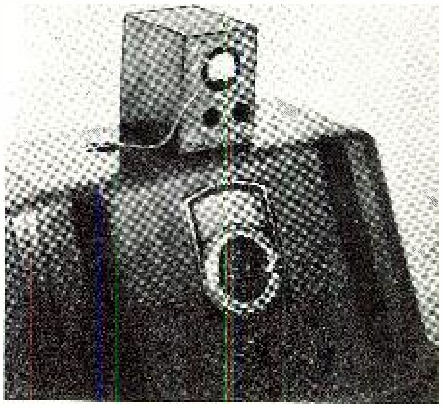
Caution! Be sure that the 4,000 ohm resistor is connected properly, and that it is not short-circuited by a piece of wire or solder. Now, advance the filament rheostat until the filament voltmeter reads exactly two volts. The panel meter should now read half scale. If the panel meter reading is very much in error, it indicates that the 4,000 ohm resistor is defective and should be replaced. The tests, which have been made so far, have served as a final check upon the filament wiring. The next group of tests will check the instrument as a working unit.

For the following tests, you will need a radio receiver in good working order and a good signal generator. Proceed with this group of tests as follows: Connect the signal generator to the antenna and ground posts of the receiver. In a.c.-d.c. sets, connect the generator to the antenna only. Tune the receiver dial to some point where no broadcast station can be heard. The signal generator should now be tuned until a signal is heard. Now, place the tip on the end of the flexible lead into the jack on the extreme right near the bottom of the instrument panel. The instrument is now set to read the highest voltage range. Set the toggle switch to the "output" position.

The two outside binding posts at the bottom of the panel should now be connected to the voice coil of the loud speaker. Be sure that the receiver dial and the signal generator are tuned to exact resonance. If the meter pointer moves backward, it is a sure indication that the connections to the "output" position of the toggle switch are reversed. This error may very easily be made without knowing it at the time. With the connections to the "output" position of the toggle switch made properly, turn the calibration control knob to the right until the meter reading is highest. If the meter reading becomes lower, the connections to the control are incorrect, and should be checked with the diagram. When all preliminary tests have been completed, and all errors corrected, the instrument is ready for calibration.

Calibration

It is recommended that a commercial output meter be used as a standard for calibrating this instrument. The use of known a.c. voltages from a transformer should not be used as standards as there is a considerable error involved. All of the equipment that was used in the preliminary tests, with the exception of the filament voltmeter, will be needed for calibrating the instrument. Before starting calibration, be sure that the tube checks well, is not shorted between elements, and that the correct filament voltage is applied.



The actual calibration is very simple. Set the standard output meter for the highest range, and connect it to the voice coil of the loud speaker. Adjust the receiver volume control until the meter reads five volts. Now, select either the ten or fifteen volt range of the standard meter, and adjust the volume control until the meter reads exactly five volts. The receiver will now deliver a five volt signal to any output meter connected to it. The meter to be calibrated should be substituted for the standard meter. The volume control should not be moved during this change. Place the tip in the five-volt range jack of the unknown meter, and adjust the calibration control until the meter reads full scale.

Calibration of the instrument is now complete. The correct position of the calibration control should be marked upon the panel. Do not expect the calibration of this instrument to be as accurate as a d.c. voltmeter. However, it will be quite uniform throughout its ranges. Two points which affect the stability of calibration should be noted. The first is incorrect filament voltage, and the second is a weak or otherwise defective tube.

The range multipliers should be checked with a good ohmmeter. Select the ones for each range which come nearest to the rated values. Example: Take several 5,000 ohm resistors to be used for the five-volt range, and check these with the ohmmeter until one is found that checks very close to 5,000 ohms. Proceed in the same manner with the resistors for the other ranges.

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QRD? de Gy

(*Continued from page* 32)

and right now he's taking on plenty. A first lieutenancy in Uncle Sam's Navy is an honor amongst honors and we're snapping to attention to Lieutenant Karl Baarslag, USN. Good luck, OM. Brother HC ends his epistle with these words of wisdom "we will all have to pull together and win this war and cut out jurisdictional strife." Which holds with our sentiments. Declare a moratorium on private battles for the duration and pitch in together to fight this one battle—wiping the slate clean of would-be big shots.

WELL, we see by the papers that Brother Brown (Brownie) he of the silver locks, is at last joining up with the Navy to do "special radio maintenance work." Teeth or no teeth Brother Brown finally got ahead of a pill-roller and had his IQ okeyed by the powers-that-be. Just another case of a guy making up his mind. Sez Brownie t'other day when we guzzled a few pots of jamoche in the corner beanerie, "This is the last chance for any fun for me, and I'm getting into this fracas if it takes all my business, my remaining teeth and/or any political drag I know." And Brownie made the grade. Good hunting, OM; we'll hit the jamoche pot again.

THERE'S one VWOA (Veteran Wireless Operators' Ass'n) of all the chapters floating around that has remained active and alive and that is the Los Angeles-Hollywood branch. Although other chapters have fallen by the wayside this organization keeps forging ahead, gaining new members and instilling brotherly love between old-timers.

Now with Brother Mack Schaefer doing the scribe honors, a monthly bulletin has seen its third issue hit the mail boxes and its acceptance hits an all-time high. As witness this note from Brother Gilson Willets broadcasting from 'Frisco. Quote . . . Herewith my $2. for which please send me the CARD. Other than the card and the honor that goes with it, I receive little contact with you fellers down there . . . but the February Bulletin I got was worth the two bucks in itself . . . informative and no fooling. The San Francisco chapter is inactive at the moment . . . unquote.

Incidentally, Brother Willets, whose genial, straightforward manner spreads a warmth about all who come in contact with him, adds, "Since my first membership card, which was No. 1 out of NY office where I had quite a hand in organizing the VWOA, my membership cards throughout the years have been marked Charter Member from there, but the cards I get from you could not carry that since I am not by any means a 'charter' member of your branch.

"Among other things I am now teaching school . . . literature and journalism. Also have a job in the Air Raid Service since it would be strange to be the only San Francisco man not in this service. I registered the other day although I've got two months to go to 44." Which all means once a radiop and the "bug" gets you. What a pun!

ATTENTION all radiops Southern California area: Brother Mack Schaefer of the VWOA, LA Hollywood, has been asked to assist the Sheriff's Office in running down subversive activities by Japs and other enemies. He requests quote . . If any of you fellows are familiar with or know of any Japs, citizens or aliens, who have received commercial radio licenses, or whose activities are unusual, or if you know of any employed at communications work, please report this either to Lt. Ellison or Radio Detail, Sheriff's Office, Duke Hancock of KGFJ, or myself, care of VWOA headquarters. This also includes any Germans or Italians . . unquote.

BELIEVE this or no, it's not our funeral but Hal Styles, President of VWOA tells this one. It was during the last shindig. The "Finland" of the American Line carrying supplies to Liverpool was several days out of New York and running without its lights in the submarine zone. Several of the officers were having a little sociable game of poker in the wireless shack. In the midst of some friendly kicking and re-kicking, there was a mighty noise and jar of the ship. All was quiet for a tense moment, and then a voice rang out: "Heck, we're torpedoed." All the card players but one jumped to their feet, and made a bee-line for the life boats. "Hey, hold on, you guys," shouted Hal who remained seated. "You can't leave me now. I've got four aces." So cheerio and let's remember to "serve in silence" lest a word dropped may do much harm to our boys and ourselves. And with 73 . . . ge . . . GY.

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R. F. Coil Analyzer

(*Continued from page 17*)

capacity of the condenser and the analyzer input circuit into the calibration, so that no future allowances need be made for it.

Note that the detector tube, type 78, is mounted upside down so that its grid-leads will be as short as possible. The length of the filament, plate and screen leads is not important. We used two gang condensers in both tuned circuits, but finally decided that one gang was sufficient in each case, and so, only one section of each gang is in use.

To Determine Resonant Frequency or Tuning Range

Turn analyzer "on" and allow to warm up. Turn "Function" switch to "coil" position. Turn "Cap" switch "off." Adjust meter to full scale deflection with the screen-grid control. Using very short leads in the pin-jacks marked "coil," connect the analyzer to the circuit under test. Vary the r.f. oscillator frequency from the higher ranges toward the lower. Stop when meter suddenly drops in reading. The frequency indicated on the oscillator dial is the resonant frequency of the circuit under test. It is necessary to approach the resonant frequency from the higher frequencies so that the circuit under test will not resonate at harmonics of the oscillator. If the coil in the circuit under test is closely coupled to another coil, it may be necessary to short out the second coil or load it with a 20,000 ohm resistor in order to eliminate spurious responses. This same procedure is used to determine the resonant frequency of R.F. Chokes.

To determine tuning range of a circuit, measure its resonant frequency at each end of its tuning range.

To find what frequency range a coil would have with a given value of condenser, turn the "cap" switch to "on" position and set the calibrated variable condenser to the value of the tuning condenser to be used with the coil. Then find the resonant frequency of the resulting circuit.

To Calculate the Distributed Capacity of a Coil or Circuit

This is accomplished by using the simple formula:

$$CD = \frac{C_1 - 4C_2}{3}$$

Turn the analyzer "on." Set function switch at "coil." Set "cap" at "on." Turn Capacity dial to a point near maximum capacity. Connect circuit to be tested to the "coil" pin-jacks with very short wires. Vary the R.F. oscillator until resonance is indicated. The value to which the calibrated condenser is set is called C_1. Then reduce the value of the calibrated condenser slowly until resonance is again indicated. This indicates that the lowered capacity has caused the coil under test to resonate at the second harmonic of the oscillator.

Note the reading on the calibrated condenser. This reading is C_2 in the formula. Multiply this last reading by four, subtract this from the first reading and divide the remainder by three. The result is the distributed capacity. It is interesting to note that if it were not for the distributed capacity in a coil, C_1 would be exactly four times C_2.

To Measure Inductance of a Coil

Turn analyzer power switch "on." Set "function" switch to "coil." Set "cap" switch to "on." Connect coil to be tested to "coil" tip-jacks. Turn capacity dial to a point near its maximum capacity. Vary r.f. oscillator from high to low until resonance is indicated. The inductance of the coil is calculated from the formula:

$$L = \frac{1}{39.5f^2C}$$

L—Inductance in henrys.
f—frequency in cycles taken from r.f. oscillator dial.
C—capacity in farads, taken from capacity dial.

To Estimate "Q" of a coil or Circuit

A parallel resonant circuit, with a high ratio of inductance to resistance, will show a much higher resonant voltage step-up across it than one of lower "Q." When making any of the above tests, an estimate of the "Q" of the circuit may be made by noting the amount of decrease in meter reading. At resonance, a good coil with fairly high "Q" will cause the meter to drop to about half scale. A poor coil will cause only a slight deflection.

Operation as a Resistance and Leakage Tester

For using the resistance ranges, it is not necessary to use the a.c. power supply, as the two resistance ranges are battery operated. Use the tip jacks marked "leakage." Tests are made as with any ordinary ohmmeter.

For use as a leakage tester for leakage between windings, rotate the function switch to "leakage" and use tip jacks marked "leakage." Leakage is indicated on the neon lamp.

The construction and operation of this coil analyzer is not very complicated. Of course, the accuracy obtained in readings is directly dependent upon the accuracy of calibration and the care used in making the tests. In operation, there is only one major requirement: when making tests using the "Coil" tip jacks, be sure that the test leads are very short and as far apart as possible. Otherwise, the distributed capacity of the leads will cause such serious detuning of the test circuit that accurate results will be impossible.

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High Pressure

(*Continued from page 33*)

"Well, you needn't get on your ear about it," he came back. "We'll just get some gas . . . and I'll deliver the radio."

"You got any money?"

"No . . . I haven't," he admitted.

"Well then . . . have you got any ideas about how we can get some gas without any money?"

Sedge pondered a moment . . . then grinned.

"Got it!" he exploded. "You can get some at the filling station across the street, on credit . . . and pay 'em when you get the money for this job."

"No soap," I said. "I haven't been able to pay those birds for the last gas I got that way, and they won't let me have any more."

With a sorrowful look on his face,

Sedge let his eyes rove over the shop like an airplane pilot in a fog, looking for a place to land. Suddenly, his long arm shot out and he pointed to my blowtorch on the shelf.

"What's that?" he barked.

"Why, that's a blowtorch."

"Uses gasoline . . . don't it?"

"Yeah," I admitted, beginning to see what he was driving at.

He grabbed the torch and shook it.

"Nearly full," he stated. "How far is that delivery?"

"About three miles."

"Well, there's about a quart of gas in this torch, and the model A gets eighteen miles to the gallon, or four and a half miles to the quart. I can make it okay, and as there's a little gas left in the tank . . . I should be able to get back. Even if I don't, I can buy a gallon of gas . . . if the customer pays off."

"She'll pay off all right," I said, and handed him the radio and the bill. The parts came to $2.10, and $2.50 labor made a total of $4.60. Not much of a job, but enough would be left to eat on, over the weekend, after paying Bink for the parts. I warned Sedge not to fail to get the money, as I had to pay Bink by one o'clock.

"Don't worry, Red," he assured me, "I'll get the money, or else. . . ."

He poured the gas out of the blowtorch into the tank of the model A, and took off.

A little after eleven, Sedge got back.

I heard a motor spitting and coughing like it was just about out of gas. I looked out the doorway and there was Sedge, grinning like a mule with a mouthful of saw-briers.

"Okay," I greeted him as he ambled in. "You got the money all right? Hand it over, quick . . . so I can see what it feels like and looks like again."

"I didn't get it," he confessed, still grinning.

"What!" I yelled. "So . . . you didn't get it! And after I told you how bad I needed it . . . how I *had* to have it! Fell down on me . . . didn't you? You long, lean cotton-headed dope. How can you stand there and grin, when I'm ruined . . . I tell you . . . ruined!"

"Just a minute, Red," he protested. "I couldn't help it. Wait 'til you hear what happened. I put over a swell deal for you . . . that's why I'm grinning."

"I can imagine what kind of a deal you put over," I sneered. "But go on . . . tell me. I can take it . . . I hope."

Sedge sat on the edge of my desk, crossed his skinny legs, and began.

"I found the house all right, Red. It was a big stone place . . . cost plenty. I parked the model A in front and took the little radio up to the door. The maid answered the bell.

" 'Radio, for Mrs. Mossbeck,' " I said.

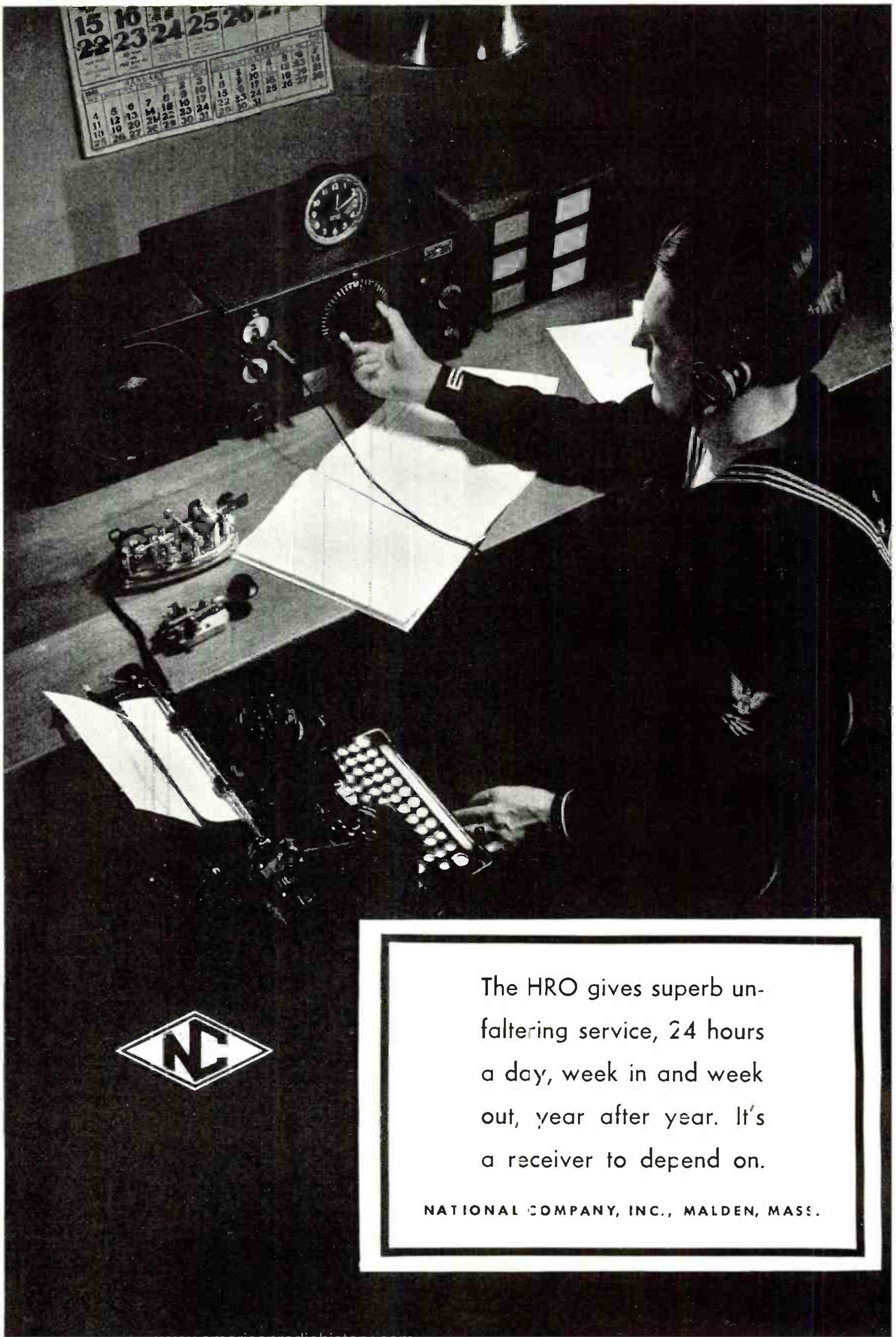
" 'Okay, friend,' " she came back.

"She was a cute little blonde trick with big blue eyes, and I figured I'd ask her for a date . . . on the way out.

" 'Where does the radio go, sister?' " I asked.

" 'It goes upstairs, pal,' " she said. " 'But you needn't hook it up. Old "Broadaxe" will hook it up herself.' "

" 'And who,' " I asked, " 'Is old "Broadaxe"?' "



" 'Why that's what I call Mrs. Mossbeck.' " She leaned over and whispered in my ear. " 'She looks like somebody smacked her in the side of the face with a broadaxe.' "

" 'Is that nice?' " I asked " 'to talk that way about your mistress . . . to call her that?' "

"She tossed her golden curls, and tipped me a wink.

" 'You haven't seen her, yet . . . big boy.' " She grinned, and giggled like a little imp. " 'I'll call her what I like . . . as long as she don't hear me.' "

" 'Then call her down,' " I suggested. " 'I've got a little love-note for her.' "

"I held up the bill.

"She called the old girl down, and right off I saw where 'Broadaxe' fitted her like the cellophane wrapper on a cigarette-pack.

" 'Mrs. Broad . . . I mean Mrs. Mossbeck,' " I said, throwing the bill in her face, " 'here's the bill on the radio.' "

" 'Oh, yes,' " she cooed. " 'Four-sixty. That's very reasonable, lad. And now . . . I've got a big job for you.' "

" 'But, the *bill* . . . on the little radio,' " I insisted, "you want to pay for that *now* . . . don't you?' "

"I reached around, pulled my empty bill-fold out of my hip pocket like I was ready to put her money into it.

" 'Oh, no, lad,' " she told me. " 'When you finish the other job, Mr. Mossbeck will pay you for both jobs.' "

"Well, Red, what could I do? I knew you had to have the money . . . but I couldn't afford to argue with a customer who was giving us another job.

" 'Okay, Mrs. Br . . . Mossbeck,' " I said, " 'where is this other job?' "

"She led me into the big sun parlor and pointed to a radio as big as an upright piano.

" 'It won't hit a tap,' " she explained. " 'What's wrong with it?' "

"I turned on the switch and went around behind the radio. I looked at the tubes. They were all burning except one . . . the power tube. I'd often heard you say that a radio wouldn't hit a lick when the power tube was dead . . . so I figured a new tube would be all it needed. Here was a chance to really do a good turn for old Red, and I was the boy who could do it!

" 'Mrs. B-Mossbeck,' " I said, doleful-like, and shook my head. " 'This is a fine old radio . . . but it's in awful shape. Looks like the main tube is burned out.' "

" 'Is it serious?' " from old Broadaxe.

" 'Yes,' " I sighed, " 'it'll run between four and five and a half dollars to fix it up,' " I shook my head again."

I grabbed his arm.

"I'll shake your head for you . . . you crooked liar!" I yelled. "You know I don't do business that way!"

"I know it, Red," Sedge agreed. "You are honest. That's why all these jack-leg radio men are making money, and you're starving. I knew you wouldn't like it . . . that you'd never do it yourself, so I did it for you, see? You have to go through with it, now."

"Sedge," I breathed, "if you had on a dress, I could almost kiss you. Ten bucks! Just think what I can do with ten bucks! I can get my car out . . . pay the 'phone bill . . . have cash to buy parts with. Where's the set? Did you bring it in?"

"Yeah." Sedge smiled. "Old Broadaxe said to fix it up. I slipped the chassis out of the cabinet. It's in the car. Let's bring it in."

We brought in the big chassis and speaker. I called Bink. He let me have a tube.

"Say, Red," Sedge blurted suddenly, "I almost forgot. Old Broadaxe said her husband gets home at eleven-thirty Saturday mornings . . . and begins drinking. By twelve, he's drunk, and *when* he's drunk . . . he won't pay *anything*. She said if I wanted my money today, I'd have to get back with the radio before twelve, before he got drunk."

"Yeowwww!" I screamed. "What next? Now, you have to get the radio back by eleven-thirty and it's eleven-fifteen, now. Mr. Barrows sent word in that he'd be here at noon to pay me a dollar on account. I was depending on that for gas money to deliver the big radio. I have to pay Bink by one o'clock, or he'll lose his job. We've got no gas to deliver the radio *now*. It's no use. I give up!"

I flopped in my chair. I buried my head in my arms.

Sedge put a comforting hand on my shoulder. I waved him aside.

"It's all right, Sedge," I said. "It's not your fault. You did the best you could. The new tube is in the radio. It's okay. It's ready to go back . . . and all we need is a dime for gas! One lousy dime is keeping us from getting five dollars . . . to say nothing of the four-sixty on the little set."

"Wait a minute," Sedge broke in. "I've got a plan. Don't say a word. Just let me have that blowtorch!"

I gave him the torch. He dashed across the street. In a couple of minutes, he was back . . . and pouring gas into the tank of the model A, from a gallon can.

I ran out to the car.

"How'd you do it?" I asked.

"Hocked the torch to the filling-station man for a gallon of gas," he grinned.

"What a brain!" I cried, admiringly.

We loaded the chassis into the car and he took off.

After he'd gone, I breathed a silent prayer. Prayed that Sedge would get there in time . . . before the old man got drunk. Man, was I worried. Suppose Sedge was arrested for speeding? Suppose the model A broke down? Suppose Sedge got reckless and wrecked the car?

Finally at twelve-fifteen, the model A rattled around the corner, and smacked into the curb.

Sedge got out and staggered into the shop. Goggle-eyed and limp, he flopped into a chair.

"Sedge!" I exploded. "You've been drinking! You're drunk!"

"Yup," he came back, "M'drunk. S'what? Had t'do it, Red . . . ol' pal. Got there okay an' put th' radio back in th' cab'net. Played okay. Ol' Mossbeck'd already started drinkin'. I had t'drink up all 'is stuff t'keep 'im f'm gettin' drunk . . . so he'd pay off . . ."

"Well, *did* he pay off?"

Sedge hauled his billfold out of his hip pocket and tossed it onto the desk.

"Yup . . . paid off like a top . . . only th' funny part of it is . . . he don' *know* it. There's fifteen buck in there, Red. You take just ten an' leave th' res' f'me. Bein' part Scotch, ol' Mossbeck raised a kick 'bout th' price. Said he wouldn' pay it, an' if I didn' like it . . . I could take th' radio."

"What then?"

"Well, Red, I tried arguin' with 'im, but no soap. Tryin' t'get 'im in a good humor, I started ravin' 'bout 'is whisky. That tickled 'im an' he offered to show me 'is cellar. Said he could see I wus a man who could 'preciate good whisky, so he made me a l'il present of a sealed quart of 'Nebony 41.' Said 'twus rare ol' stuff . . . hunnert years ol'. Said he wus jus' 'bout th' only man in town had any of it, an' it wus awful scarce an' hard t'get.

"He gave me th' bottle. I beat it over to Joe Letrone's liquor store. Joe grabbed it quick for fifteen bucks."

I laughed. "Well, Sedge," I said, "We're all to the good on that deal . . . but I feel kind of sorry for poor old Joe Lethrone. Even if it is rare old stuff, I expect he'll wait a long time before he can sell it. Just between you and me, I think Joe was pretty dumb to buy it."

"Think so?" Sedge asked, sarcastic-like, and grinned. "I'll tell you how dumb he wus, Red. Soon's he paid me off, he grabbed his 'phone an' called . . . who do you think? Ol' man Mossbeck, himself. He tol' th' ol' man he could get 'im a sealed quart of 'Nebony 41,' an' sold it to 'im for twenty-one bucks!"

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Inventions

(*Continued from page 13*)

submarine, the airplane, the tank, and radio itself. Such ideas, obviously, are few and far between. The *Council*—hoping for the best—has never been too optimistic that it would find such an idea in the morning mail. But one can never tell.

The second class of inventions comprises by far the larger number and this is the field where most men will find the greatest opportunity. This second class includes the kind of inventions which are improvements on present devices or methods, rather than entirely new concepts. Such an invention might be a major discovery like the super-het—which was born out of the last war—or might be something less sensational, but nevertheless important, like an antenna improvement. The history of invention reveals few major discoveries—but thousands of little discoveries, which have carried us along the road to progress.

There is always the possibility that the inventor will come upon some major discovery, but his greatest chance of success lies in the field of improvement. The *Council* emphasizes that it is interested in every improvement on present equipment or methods — no matter how small the invention may be. Don't forget that there have been very few basic discoveries in the radio field. Most of the progress from the crude transmission facilities of thirty years ago to the intricate sets of today has grown out of improvements in details.

Each small improvement has been followed by another and another, until in their total these minor inventions constituted a major step forward. It was in 1859 that Maxwell first predicted the discovery of electric waves, yet years of experimentation and work on details passed before Hertz demonstrated the existence of these waves. Again, years passed before Marconi made radio usable. Marconi's discoveries could be classified as a major landmark—yet the radio he developed was usable only in a limited way. Transmission was almost all ship-to-shore until the invention of the vacuum tube made possible modern radio.

The broadcasts from Arlington to Paris during the last war constituted a milestone in the history of radio invention. There have followed many years of work on details. In the last 15 years, there have been no new radio principles discovered. Yet the sets in use today make the rigs of the 1920's look crude indeed. The great change has been brought about by hundreds of minor inventions and improvements.

Those who think that they might be able to contribute something to the future of radio might do well to bear this in mind. Consider the history of the vacuum tube. There was the original invention of the two electrode tube. Then De Forest put in three electrodes. Study and minor improvements saw more and more electrodes put in, and as a result we have tubes today which can do many things at once.

Research and invention is no longer a one-man job. It is a task which requires the talents of hundreds and hundreds of men, each making a little suggestion here and a small improvement there. The result of the work of all these men making small inventions is to bring about a major improvement. There is no one company today which could put on the market the best television equipment without using some inventions made by the men of another company. The job of developing television, after the basic discoveries had been made, became a task for many minds. So it is with everything else in radio.

One of the chief functions of the *Inventors' Council* is to act as a clearing house where all these ideas can be correlated. Often, two inventors—working on different problems—may send in ideas which, alone, are not complete. But put together, they may be an important invention. Often, the adoption of major changes may have to wait upon the development of a number of minor ideas. For instance, the *Navy* waited years before installing super-het equipment in its vessels because of the fear that radiation from this kind of equipment would make it easy for enemy submarines to spot our ships. It was not until a very few years ago, when some comparatively minor discoveries and improvements were made, that the *Navy* was satisfied that it was possible to shield this equipment so as to prevent any radiation. Here was a case where the *Navy* was not able to take advantage of a major invention—the superhet—until some inventive soul had made a small discovery in connection with shielding.

Frequency - Modulation offers another example of a major development which had to wait until a number of smaller inventions were perfected. The principle of FM was known for many years, but its use was delayed until the small inventions were brought forth. Today, it is highly important in the military field, because of the noise-elimination and for other reasons.

So it can be seen that no one need hesitate about sending in any kind of invention, whether it be something which is radically new or something which is only in the nature of an improvement. In either case, the inventions may be of great importance.

There are two general fields in which the *Council* seeks to find radio inventions which might be of use in the war. One of these is in the field of remote control devices and the other is in the field of normal signal equipment. The *Council* has committees of experts in both these fields, which pass upon the worthwhile suggestions which come in.

In the field of remote control, there is opportunity for inventions of devices for us in connection with aerial or marine torpedoes. The *Council* also considers of great interest any types of vehicles which can be controlled from a remote point, or types of land, sea or air mines which can be operated under remote control. There is great interest in any kind of apparatus which might be used for remote control of any device. All types of radio locators are considered in this field.

The types of inventions which the *Council* seeks in the Signals and Communications fields includes those dealing with radio transmitters and receivers, circuits, vacuum tubes, static eliminators, television devices and apparatus, iconoscopes, etc. Inventions which would improve present teaching systems for radio operators would be useful. The *Council* also is interested in machines and apparatus for use in coding or decoding messages.

The use of radio as a means of communication in the armed services has become so widespread that it is obvious the Government is anxious to get inventions relating to standard equipment in common use. But beyond this, there are many fields of radio which are adaptable to military use and about which comparatively little is known. In these fields, there is great opportunity for useful invention — television, frequency modulation, and facsimile, for instance.

Little is known about the ultra high frequencies, above 300 megacycles. Amateur radio men have pioneered in UHF in the past and there is opportunity for them to pass their knowledge in this field along to the Government now. There are dozens of other kinds of inventions and ideas which could prove useful. Aviation radio, for instance, has always been troubled by the high noise level. Amateurs in the past have developed excellent noise-reduction circuits. The most important radio developments applicable to war recently have been in radio locator and remote control devices—and here again the experienced radioman may be able to make an important contribution.

Officials of the *Federal Communications Commission* point out that it is possible for amateurs and professional operators to conduct experimental work with dummy loads without violating the present regulations against broadcasting. As long as the amateur's set does not send forth any radiation which can be picked up at any distance, the equipment may be operated. It has been found that dummy antennae can be used satisfactorily in experimental work. If the radioman is able to show that he really has made some progress in his experiments and that he is working on something that is new and important, he can still obtain from the FCC an experimental license. Of course, licenses to transmit on the frequencies set aside for experimental work will be granted only to those who can demonstrate very clearly that they are on the track of an important discovery.

It is possible also for radio men to do research and experimental work on the receiving end, without running contrary to any Federal regulations. There is a great opportunity for studies in static elimination, equipment arrangement, and design, etc. In the field of radio production there are many inventions which can be made. The shortage of certain materials which are needed in manufacturing would suggest the necessity for new ideas on substitutes. This is a never-ending problem—since the widespread use of certain kinds of substitute materials has caused shortages of them. So that the *Inventors' Council* now finds itself seeking substitutes for substitutes.

The *Inventors' Council* has its offices in the Department of Commerce Building, Washington, D. C., and communications may be addressed to it there. It is requested that all inventions and ideas be submitted in writing, preferably on a typewriter. It is essential that the communications go into enough detail so that the objectives and proposed methods or means of carrying them into effect are fully and clearly stated. The technical staff of the Council is well qualified to evaluate suggestions from written descriptions and drawings. Suitable blueprints or plans should accompany the written descriptions, when necessary. Pages should be fastened together.

No models are to be submitted to Washington. Inventors will probably find it necessary to construct models, for their own use, but these should not be sent to Washington. The *Council* will retain all documents submitted to it. Those sending in inventions are advised to make duplicate copies for their own files and the inventor would be wise to sign and date these duplicates, in the presence of witnesses. Submission of an invention to the *Council* does not constitute a patent. If the inventor feels that his idea is worth patenting, he should take the proper steps. The *Council* will hold all suggestions sent to it in strictest confidence.

The *Council* cannot enter into correspondence with the inventor about the reasons for rejection of ideas. When communications come in, they are examined by the technical staff. If they are considered promising, they are passed on to the advisory committees and may at length be considered by the entire *Council.* During any one of these steps, there may be advanced a valid reason for rejection of the idea. It may be that the Government already has something along the same line which is better. Obviously, it would be disclosing valuable information if the *Council* wrote back to an inventor to explain that the Government already had something like it and to explain just why the other invention was better. So the policy is to tell the inventor nothing, unless his idea is accepted.

The *Council* does not undertake to do any developmental or experimental work on the basis of inventions received. If an invention seems to have merit, but obviously needs more development, it is possible that the *Army* or *Navy* or other interested department will undertake the experimental work, but the *Council* cannot do this.

Those who have the technical knowledge necessary to work in radio will have the background necessary to work out their inventions in some detail. The *Council* would not profit, for instance, from the mere suggestion that the *Army* should have some kind of radio wave which would cause enemy planes to fall to pieces. Such a suggestion would not be of value unless the writer set forth plans for the apparatus which could generate such a wave. In other words, inventors in the radio field should use their knowledge to work out details of the invention.

It is important that radio engineers and others who are highly trained use their professional background to help others. Often, a younger or more inexperienced man will have a good idea, but will not be able to organize it. Engineers and foremen can give assistance to such men. Help them prepare their material for orderly consideration. Discuss inventive ideas with others and try to help them. A large percentage of inventions coming to the *Council* are found useless because the inventor is not familiar with prior developments in the field and is not familiar with the fundamental physics or mechanics upon which his invention is based. For instance, many inventors think of sound waves or light waves as a prime medium for energizing a projectile for chasing airplanes — "bloodhound projectiles," the *Council* calls them. But they forget that airplanes now race through the air at about half the speed of sound. By the time the sound from airplane engines reaches the sound detector, the airplane may be two or more miles away from where it was when the sound left it. Radio seems to be the most promising element in this remote control field, but inventions must have their basis in knowledge.

In factories and shop and in radio clubrooms, there can be set up "Invention Boxes," into which workers and members may drop their ideas. The officials of such businesses and organizations should encourage everyone to give the Government the benefit of their inventive ability.

Possibly the following texts may be found useful in building up background information on what has been done in the remote control and radio signal fields so far: Radio at Ultra-High Frequencies, R.C.A. Institutes, Technical Press, 75 Varick Street, New York City; R.C.A. Remote Control Bibliography, Serial No. T.R. 447, R.C.A., New York; Radio Facsimile, R.C.A. Institutes Technical Press; Wireless Principles and Practice, L. S. Palmer, Longmans Green & Co., New York City; Radio Amateurs Handbooks, American Radio Relay League, East Hartford, Conn.

Don't forget that this is a war which may be won by ideas. The American people have always boasted of a genius for invention. *Now—if ever—is the time when we must mobilize that talent.*

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Practical Radio

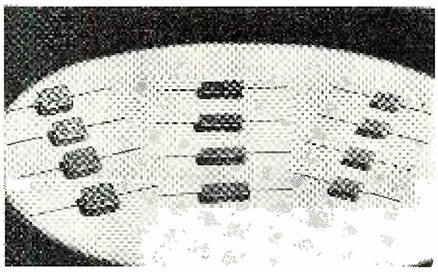
(*Continued from page* 31)

flow. This action is best explained by considering the distribution of electrons in the circuit.

Before the capacitor is inserted in the circuit of Figure 4(a) it can be assumed to have no charge, and that if its two plates were connected together as in Figure 5(b) there would be no flow of current. So far as the distribution of electrons in the plates and the intervening insulation is concerned the capacitor would be considered balanced or *neutral.*

When connected to the battery by closing switch S in Figure 4(b) there will be a surge of free electrons from plate No. 1 of the capacitor to the positive terminal of the battery. This surge of electrons will be indicated as current flow by the meter. At the same time there will be a movement of electrons through the other half of the circuit toward plate No. 2 of the capacitor, this movement being caused by the repelling effect of the negative terminal of the battery.

As a result of these movements, a scarcity of electrons will develop at one plate, and an overabundance at the other, and the capacitor will no longer be neutral. The plate from which the electrons moved (No. 1) assumes a positive charge, the other one (No. 2) (into which electrons were supplied) a negative charge. Once the difference of potential between the two plates

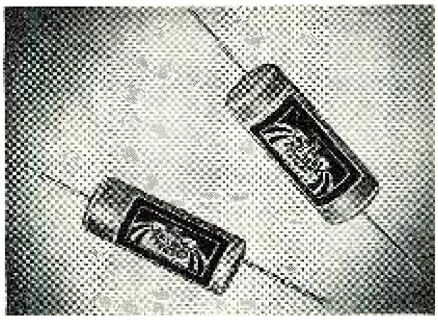


Typical mica capacitors.

equals that of the battery it is apparent that no more electrons will flow and that a state of stable charge will have been achieved.

Now, if the battery is removed from the circuit as in Figure 5(a) the capacitor will retain this charge and its polarity will be as indicated. The instant the switch is closed, completing the external circuit between the two plates as shown in Figure 5(b), there will be a surge of electrons from the negative plate to the positive and this will continue until the charge is dissipated and the capacitor again becomes electrically neutral.

While in a charged condition, there



Paper tubular condensers.

is not only the unbalanced distribution of electrons at the plates, but also a strained condition of the atomic or molecular structure of the insulating material. This is due to the attraction of the positive plate for the electrons which are still too tightly bound to their molecules to break loose, and to the repelling action of the negative plate.

This condition of strain is the electrical equivalent of the strain within a stretched rubber band or a compressed steel spring—mechanical strains which will cause these devices to return to their normal condition when released, and to release energy in so doing.

The unit of capacity is the "Farad" but this is far too large for practical use. In radio work, therefore, the microfarad (mfd.) (1/1,000,000th part of one farad) is commonly used and next most common is the micro-microfarad (mmfd.) (1/1,000,000th part of one microfarad). Actually the capacities with which we have to deal in radio receiving and transmitting equipment vary from a fraction of one micro-microfarad to approximately 100 microfarads.

The amount of electrical energy that can be stored in a capacitor depends on the e.m.f. applied to it and on its capacity value. The capacity value in turn depends on (1) the area of the plates, (2) the separation between the plates and, (3) the dielectric (insulating) material employed.

Were only two plates employed, they would have to be very large and closely spaced to provide an appreciable amount of capacity. The capacitors employed in radio are therefore usually made up of groups of plates connected as in Figure 6. Actually these may be plates or they may be strips of thin metal foil. The dielectric may be air, mica, paper, oil, or a chemical film. In "paper" capacitors several long strips of aluminum foil, separated and insulated from each other by sheets of special paper, are tightly rolled into compact cylindrical units, thus providing the equivalent of large plates in concentrated form.

Even greater compactness is achieved in the "electrolytic" capacitor. Here aluminum foil serves as one plate and an electrolyte or electrolyte-impregnated gauze or paper as the other. The dielectric is a very thin insulating film of aluminum oxide which forms on the surface of the foil. The thickness of this film may be only a few millionths of an inch. Because the capacity for a given surface area increases inversely as the thickness of the dielectric, relatively very high values of capacity may be thus obtained in the form of electrolytic capacitors of small physical size. (Another factor contributing to this is the fact that the dielectric constant of this oxide film is very much higher than that of air or of other commonly used dielectric materials such as mica or paper.)

The dielectric material employed in a capacitor has much to do with the capacity value. If two capacitors have plates of identical surface area and spacing but one uses air as the dielectric and the other uses mica, the latter one will have from three to seven times the capacity of the former. The relationship of any material to air in this respect is known as its dielectric constant. Thus the dielectric constant of air is 1, of mica from 3 to 7 (depending on quality, etc.); of paper about 2 to 3, and so on.

The dielectric material is important

from other standpoints, too. Some materials introduce losses through absorbing some of the electrical energy with which they are charged, dissipating it in the form of heat. Some permit leakage current to flow between the plates, within the capacitor. Some cannot withstand high voltages unless used in considerable thickness.

Capacitors are classified according to the dielectric material employed in their manufacture. Thus we have types known as air, paper, mica and

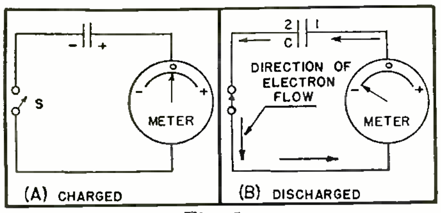


Fig. 5.

electrolytic. Each of these types has its special applications, its advantages, and its limitations.

Air Capacitors: Air as a dielectric offers extremely low losses and is therefore highly efficient. Where capacity must be continuously variable, as in tuning condensers, the air type is the most practical inasmuch as two sets of metal plates can be so arranged that one set intermeshes with the other and is rotatable in order to vary the effective area of the plates without danger of contact or friction. Usually air condensers are employed only where the required capacity does not exceed about .0005 mfd., and where the capacity must be variable or where the utmost freedom from losses is essential. Such capacitors are large in physical dimensions for a given capacity and are relatively expensive per mfd. of capacity.

Mica Capacitors: Mica capacitors are made by sandwiching small sheets of aluminum foil between slightly larger sheets of high-grade mica, then moulding the assembly under pressure into a block of Bakelite or other good insulating material which forms a moisture and dust-proof covering. This type of "postage-stamp" capacity offers the advantages of low losses and of much greater compactness than the air type.

As used in receiver circuits values normally run from a few micro-microfarads to about .1 microfarad. For values higher than this latter one the cost becomes relatively high. High voltage units are made by increasing the thickness of the mica sheets and such capacitors can be made to withstand many thousand volts in high power transmitting circuits. Variations of the standard mica capacitor are a relatively new type in which the plates consist of silver deposited directly on the mica, thus insuring even higher efficiency and stability, and a semi-variable type in which alternate leaves of metal and mica are so arranged that variation of a pressure screw varies the total capacity. This latter type is extensively used in tuned radio circuits which require only occasional adjustment of the tuning capacity.

Paper Capacitors: The average radio receiver includes from three to six or more paper capacitors to one of any other type. The reason is that this type meets a wide variety of capacity and voltage requirements and offers sufficiently low losses to be entirely satisfactory for most radio circuit applications although not as efficient as either the mica or air types. This type is commonly used in values from 0.001 to about 1.0 mfd. in radio receivers and up to considerable higher values in transmitting equipment. The type of construction, which has already been described, is such as to provide considerably greater compactness as compared with mica capacitors and is much less costly.

Paper capacitors are available in various voltage ratings up to several

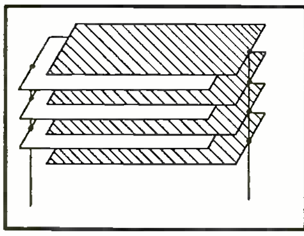


Fig. 6.

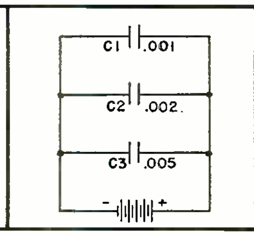


Fig. 7.

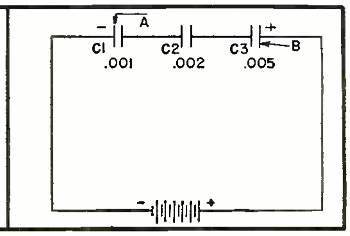


Fig. 8.

thousand volts. The ability to withstand higher voltages is achieved by the use of several thicknesses of paper between the strips of foil and in addition the assembly is oftentimes impregnated and filled with special oil to further improve the insulation qualities.

Electrolytic Capacitors: This type of unit has been described in some detail earlier in this article. Its primary application is in filter and by-pass circuits where capacity values of 1 to about 100 mfds. are required. This is the most compact form of capacitor available and by far the most inexpensive per unit of capacity. Its losses are too high for use in critical circuits. Moreover it cannot be used in alternating current circuits. But there are many applications where these limitations are of no consequence. It is the availability of this compact, inexpensive type of capacitor that has done much to make possible the compactness and low cost of the modern radio receiver.

Capacitors serve an almost unbelievable variety of purposes in radio circuits. Many of these will be discussed in detail in later lessons. It might be well to point out now, however, that while this discussion has been limited almost entirely to capacitors which are purposely included in circuits, there are numerous capacities inherent in other circuit components, in the wiring and in vacuum tubes, some of which are unfortunately highly undesirable and complicating. Capacity existing between the elements of a vacuum tube, for instance, may in certain cases impose definite limitations on the purposes for which the tube may be used.

Capacitors in Series and Parallel

There is frequently occasion to condriven low-voltage-high-current generator. The batteries found in most aircraft are usually constructed so that electrolyte always surrounds the plates regardless of their position; these are known as "spill-proof constant level" batteries. The ampere hour ratings of aircraft batteries vary according to size and "bank connection." The voltage rating of most aircraft batteries is 12 volts. However, 6 and 24 volt batteries are sometimes found in certain aircraft. The aircraft storage battery can take much punishment either from unintentional overloading or direct misuse. But its ability to take punishment should in no way be construed as a license to neglect its proper maintenance. Every aircraft storage battery should be tested at least once a week and inspected for deterioration, water added if necessary. If the hydrometer test indicates low specific gravity (1100 to 1150), the battery should be removed and recharged. A full charged battery should test 1300. It would be well, when inspecting the battery, to clean and tighten terminal connections. In addition to these operations, it would be wise to coat the terminals with grease.

Storage batteries should not be subjected to "over-charging," large overloads, or high temperatures; buckling of the plates will inevitably result. Once every sixty hours a careful examination should be made of the internal structures of aircraft batteries. If a test under load can be made, it is highly advisable to do so.

(To be continued)

Electronic Gadgets

(Continued from page 23)

neon discharge is extinguished. The circuit is then ready for a repetition of the cycle.

By properly proportioning the values of C and R, the alternate charge and discharge of the condenser may be set at any desired rate, the relay opening and closing at the same rate. In arranging the circuit, the experimenter must be careful to choose the R value such that the sum of the resistance in the base of the neon lamp and the reactance of the relay be half (or less) of the timing resistance.

A capacity-operated relay circuit is shown in Figure 7. This simple device may be used in window exhibits where onlookers point at a spot on the glass to actuate a moving object, in counters, invisible burglar alarms, and the like.

This is a "blocked-grid" circuit which actuates a relay whenever a nearby conductive body moves close to the "sensitive" plate—a metal sheet of almost any convenient size.

A simple triode, such as a 6C5, 6J5, or even a 117-volt type with screen and plate tied together is employed *without* grid leak. No rectifier tube is required. The coupled coils, L1 and L2, are ordinary T.R.F broadcast coils. The condensers connected in parallel with these r.f. transformers are set so that the circuit is just on the verge of oscillating. Any small additional capacitance, such as that introduced by a body, approaching the sensitive plate, will be sufficient to spill the circuit over into oscillation and close the plate-circuit relay.

Success of the circuit is due to the absence of a grid leak. On each positive half-cycle of excitation, the grid collects electrons; and, since there is no grid resistor path for these electrons, the resulting negative charge on the grid soon attains a value sufficient for plate-current cut-off.

The circuits shown here are only a few of the representative electronic hookups that may be placed into operation by the amateur experimenter. Various applications will be apparent to each reader. Other circuits and devices will be explained in subsequent articles.

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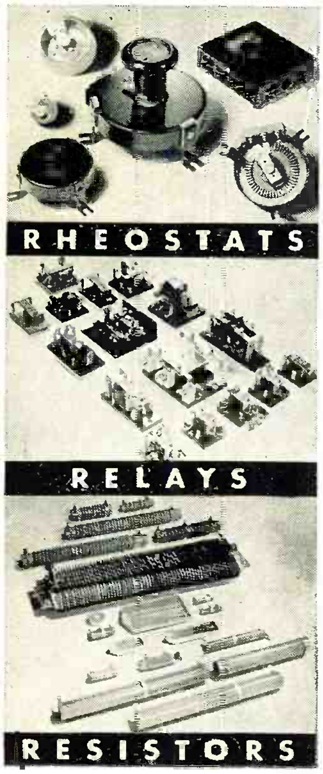

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