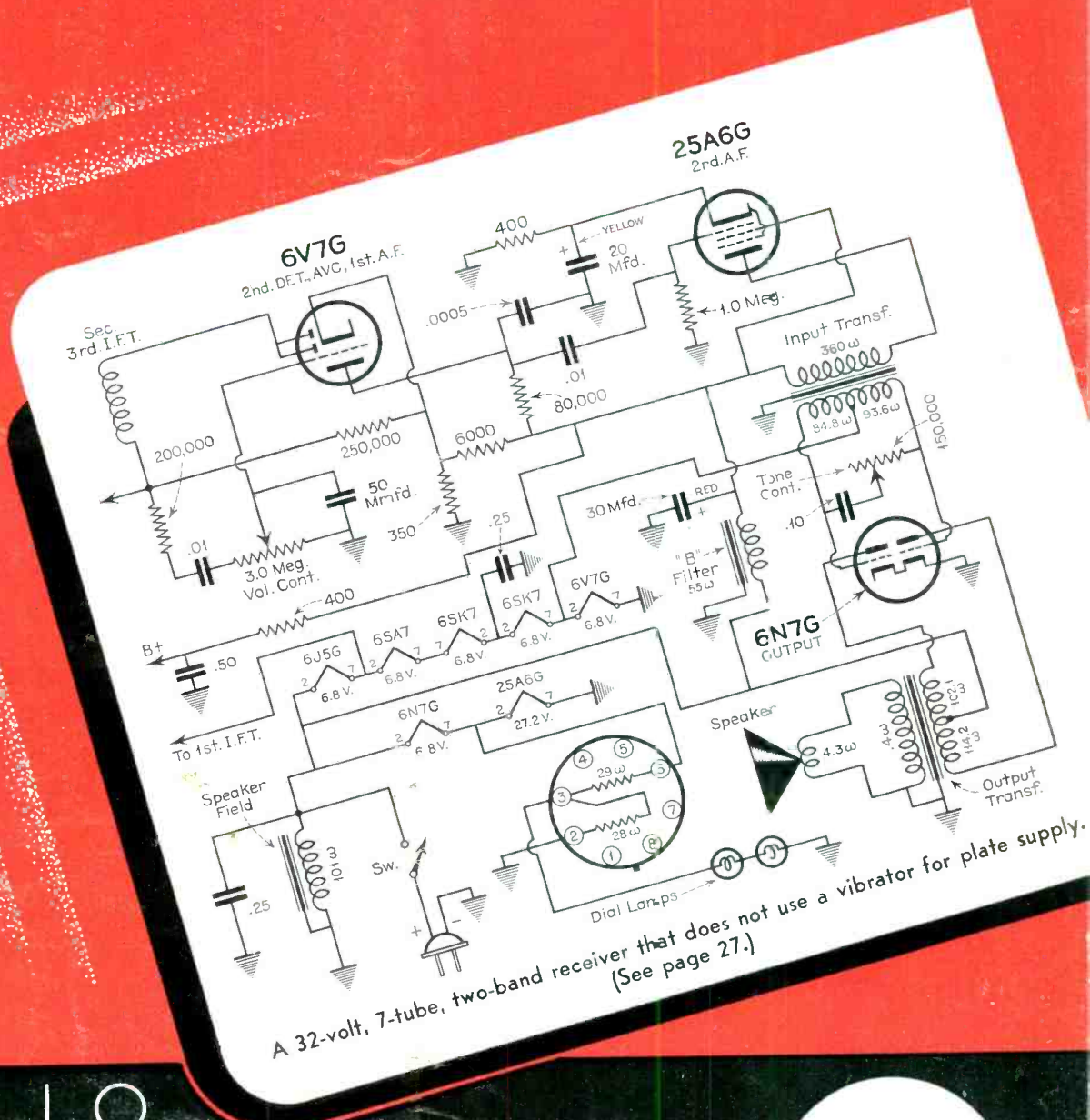
SERVICE

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE



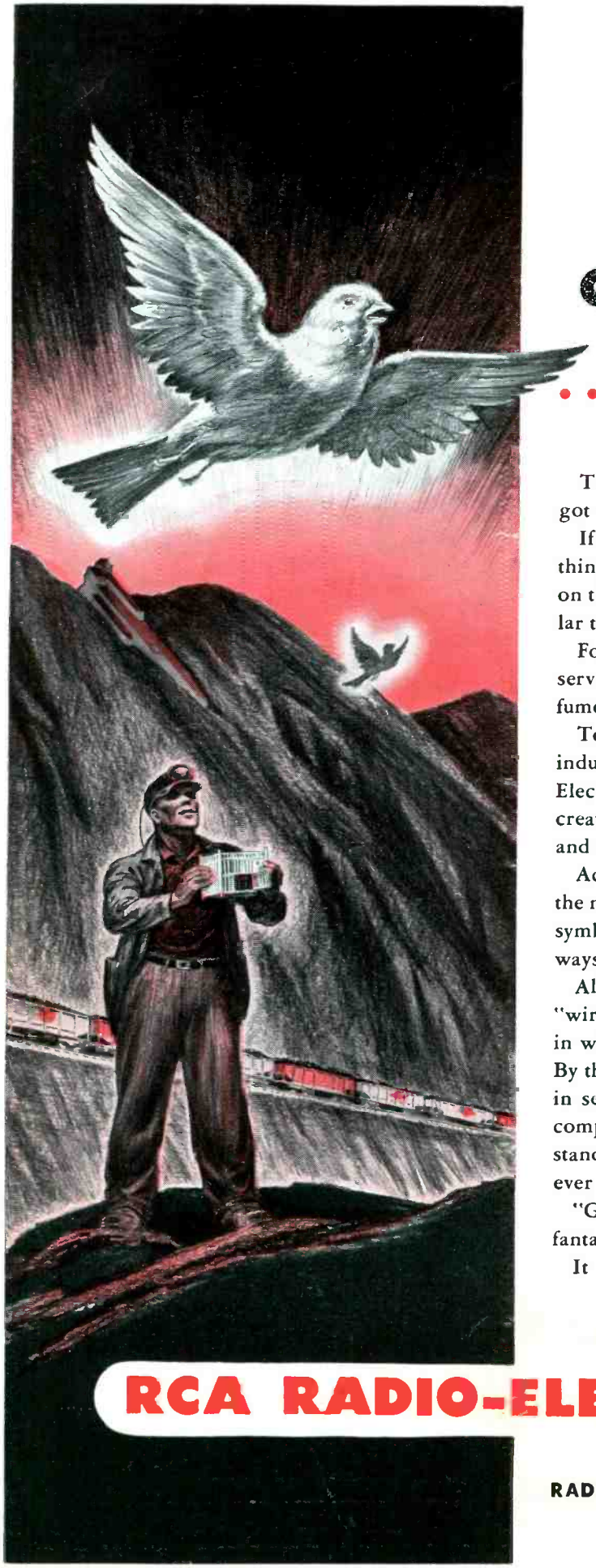
A 32-volt, 7-tube, two-band receiver that does not use a vibrator for plate supply. (See page 27.)

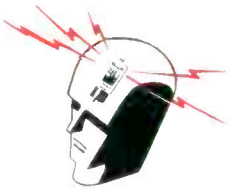
★ RADIO

★ TELEVISION

★ ELECTRONICS

APRIL
1943





GOODBYE, CANARY BIRDS

. . . hello, serviceman!

This might well be entitled: "What has a vacuum tube got that a canary bird hasn't?"

If so, it could be answered by saying that, among other things, a tube has far greater dependability and durability on the job of detecting poisonous gases in mines, vehicular traffic tunnels and the like.

For, in the old days B. E. (Before Electronics), canaries served as "gas alarms." At the first trace of poisonous fumes in a mine they'd keel over in their cages.

Today, this is just one of the countless tasks throughout industry that are being done better, more dependably The Electronic Way. It is one of many developments that are creating vast new potentialities for RCA Distributors and Servicemen.

Actually, Electronics is merely a new word describing the newer uses of the radio tube and its derivations. It is a symbol of the radio-electronic circuit at work in new ways, and in widely different fields.

All of which means simply this: Since the days when "wireless" itself was still a scientific novelty, RCA has led in what we now know as Electronic Tube development. By the same token, it means that, as long-time specialists in servicing radio-electronic circuits or supplying their components, RCA Tube and Equipment Distributors now stand on the threshold of a far greater market than ever before.

"Goodbye, Canary Birds—hello, Serviceman!" is not fantasy.

It is an actual glimpse into our future—*and yours.*

RCA

RCA RADIO-ELECTRONIC TUBES

RCA Victor Division

RADIO CORPORATION OF AMERICA, Camden, N. J.

BUY U. S. WAR BONDS AND STAMPS

LAST YEAR'S BONDS GOT US STARTED

THIS YEAR'S BONDS

ARE TO WIN!

★ Last year saw nearly 30,000,000 workers voluntarily buying War Bonds through some 175,000 Pay-Roll Savings Plans. And buying these War Bonds at an average rate of practically 10% of their gross pay!

This year we've got to top *all* these figures—and top them handsomely! For the swiftly accelerated purchase of War Bonds is one of the greatest services we can render to our country . . . and to our own sons . . . and our neighbors' sons. Through the mounting purchase of War Bonds we forge a more potent weapon of victory, and build stronger bulwarks for the preservation of the American way of life.

"But there's a Pay-Roll Savings Plan already running in my plant."

Sure, there is—but how long is it since *you've* done anything about it? These plans won't run without winding, any more than your watch! Check up on it today. If it doesn't show substantially more than 10% of your plant's pay-roll going into War Bonds, it needs winding!

And you're the man to wind it! Organize a vigorous drive. In just 6 days, a large airplane manufacturer increased his plant's showing from 35% of employees and 2½% of pay-roll, to 98% of employees and 12% of pay-roll. A large West Coast shipyard keeps participation jacked up to 14% of pay-roll! You can do as well, or better.

By so doing, you help your nation, you help your workers, and you also help yourself. In plant after plant, the successful working out of a Pay-Roll Savings Plan has given labor and management a common interest and a common goal. Company spirit soars. Minor misunderstandings and disputes head downward, and production swings up.

War Bonds will help us win the war, and help close the inflationary gap. And they won't stop working when victory comes! On the contrary—they will furnish a reservoir of purchasing power to help American business re-establish itself in the markets of peace. *Remember, the bond charts of today are the sales curves of tomorrow!*

You've done your bit Now do your best!

THIS SPACE IS A CONTRIBUTION TO AMERICA'S ALL-OUT WAR EFFORT BY

SERVICE

EDITORIAL

ONE of the gravest situations confronting the Service Man today, is the tube problem. A short time ago, it appeared as if a solution had been evolved. Unfortunately, though, there are still many hurdles to go. There is no denying that the problem is a complex one, involving many phases of production, transportation and end-use. While some of these difficulties have been ironed out, there are still quite a few to overcome.

Government and industry are cooperating in an effort to provide a workable plan. They realize that time is at a premium, for the situation becomes more acute every day. As a result, a comprehensive program must be developed, and *very* soon.

THERE have been ugly rumors that the new *V* line of parts will be hodge-podge assemblies, with inferior material. Studies of the specifications and typical units, reveal that the new *V* units will be attractive, sturdy and reliable. And the material will be of the standard approved type. The items will not be embellished in fancy packages. They will be packaged simply and neatly. And most important of all, the *V* parts will be dependable.

AIRCRAFT communications servicing has become quite a project. Although much of the servicing is performed by commercial aircraft units, there are still many private planes, cooperating with Civilian Defense and the military, that require independent servicing. It is an interesting field in which too few Service Men have taken an interest. And the field will be still more interesting later on, when flying becomes as commonplace as auto travel. Keep your eye on aircraft communications!

THE Service Man has a real friend in radio commentator Frazier Hunt. Listen to his messages on servicing on the home front. What a story they tell!

SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U.S. Patent Office

Vol. 12. No. 4 April, 1943

Published monthly by Bryan Davis Publishing Co., Inc.
19 East 47th Street, New York City. Telephone PLaza 3-0483

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Entered as second-class matter June 14, 1932, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Subscription price: $2.00 per year in the United States of America and Canada; 25 cents per copy. $3.00 per year in foreign countries; 35 cents per copy.

The SPRAGUE TRADING POST

EXCHANGE — BUY — SELL

Your Own Ad Run FREE!

"My Trading Post Ad certainly produced results!"

"Thanks for starting a good thing!" . . . "Congratulations on your Trading Post idea!"

Such are the enthusiastic comments pouring in from servicemen on all sides about the Sprague Trading Post.

Send in your ad today. We'll run it *absolutely free of charge* in at least one of the five Radio magazines in which this Sprague feature appears regularly. All we ask is that it fit in with our plan of helping servicemen buy, trade, or sell needed equipment during these days of wartime shortages. "Emergency" ads will receive first attention. Keep your copy short. *Write clearly.* Please mention the magazine in which you saw the Trading Post. Address your ad to: SPRAGUE PRODUCTS CO., Dept. S-34, North Adams, Mass.

WANTED—Meter with capacitance incorporated, or what have you? State make, model, condition, price. Radio Shop, 142 Ralph Ave., Brooklyn, N. Y.

WANTED—Used Scott or any other receiver that's A-1 on the short-wave bands and has good output. Must have 18 or more tubes. Can use chassis alone. Will trade or pay cash. Write. Will answer all. Henry Ecklund, 290 E. Lawson St., St. Paul, Minn.

VOLT-OHMMETER WANTED—Simpson Model 240 "Hammeter" or similar unit badly needed. Mention ranges and price. M. A. Walsh, Casa De Vallejo, Vallejo, California.

WANTED FOR CASH—Rider, RCA, and Philco manuals; Superior channel analyzer; condenser analyzer; vacuum tube voltmeter. Please state make, model, condition, and price. Radio Technical Service, 2821 W. Girard Ave., Philadelphia, Pa.

TUBES WANTED—Distributors are requested to write promptly if they can supply the following tubes at dealer discounts: 20—12SA7GT; 20—12SK7GT; 20—12SQ7GT; 50—35Z5GT; 30—50L6GT. G. C. Duncan, Longhurst, N. C.

SIGNAL GENERATOR FOR SALE—Model 10B Ferris, Ferguson Radio, 4453 Dickens Ave., Chicago, Ill.

WILL SWAP—Will trade chanalyst, CB 3" scope and OMA signal generator, condenser analyzer, Precision tube tester, Rider's Manuals to Vol. 12, and Precision meter 844L and 844. Will trade only for tubes, and for AC-DC radios at list or regular discount. Make offer in tubes in sealed cartons. Not for cash sale. C. J. Burns, Box 211, Ogden, Utah.

FOR SALE—2 mf. filter condensers, 600 volt @ 3 for $1. Also have some telephone mikes, $1 ea. Walter Juranic, P.O. Box 36, Red Hook, N. Y.

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WANTED—Last 5 editions of Rider's Manuals, also radio parts, and an AC/DC multitester. T. F. Waters, 211 East 42nd St., Norfolk, Va.

COMMUNICATIONS RECEIVER WANTED—Will pay up to $65. Eddy Hazlinger, 3590 E. 116 St., Cleveland, Ohio.

USED TUBES WANTED—Until new tubes are available, I will buy or trade for good second-hand radio tubes of the critical types such as 1A7, 35Z5, 80, etc. Send me your list and price. Roxy Radio Repair, Mitchell, South Dakota.

TUBE TESTER WANTED—Need tube tester such as 432A Readrite; 1213 Triplett; or 309C R.C.P. For sale, one Audel's Auto Guide; also one new Zenith cabinet for Model 5L228A in original carton. H. Ursillo, 85 State Street, E. Providence, R. I.

A-C VOLTMETER FOR SALE—Weston model 528 like new in bakelite case, 3 scales, 0-4, 0-8, and 0-150. Also have three type 250 power tubes, and one 210 power tube, and one 374 ballast tube. Make offer. Herman C. Brown, 2940 N. 26th St., Philadelphia, Pa.

EQUIPMENT TO TRADE—Will swap a Triplett vibrator tester No. 1672, brand new; C-B 79-B audio oscillator; and Rider's Manuals 4, 5, and 6. Need a good condenser tester; frequency standard and V. T. V.O.M. Will pay any cash difference. The Radio Hospital, 420 N. Hudson St., Oklahoma City, Okla.

TUBES WANTED—Will pay list less 40% and shipping charges on any of the following tubes: 50 each 35L6G (or GT); 35Z5GT/G; 50L6GT/G; 12SA7, or GT; 12SK7 or GT; 12SQ7 or GT; 35Z5G/GT; 35Z4G or GT; 80, 75; 5Y3G; 12K7G or GT; 1A7G or GT; 1H5G or GT; 70L7GT; 117Z6GT. Any good brand. Munroe Radio Service, 111 Shelby St., Kingsport, Tenn.

TRANSFORMERS WANTED—UTC transformers LS10, LS12, LS-6L1, LS-6L3; also Kenyon T-317. Must be in good electrical condition. Any quantities. Write giving price, etc. Henry W. Hold, 320 Roselle St., Linden, N. J.

CRYSTALS TO SWAP—Will trade Bliley crystals 1950 kc., 1801.5 kc., and 7199 kc., for collection of boogie-woogie records. Franklin Williams, 748 Glenview Road, Glendale, Calif.

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INSTRUMENTS WANTED—Signal generator, milliammeter, and ohmmeter. Give details and price. Sprague's Radio Service, Box 82, Gardiner, Me.

INSTRUMENTS TO TRADE—Will trade Jackson set tester model 637 and RCA oscillator type TMV-97-C. Want high-power sound system complete. Campbell Radio Service, 154 Woodland Ave., Campbell, Ohio.

WANTED FOR CASH—Full set of Rider's Manuals; late model condenser tester; pocket-size AC-DC voltmeter; table model AC-DC radios. L. W. Bakewell, 434 W. Locust St., Springfield, Mo.

SHORT WAVE RADIO WANTED—Will pay cash for good s-w set up to five years old. Robert Mulligan, 501 Park Ave., Bridgeport, Conn.

CATHODE-RAY TUBE WANTED—Any size; may have defective screen. Also want RCA type 930 phototube. Give condition and cash price. Philip J. Allen, 520 McKee St., State College, Pa.

EQUIPMENT WANTED—Want Solar capacity & resistance bridge. Rider's Manuals, set analyzer, midget sets with or without cabinets; also tubes of the types that are slow sellers. Latter must be new in sealed cartons. Will pay cash. Roda Radio-Electric Service, 2130 Westchester Ave., Bronx, New York.

P.A. EQUIPMENT TO SWAP OR SELL—Have 3' and 6' trumpets and P.M. driving units; fan belt A-C generator and much other P.A. equipment. We are urgently in need of test equipment for our pre-induction training classes. Send details. Platten Radio Co., 407 Dousman St., Green Bay, Wisc.

EQUIPMENT FOR SALE—1 Radio City Products portable tube tester model No. 307; 1 ditto model No. 304; 1 Philco signal generator, battery operated; 2 Jewell 7" meters; 1 Supreme No. 585 diagnometer; also 100 used tubes of various types. Frank G. Foy, 7200 Ridge Boulevard, Brooklyn, New York, N. Y.

WANTED—Need oscillograph, tube checker, voltohmmeter, or most anything in testing equipment, manuals and books. Also want short-wave radio. Make or condition not important. Cash or trade. Advise what you have and what is wanted. Glenn Watt, Chanute, Kans.

INSTRUMENTS WANTED—Want to buy a tube tester, signal generator, and a voltohmmeter. Send full details and price. Wm. A. Wagner, 3814 Faversham Rd., Cleveland Heights, Ohio.

TUBES, PARTS, RADIOS FOR SALE—Have to leave for induction within a month and am offering all my materials at low prices. Send list of parts needed and prices you expect to pay. Geo. Musico, 1880 West 12th St., Brooklyn, New York.

WILL SELL OR TRADE—Meissner television set with tubes, but no cabinet; Savage 12 gauge over-and-under gun, like new. Want 2" or 3" scope, chanalyst, manuals, voltohmyst, or any good test eqpt. John Repa, Jr., Main St., Richlandtown, Pa.

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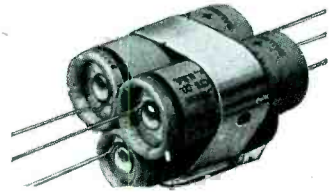
It pays doubly to use Sprague Atom Midget Dry Electrolytics on EVERY job these days! Atoms are still obtainable from Sprague distributors. Atoms always fit—even in the most crowded chassis.

Atoms come in a variety of single sections as well as in multi-capacity units. Several Atoms can be strapped or taped together (as illustrated) to give you a quick, inexpensive answer to any hard-to-get condenser replacement problem. Above all, Atoms are fully dependable for ANY replacement up to the full limits of their ratings. Ask for them by name!



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North Adams, Mass.

SPRAGUE CONDENSERS AND KOOLOHM RESISTORS

Obviously, Sprague cannot assume any responsibility for, or guarantee goods, etc., which might be sold or exchanged through above classified advertisements

If they win ...only our dead are free

These are our enemies.

They have only one idea — to kill, and kill, and kill, until they conquer the world.

Then, by the whip, the sword and the gallows, they will rule.

No longer will you be free to speak or write your thoughts, to worship God in your own way.

Only our dead will be free. Only the host who will fall before the enemy will know peace

Civilization will be set back a thousand years.

Make no mistake about it — you cannot think of this as other wars.

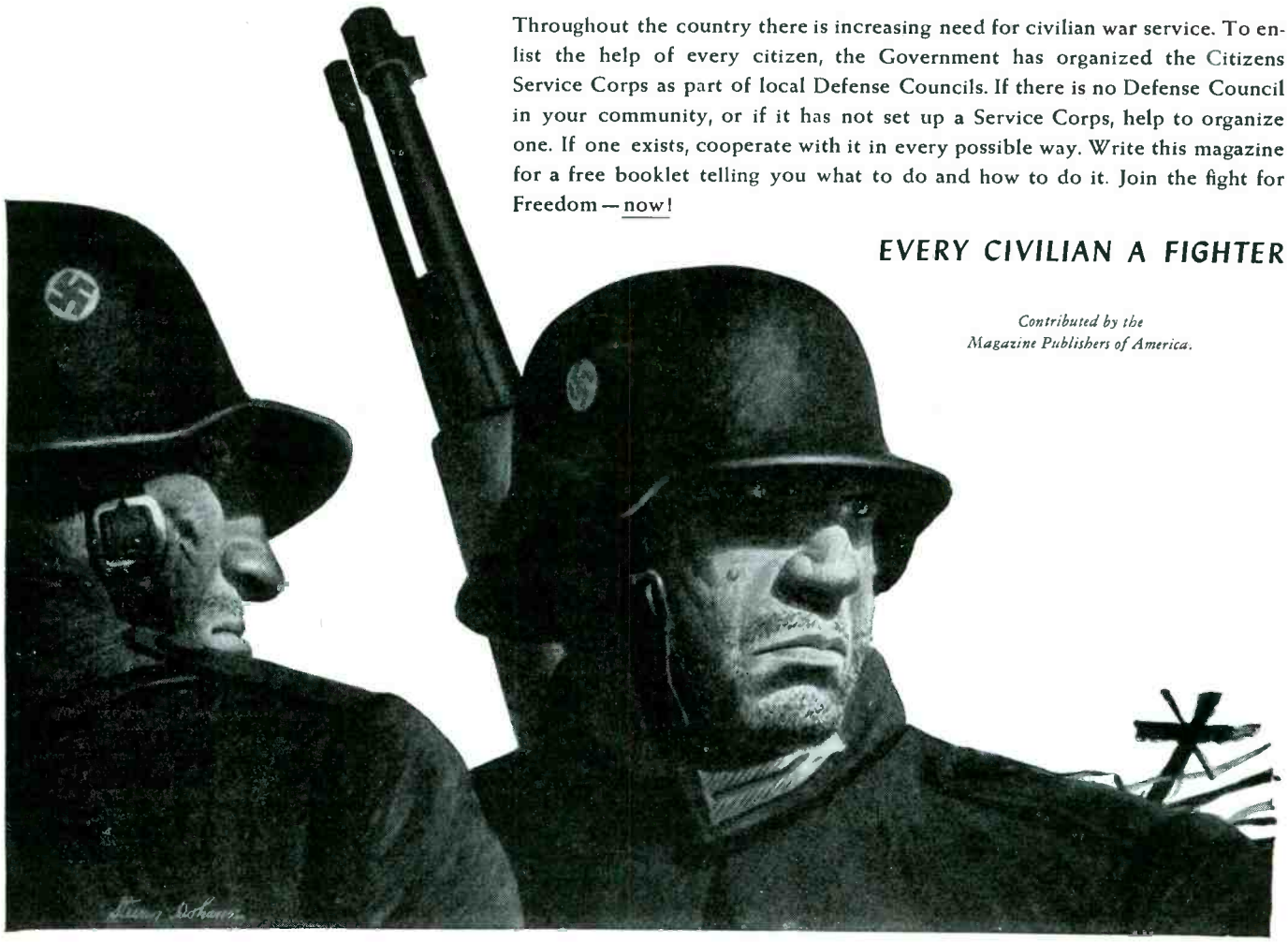
You cannot regard your foe this time simply as people with a wrong idea.

This time you win — or die. This time you get no second chance.

This time you free the world, or else you lose it.

Surely that is worth the best fight of your life

— worth anything that you can give or do.



Throughout the country there is increasing need for civilian war service. To enlist the help of every citizen, the Government has organized the Citizens Service Corps as part of local Defense Councils. If there is no Defense Council in your community, or if it has not set up a Service Corps, help to organize one. If one exists, cooperate with it in every possible way. Write this magazine for a free booklet telling you what to do and how to do it. Join the fight for Freedom — now!

EVERY CIVILIAN A FIGHTER

Contributed by the Magazine Publishers of America.

SERVICE
A Monthly Digest of Radio and Allied Maintenance

AN ANALYSIS OF RADIO-FREQUENCY INPUT CIRCUITS

By ALFRED A. GHIRARDI
Advisory Editor

ONE of the vital links in a receiver is the r-f input circuit. It is here that we can provide an effective signal input, control selectivity, etc.

For instance, with large signal voltages that are delivered by a large external antenna in urban locations, or in the vicinity of a strong station, more than one standard type of tuned circuit is needed to prevent interference. The additional tuning required is known as preselection and is usually followed by an r-f amplifier tube, although it need not be. Where an amplifier is used, better signal-to-noise ratio is obtainable in the converter, in addition to increased gain. The tuned r-f stage is, therefore, an excellent design feature. Incidentally, an r-f stage may be used without contributing any additional selectivity.

With a loop or antenna plate serving as the sole aerial, signal voltages are much lower than with external antennas. Thus preselection is usually not so vital and may often be omitted. If a strong station is present, however, there is no guarantee against interference, even though orienting the loop to minimum signal position usually helps. The great majority of a-c/d-c compacts and portables have no preselection. That they get by as well as they do is an excellent endorsement of the performance of the variable-mu or super control amplifier tubes which prevent cross-talk.[1]

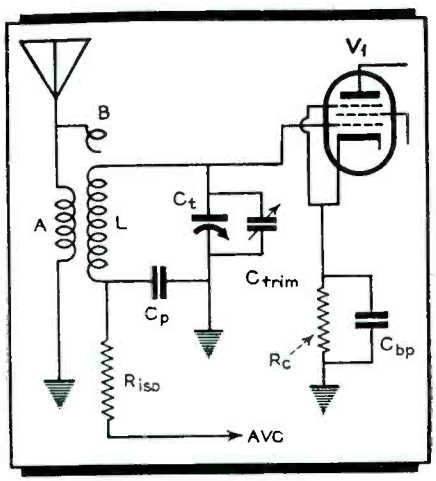


Fig. 1. External antenna coupling system using inductive and capacitive methods.

There are many methods and combinations of methods used to get signal voltage to the input grid while, at the same time, maintaining a reasonably high degree of selectivity in the input circuit. No single r-f transformer design is correct for all types of antennas so a *happy medium* compromise design must be used. Fig. 1 shows one of the most popular coupling systems for external antennas. It is a combination of inductive (or magnetic) and capacitive (or electrostatic) coupling, the capacity being provided by the link, or coupling turn *B*. Though this "capacitor" hardly resembles what we usually use for condensers, they are very useful in r-f or i-f interstage coupling transformers and for grid condensers in oscillator circuits.

The coil *A* in this circuit is often a concentrated universal or choke type winding below the tuning coil *L*. Typical inductance values run around 1.3 or 1.5 millihenries. This usually produces resonance or near-resonance near the low frequency end of the band and, hence, favors the low frequencies, whereas the capacity coupling favors the high frequency end. Thus, the percentage coupling can be made fairly uniform over entire band.

Another method of antenna coupling suitable for both loop sets and standard coil sets is shown in Fig. 2. Here, the antenna voltage is impressed upon C_{tank}, a common impedance element in both the antenna circuit and the first tuned circuit. This system would appear to favor the lower frequencies because the highs would be more easily bypassed to ground. But there is also an antenna series condenser, C_{ant}, which passes high frequencies more readily than low, thus striking a balance. In this circuit R_2 is used to minimize hum modulation in power-line operated receivers. Antennas sometimes act similarly to an open grid in producing annoying hum modulation. This can be eliminated by keep-

Fig. 2. Antenna coupling method suitable for loop and standard receivers.

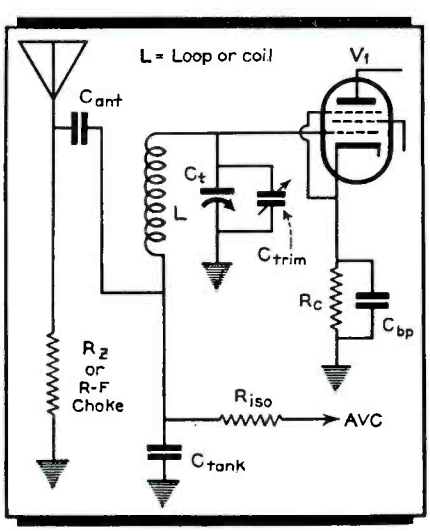
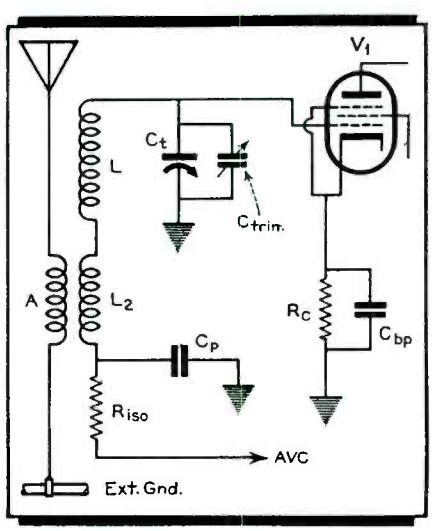


Fig. 3. Loop set coupling with low-impedance loop.



1 Bartholy, SERVICE, March, 1942.

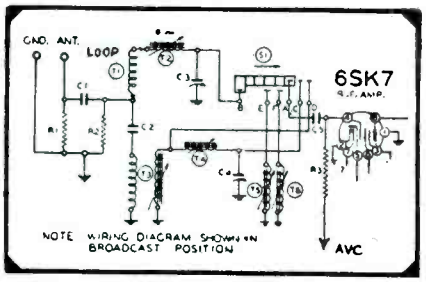


Fig. 4. Input system with high-pass resistance filter.

ing them at d-c ground potential. C_{tank} is part of the tuning circuit consisting of the coil, or loop, and the variable condenser. Hence, the variable capacity must be larger than usual in this application.

The most common method of coupling an external antenna to a loop receiver is an inductive one using a small high Z primary coil, as shown in Fig. 8. Another popular method uses a low Z primary consisting of a single turn wound around the loop. This is often used in portables, as shown in Fig. 5.

Fig. 3 shows another method of coupling to a loop set. A low impedance loop of comparatively few turns, L, is placed in series with a high Q loading coil L_2 to which the antenna is inductively coupled. Fig. 4, taken from Ward's Airline model 14BR911A, is a sort of combination of Fig. 2 and Fig. 3 with a high pass resistance filter added. We have here a set of permeability tuned elements for broadcast and several short-wave bands. For b-c, a low Z loop is used in series with the tuning element and another small inductance which serves as the primary of T_3, the short-wave input transformer. The external aerial is fed into the loop circuit in auto-transformer fashion to a low Z tap. In short-wave operation, the antenna is conventional, feeding the transformer through C_2. The highest waveband makes use of two inductors in series (T_3 and T_4), next lower band uses T_3 only and the two lowest bands are obtained by using shunts T_5 and T_6, all in all a very novel system. These coils are all grounded, being capacity-coupled into the i-f amplifier by C_5. The antenna filter prevents resonance peaks which would cause too tight a coupling and possibly introduce interference problems around the resonant frequencies (harmonics of the antenna frequency are included). The high-pass filter favors the short-wave pickup.

Many portable sets have, as a useful accessory, an external loop which may

Fig. 6. Low-impedance method of directly coupling loop.

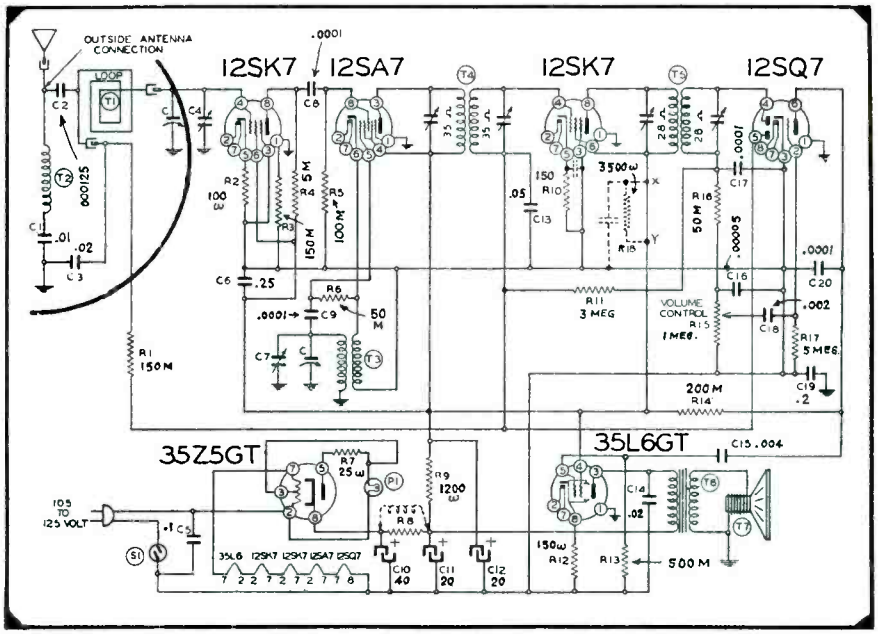
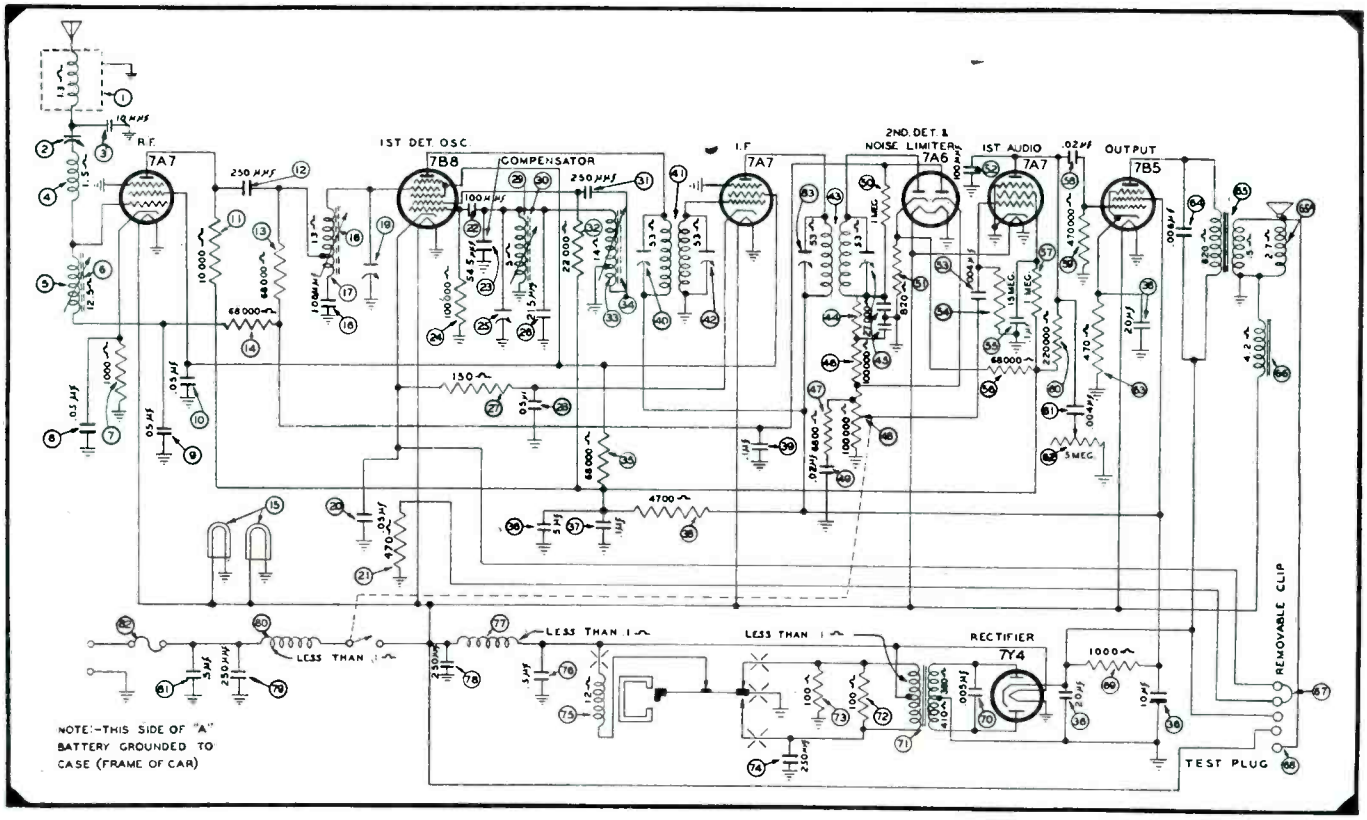


Fig. 6 (below). Portable receiver using a low Z primary for coupling



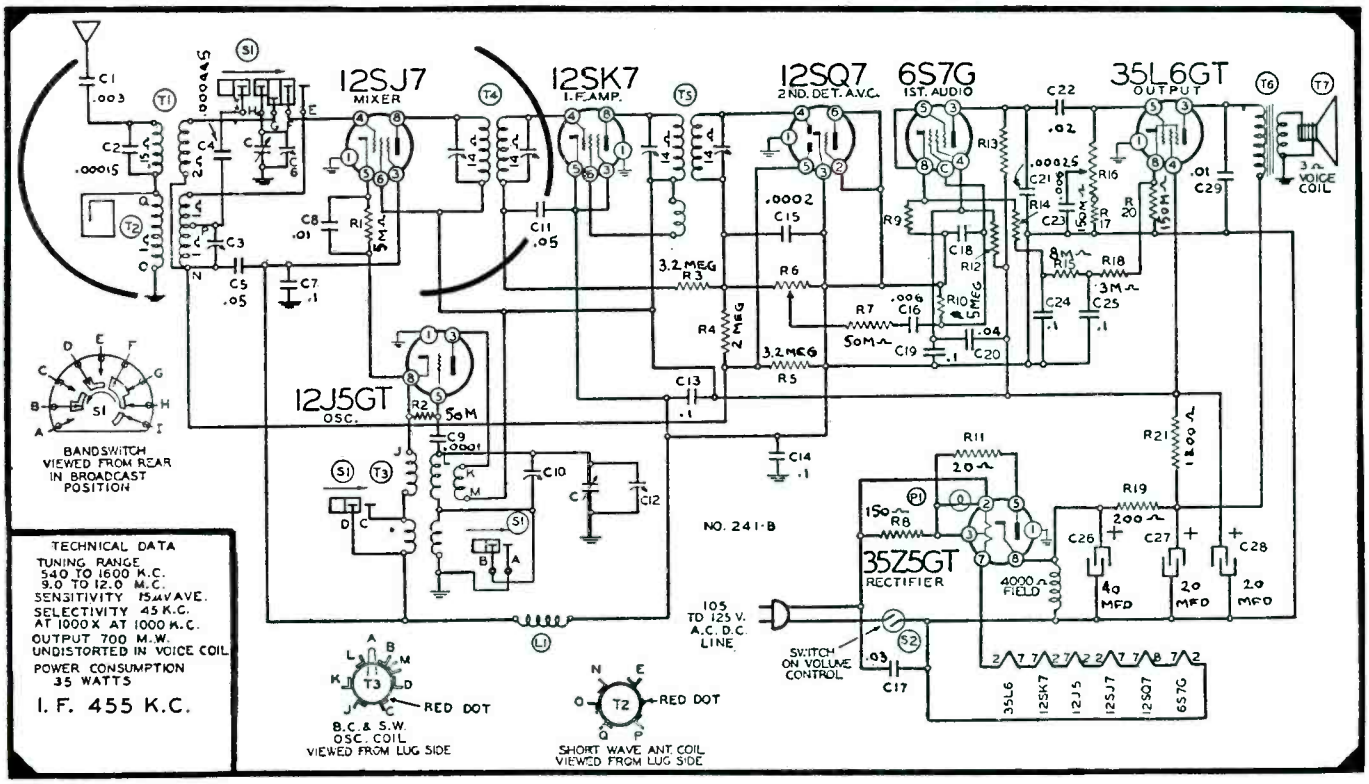


Fig. 7. Two-band switching system using a short wire for short-wave reception.

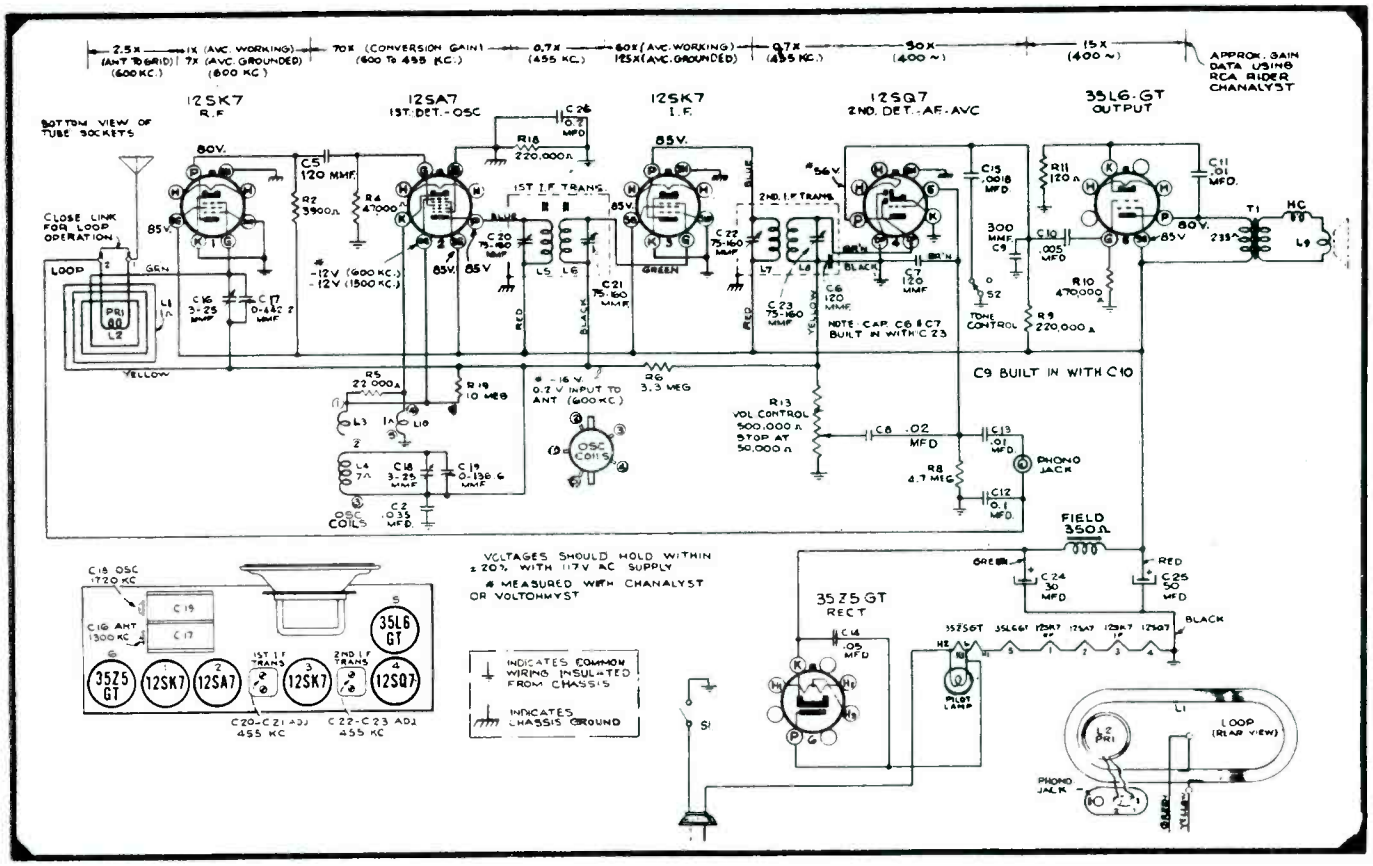
be plugged in when reception on the self-contained loop is poor due to signal shielding effects, as in cars, steel buildings. Fig. 5 shows such a receiver, Silvertone 7085 and 7090. An adjustable high-Q loading coil is used for trimming the low frequency end. (C_1 is the high frequency trimmer.) The fixed loop is provided with a one-turn antenna primary for coupling to an external antenna.

Fig. 6 shows a low impedance method of directly coupling the loop to an external aerial, again as an auto-transformer. This circuit also serves to introduce the subject of i-f interference, in that it includes a wave trap tuned to the intermediate frequency (T_2 and C_1).

Fig. 8. A resistance-coupled first detector method.

I-F Interference

Although a discussion of i-f amplifiers is not within the scope of this



article, the input circuits have the function of preventing i-f pickup. Among the benefits of preselection is the remote chance of transferring signals of i-f from the antenna to converter tube. Where adequate coil and tube shielding is used, a 3-gang variable or the equivalent permeability tuned system used in a t-r-f stage precludes the possibility of i-f interference in all but extreme cases. No wave trap is required. On the other hand, where preselection is absent and a large external antenna is used, interference will almost certainly be experienced unless a wave trap is used. In coastal and Great Lakes areas where some commercial stations operate at these i-f's very often even the best wave trap is not good enough. Cheap sets usually have insufficient shielding and the direct i-f pickup from these unshielded parts may be sufficient to pick up these commercial stations regardless of antenna wave traps, or even preselection circuits.

In Fig. 9, we have a receiver in which a wave trap has been placed between the plate of the r-f stage and ground. Often, they are placed at the converter grid, on the other side of the coupling condenser. These traps take care of i-f pickup in the r-f tube, as well as the input circuits, except that non-linearity of the r-f amplifier may produce modulation effects so that the i-f signal might ride through on the carrier of a station. In such a case, it would not be trapped.

Fig. 7 shows a 2-band switching system and the use of a short wire for

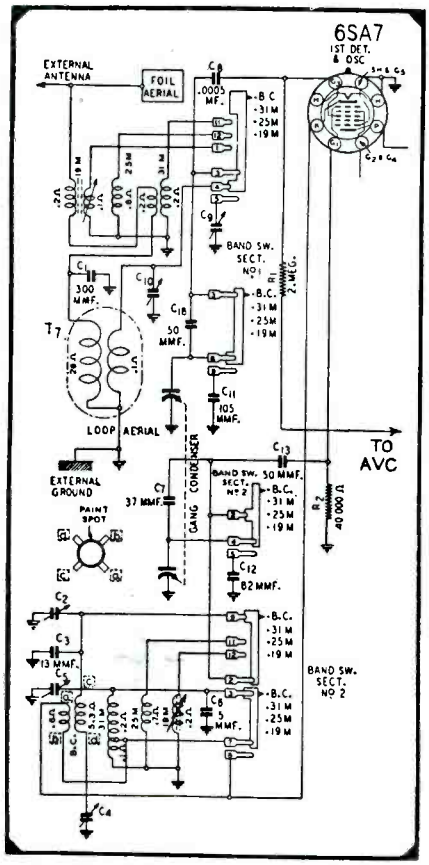


Fig. 10. Foil antenna system feeding two short-wave primaries and a loop primary.

short-wave reception where an outside aerial is not used. The broadcast transformer is at the top and short-wave unit is below. C_2, which is comparatively ineffective at broadcast frequencies, bypasses the short-wave signals with little loss. The secondaries to the mixer grid and the tuning condenser are switched so that, on short-waves, the condenser shunts only part of the secondary for bandspreading.

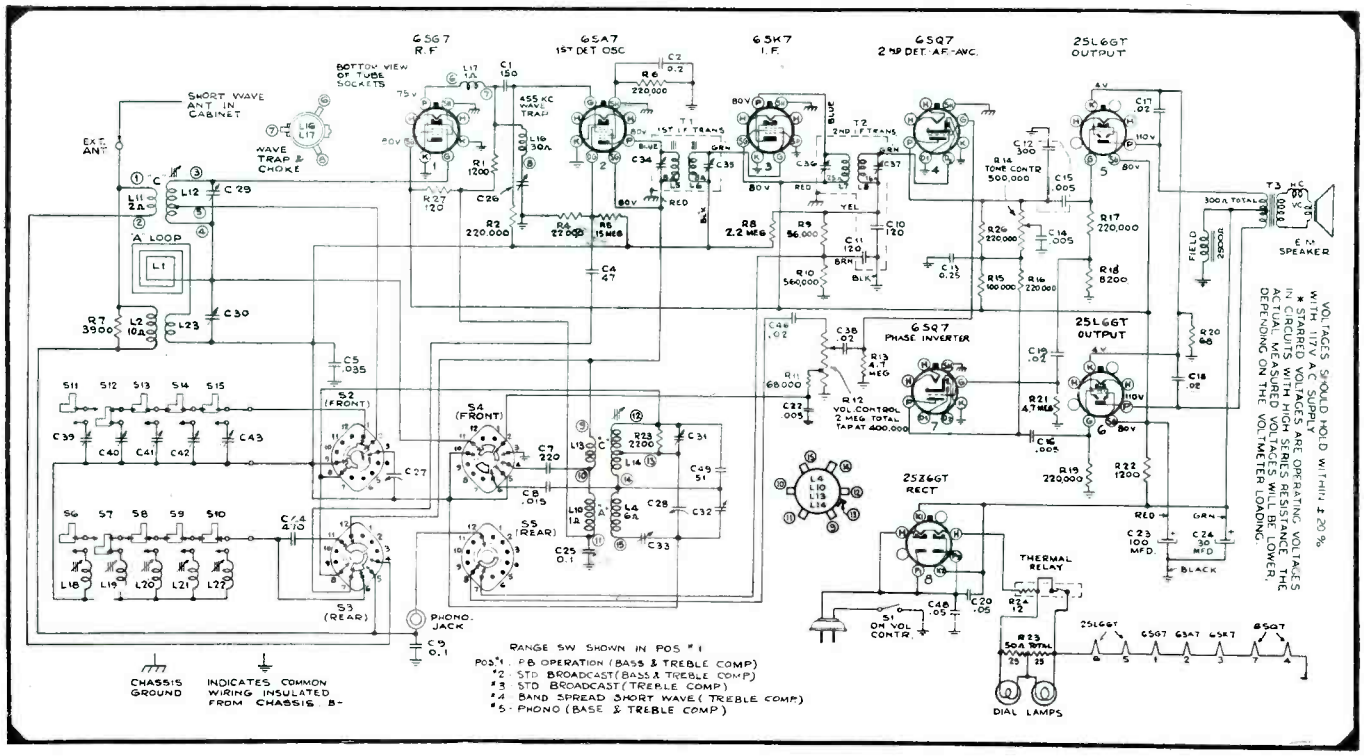
Untuned Detectors

In the past few years untuned first detectors used with a preceding r-f stage have been common. Only a 2-gang condenser is used, for r-f input and oscillator. There is little, if any, gain in selectivity, over the simpler sets without the r-f tube. Fig. 8 shows a typical receiver of this type, the RCA Victor 36X, which uses a straight resistance coupled first detector. We have already referred to the antenna coupling to the loop. It is important that the primary coil be shorted for loop operation to prevent absorption of signals from the loop at any resonant point of the primary coil.

Fig. 9 shows Westinghouse receiver, WR-12X16, with a small plate choke and a wave trap added to the simple resistance coupled stage. With an untunable detector there is ample opportunity to include an equalizer to favor the gain at one end or the other in the frequency range. This set uses a short antenna wound around the console feeding a short-wave transformer (on top) and a broadcast coil (at bottom). On broadcast, the circuit of Fig. 3 is employed. A set of five push-buttons with individual condensers for r-f tuning (and tuned coils for oscillator tuning) is provided. The tuning condenser is connected to a tap on the

(*Continued on page 27*)

Fig. 9. A small plate choke and wave trap are included in this resistance-coupled input to the detector stage.



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INTERCOMMUNICATION SPEEDS WAR INDUSTRY

By F. D. WILSON

Sales Manager, Commercial Sound Division,
Operadio Manufacturing Co.

For direct, personal communication between executives, department heads and secretarial assistants, an intercommunication system made up of two or more desk units, will result in an almost unbelievable saving in man-hours daily. Such systems have come into tremendous demand by both small and large industrial concerns, whose facilities and personnel are strained to the utmost to produce vitally needed war material. Many of these concerns have lost valuable men to the armed forces, and at the same time production must be raised higher than ever before.

The management of these plants have in most cases examined all departments in an effort to eliminate delays and bottlenecks. The plants have been expanded, and new buildings have been built. These new buildings or departments required new telephones, as long as they were available. At best, the average plant switchboard today is grossly overloaded. One of the serious bottlenecks in many plants is this *switchboard blockade,* and one of the obvious means they are taking to relieve it is the intercommunication system.

The savings, both in critical man-hours and in dollars obtained by the use of an intercommunication system, are apparent in a great may ways, and are readily demonstrated to the plant management. Suppose, for instance, a plant manager receives a long distance call from a subcontractor desiring immediate information on some product, delivery of material, etc., as production is in danger of being held up. The executive, while holding the phone, turns to his *i-c* unit, punches the button for his chief engineer or production manager, and receives an instant reply. Thus, in a matter of seconds, the proper information is relayed to the subcontractor, and he acts promptly on it.

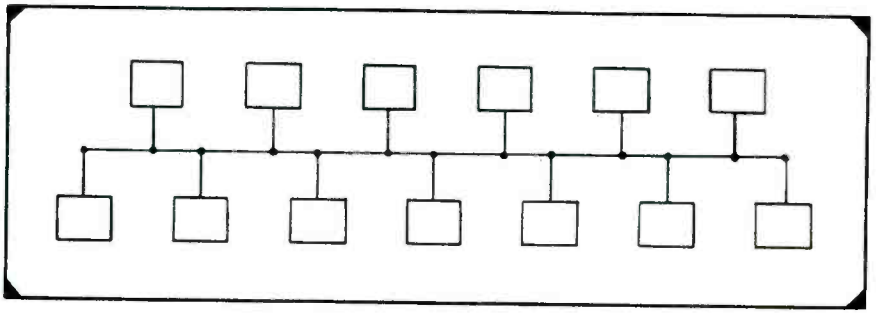


Fig. 2. Executive intercommunication system hookup.

Without the intercommunication system, in all probability the executive would be unable to reach his assistant, precious time would be wasted trying to get in touch with him, or he would have to phone his caller back later and give him the needed information. Thus we have the added expense of another phone call. It also places one more long distance call over the nation's already crowded trunk lines, a call that could have been eliminated.

In Fig. 1 appears a master station unit and a matching speaker station used for outlying positions. The master station, equipped with 12 push-button station selectors, is capable of calling and intercommunicating with 12 other master stations. The operation is simplicity itself; the buttons are all labeled with the names of other executives who also have units. To call another office, the proper push button is punched and the name announced in probably the following manner: "Harry; Jones calling." Harry then punches Jones' button on his set, and they are in private conversation. When finished, both press the release button at the bottom and the connection is broken.

While they are talking in this manner, no one else overhears their conversation, there is no eavesdropping, and a telephone line needed for outside calls is free. A third party is unable to come into their conversation until they in turn punch his button on their units, and bring him into a conference hook-up. Then all three may hear and talk to each other, and a conference may be held with each man in his own office, at his own desk, with all his pertinent data in front of him.

In Fig. 2, an executive hookup of this nature is shown. Besides this executive hook-up, these same units are also used for what is called *supervisory service* (Fig. 3). For this use, one master can be connected to 12 outlying speaker stations. It can be used to call any of them individually, or in groups, to issue instructions or obtain information. When a speaker is called by the master station, the party called can answer from any point in the room. He need not walk to the speaker, and need not interrupt his work to answer. Also, by attaching a "call switch" to such a speaker, people in that department are able to call the master station, and originate a conversation.

With these units it is also possible to combine the executive and supervisory services described above (Fig. 4). Six masters, say, may be intercommunicating, that is each may call the other, and at the same time each of the masters may be connected in a

Fig. 1(a). Speaker unit for master station system.

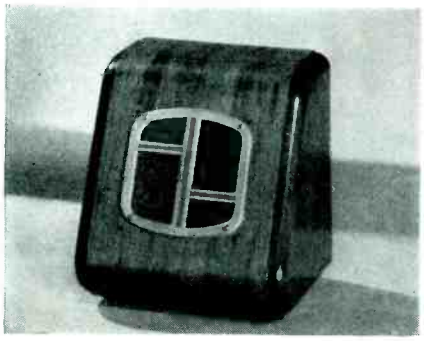
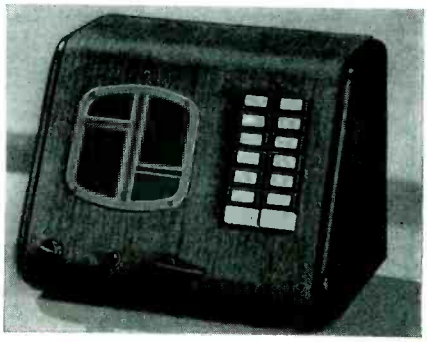


Fig. 1(b). Master station unit with twelve selectors.



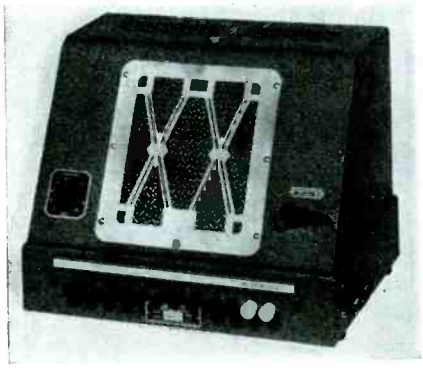
supervisory capacity with up to seven speaker stations. In this case each of the seven speakers will be able to hear, or communicate with their own master only.

Each master station contains its own amplifier, and power is transmitted from it to actuate the speaker of the distant master, or speaker station. A combination power switch and volume control regulates the volume for varying noise conditions, and a pilot bulb indicates when the unit is in operation.

The intercommuncation system is not intended to substitute for the telephone, but rather to extend its usefulness, and to augment the service which it gives. With the critical need of important war agencies for telephone service, it is now often impractical for departments of a company to have more than one telephone line serving that department. So, if a call is received from another department or outside, the party called is unable to confer with any other department for information. With the *i-c* unit he can talk to other officials, even with his telephone busy. This ready access to other departments reduces the number of trunk lines and switchboard space needed, reduces the number of outside calls, and reduces considerably the toll charges for *holding the wire*.

One firm of business consultants in Rockford, Ill., advise that they were able to discontinue the use of a central switchboard with its operator, and instead now employ three trunk lines, a secretary announcing calls over an *i-c* unit to the proper executive. In this case both the switchboard and the operator were released for important war work in a plant where the critical material and the girl were sorely needed.

Fig. 5. Intercommunication and paging unit.



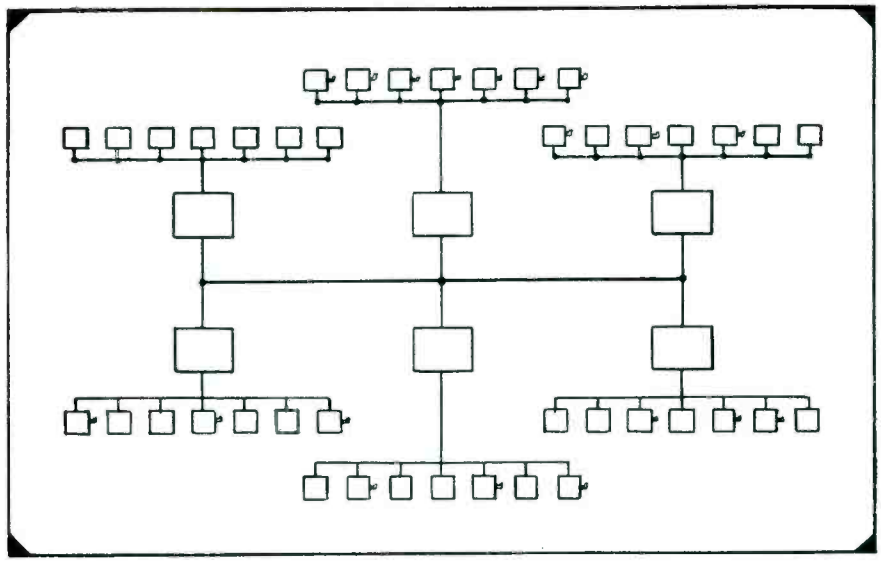
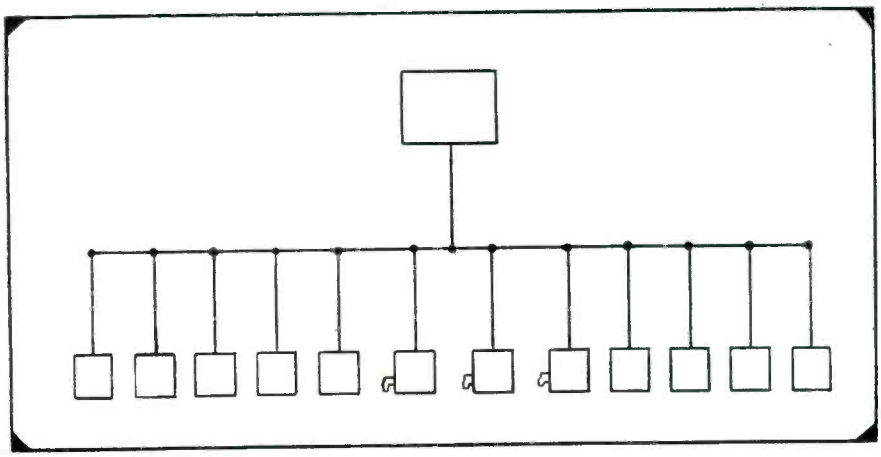


Fig. 4. Combined executive and supervisory-service system.

There is also another type of system which is used for both intercommunication and paging, combined (Fig. 5).

These masters have a rated output of 8 watts, and a maximum output of 15 watts. They are designed for supervisory service primarily, and have sufficient power to operate heavier speakers in noisy factory areas, for paging service. For small plants, machine shops, warehouses, etc., these units render very efficient service over higher noise levels. Each master may call ten outlying speakers. Formerly an almost unlimited number of speakers could be called by adding additional banks of switches, in groups of ten. This practice, however, has been discontinued in favor of standard models for the duration.

Fig. 3. Supervisory-service intercommunication hookup.



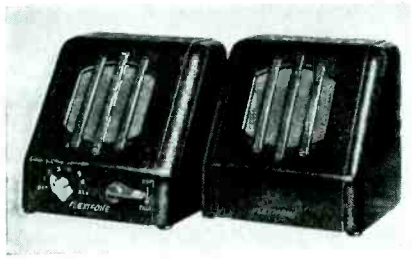


Fig. 6. Consumer and professional type intercommunication units.

A third type, brought out just before the war, is shown in Fig. 6. This is undoubtedly a preview of models that will be used for communication in private homes of the future. This is a very inexpensive system, used where one master must talk with one or more speaker stations. The price range of these units is such that many hundreds have been installed in doctor's and lawyer's offices, grocery, hardware and furniture stores, etc.

The installing and servicing of intercommunication systems presents to the Service Men of the country an opportunity to be of genuine service to war production. Good communication between departments is a prime requisite to good production, and the cheapest method of providing good communication is the *i-c* system. There is very little maintenance expense. The only maintenance item is usually an occasional tube. Installation is quite simple; one pair of coded wires is run to each unit in the system. Such wire is available in cables of 7-pair and 13-pair.

Almost every business magazine now carries copy designed to educate war plant managers in the coordination and man-hours that may be saved by better intercommunication between departments. Many Service Men have

(*Continued on page 32*)

SER-CUITS

By HENRY HOWARD

A VERY popular and effective receiver design feature included in many of the later type receivers is the resistance coupled i-f system. It appears in the table and console type units. An interesting example of this method is found in Truetone's model D1104 7-tube, 3-band receiver shown in Fig. 1. There are two i-f stages here with resistance coupling between them. A 6SJ7 is used as the first detector fed by a 6J5GT oscillator through cathode-to-cathode coupling. On the shortest wave band, plate feedback is used in addition to the common cathode tap to obtain sufficient amplitude for high conversion gain in the converter tube. A 7 mmfd coupling condenser is used between oscillator plate and detector grid.

While this set comes without a record player, provision is made for easily adopting one. Besides the usual phono socket, a changeover switch is located in the rear of the chassis which kills the r-f gain of the receiver in addition

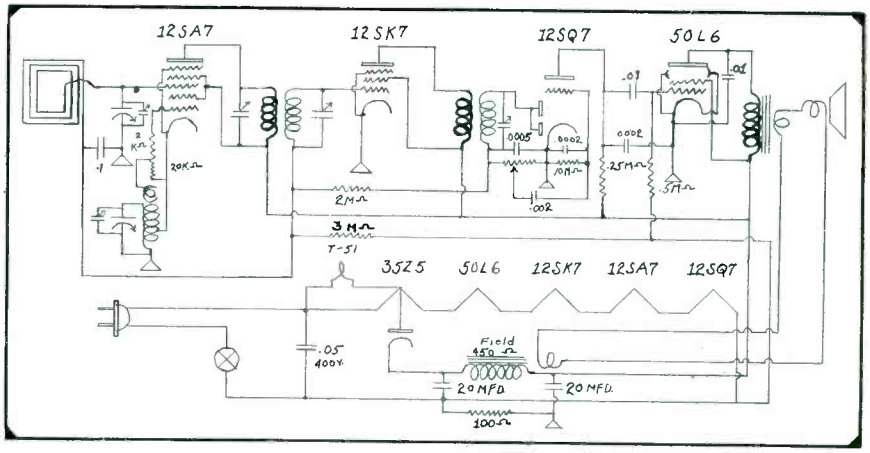


Fig. 2 (right). Automatic Radio 202-206 with 2000-ohm grid resistor to flatten oscillator output voltage.

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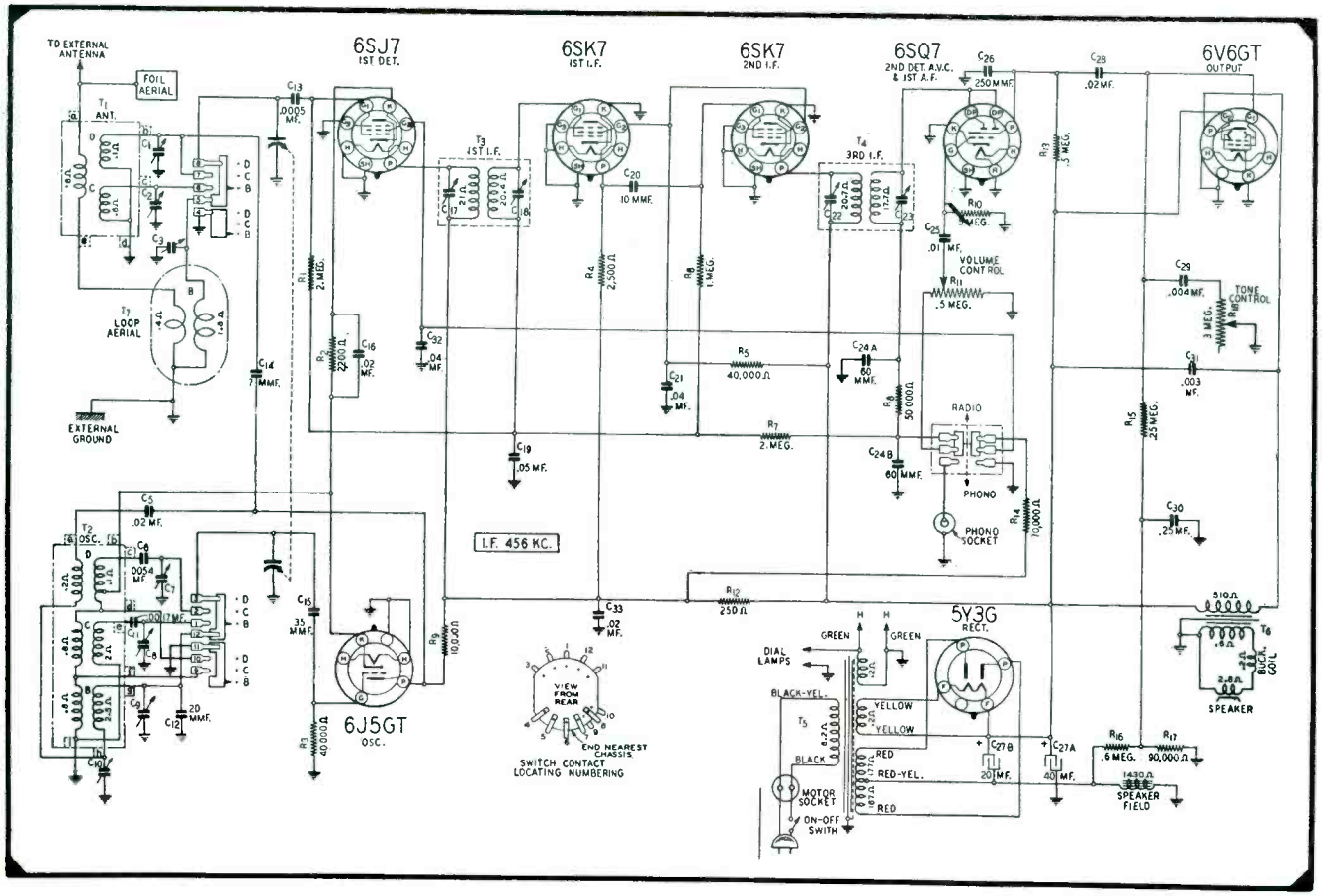
Fig. 1 (below). Truetone D1104, featuring resistance-coupled i-f system.



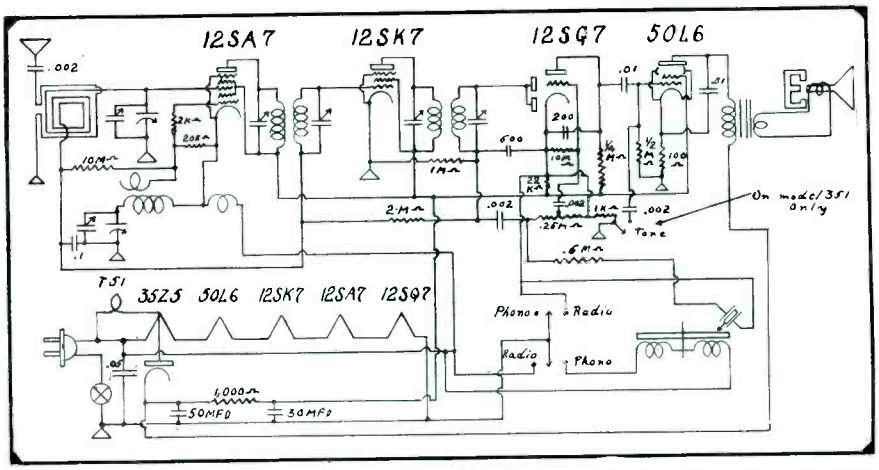


Fig. 3. Automatic Radio 245-351 with 10-megohm biasing resistor in oscillator grid.

to switching over the amplifier. The second grid of the 6SJ7 is removed from plus B and grounded, thereby making the first detector inoperative.

Automatic Radio 202-206

In the Automatic Radio models 202-206 (Fig. 2), a 2000-ohm grid resistor is used to flatten the oscillator output voltage with a change in frequency to provide constant converter gain. The resistor, combined with the 20,000-ohm grid leak, forms a potentiometer with the grid lead to the oscillator coil tapped down 9% from the grid end. The beam-power tube grid bias is obtained by means of a 100-ohm resistor in the *B* leg. This bias point also serves to bias the avc bus through a 3-megohm resistor.

Automatic Radio 245-351

The Automatic Radio 245-351 small phono models, (Fig. 3), employ a 10-megohm biasing resistor from the oscillator grid circuit to the avc bus for initial bias. The grid potentiometer is also used in these models.

Automatic Radio P77

The Automatic model P77, (Fig. 4), is a portable, featuring battery rejuvenation. Both *A* and *B* batteries float on the rectifier output and can be recharged by the rectifier when they have become too weak to operate the set. Instructions call for leaving the batteries on charge 25 to 30 hours. This is done by throwing a switch which turns off the filaments, but permits the rectifier tube to operate. It is claimed that the batteries will then operate the receiver for an additional 20 to 25 hours, at the end of which time the charging may be repeated. This rejuvenation may be repeated many times making it possible to get two to five times normal life of the batteries under ordinary conditions. This should be handy, to squeeze out a few remaining hours from any portable, lucky enough to still have unswelled batteries.

A 25Z6GT rectifier with a protective resistor is used, this being in series with each plate and with a pilot lamp in series with the filament rectifier element. When the set is plugged into a power line, it will start operating immediately from battery power until the pilot light starts to glow, which indicates that the rectifier has taken over and the batteries are floating. If no batteries are connected, the set will take the usual minute or so to get going.

Fig. 4. Automatic Radio P77 portable, featuring battery rejuvenation system.

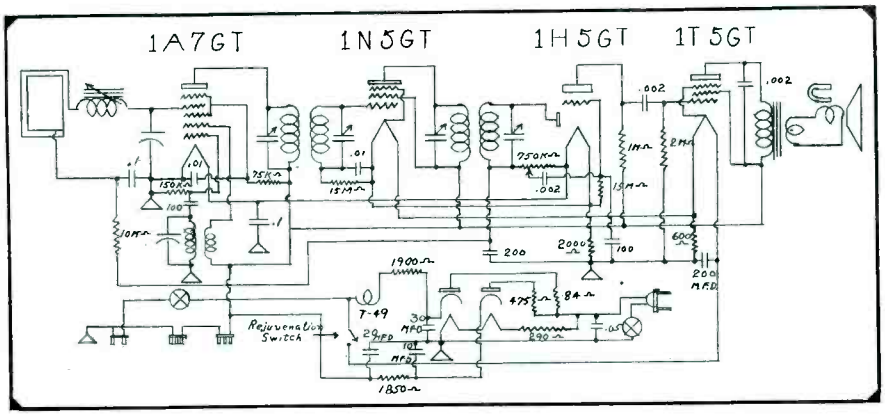
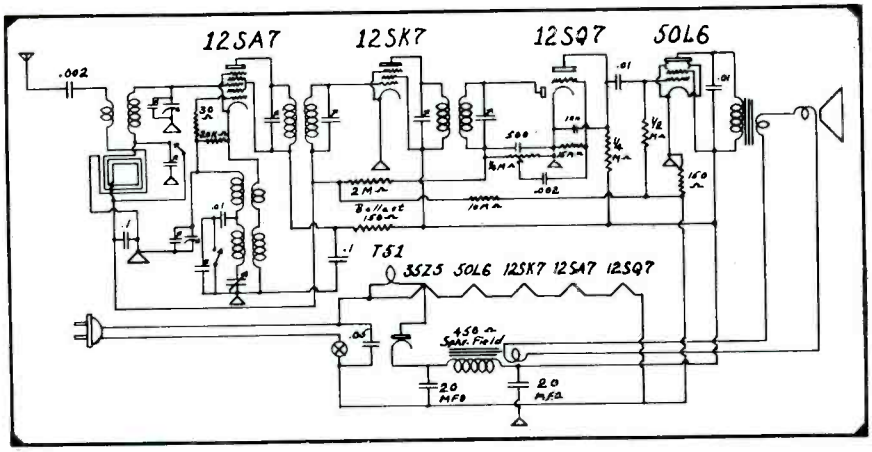


Fig. 5. Automatic Radio 215-220 with simple yet effective broadcast-to-short-wave switching system.



Automatic 215-220

Automatic model 215-200, Fig. 5, has a simple broadcast-to-short-wave switching system. The broadcast loop antenna is in series with the short-wave transformer secondary and the loop is simply shorted for the short-wave position. The same stunt is used in the oscillator, but a .01 mfd blocking condenser is included in the shorting circuit to prevent disturbance of the d-c grid potential. A 30-ohm resistor is in series with the grid.

Wells-Gardner 6B23-1

A 6-tube battery and line-powered receiver in which the designers paid a great deal of attention to details is shown in Fig. 6. The set contains both broadcast and short-wave loops and an efficient tuned r-f stage. The band-switch is located on the right side of the cabinet, being operated by a lever. In the antenna circuit, the broadcast loop (lower one) has a tap to which the trimmer is connected. This tapping down makes the trimmer tuning less critical. Across the short-wave loop (on top) is a variable inductor shunt and a 35 mmfd fixed condenser in addition to the trimmer. The 3-gang tuning condenser has a series

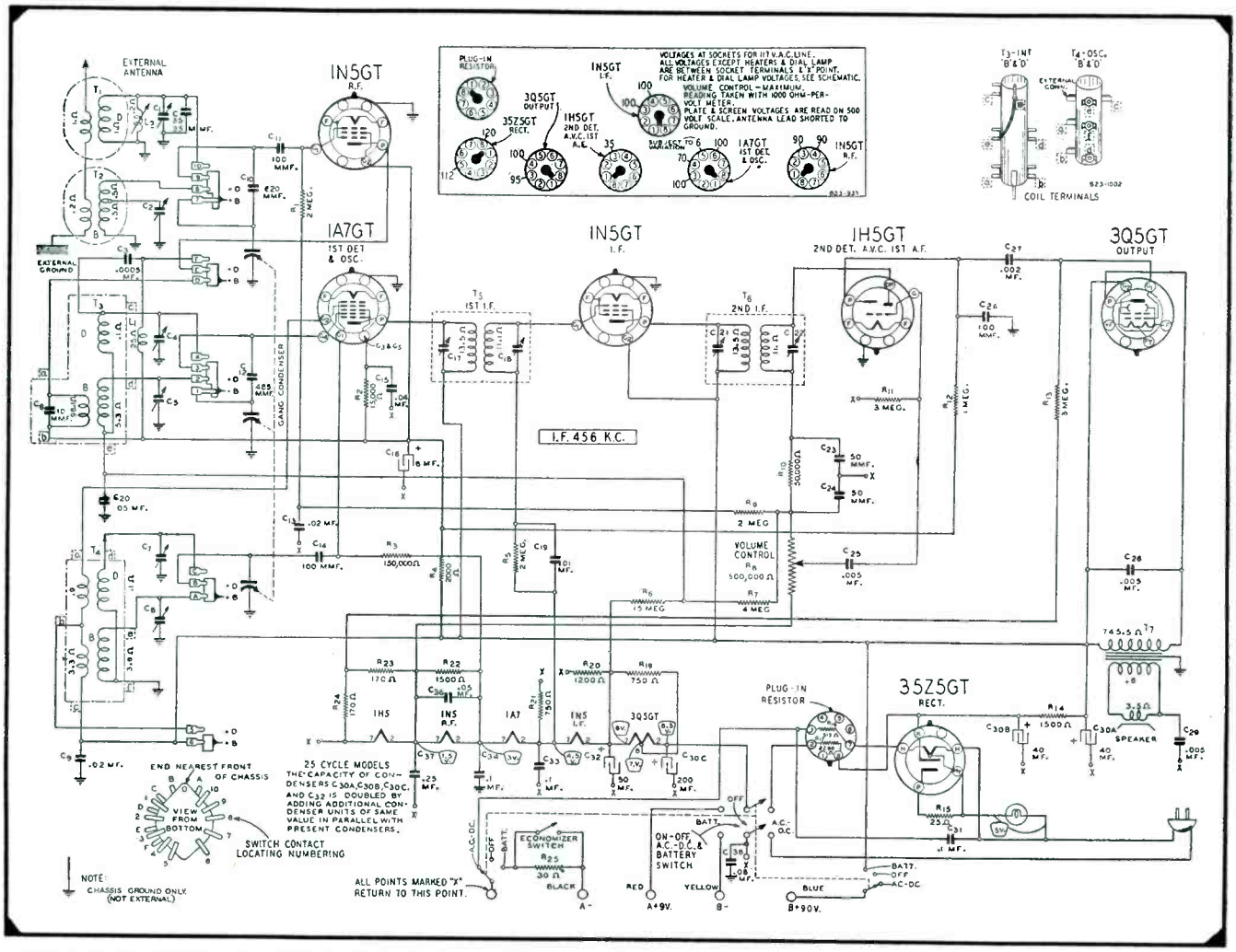
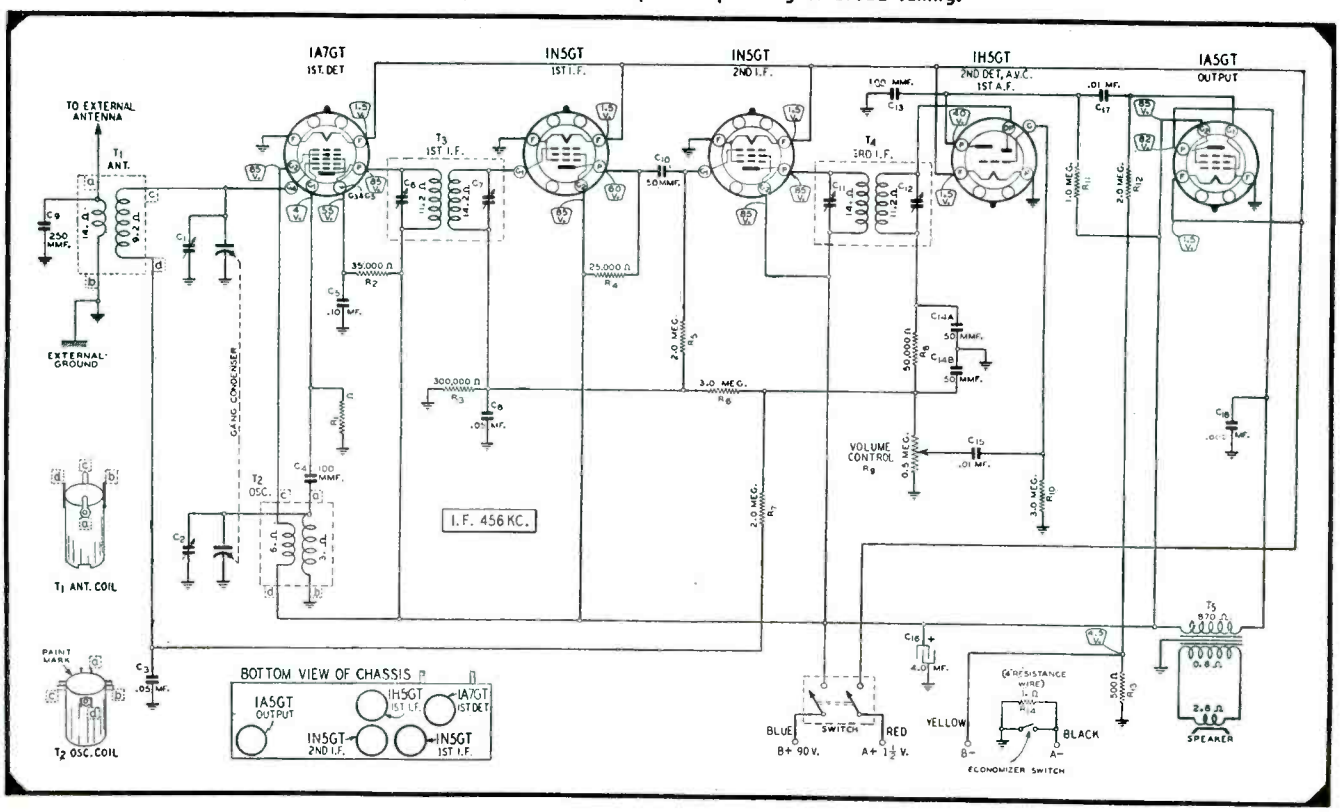


Fig. 6 (top). Well-Gardner 6B23-1, 6-tube battery and line-powered receiver, with broadcast and short-wave loops. Note the variable inductor shunt across the short-wave loop, and a 35-mmfd fixed condenser in addition to the trimmer. Fig. 7 (below). Wells-Gardner 5B17-1. A 250-mmfd bypass condenser is used from the external antenna circuit to chassis ground to reduce signal intensity at high-frequency end of band to prevent jamming or broad tuning.



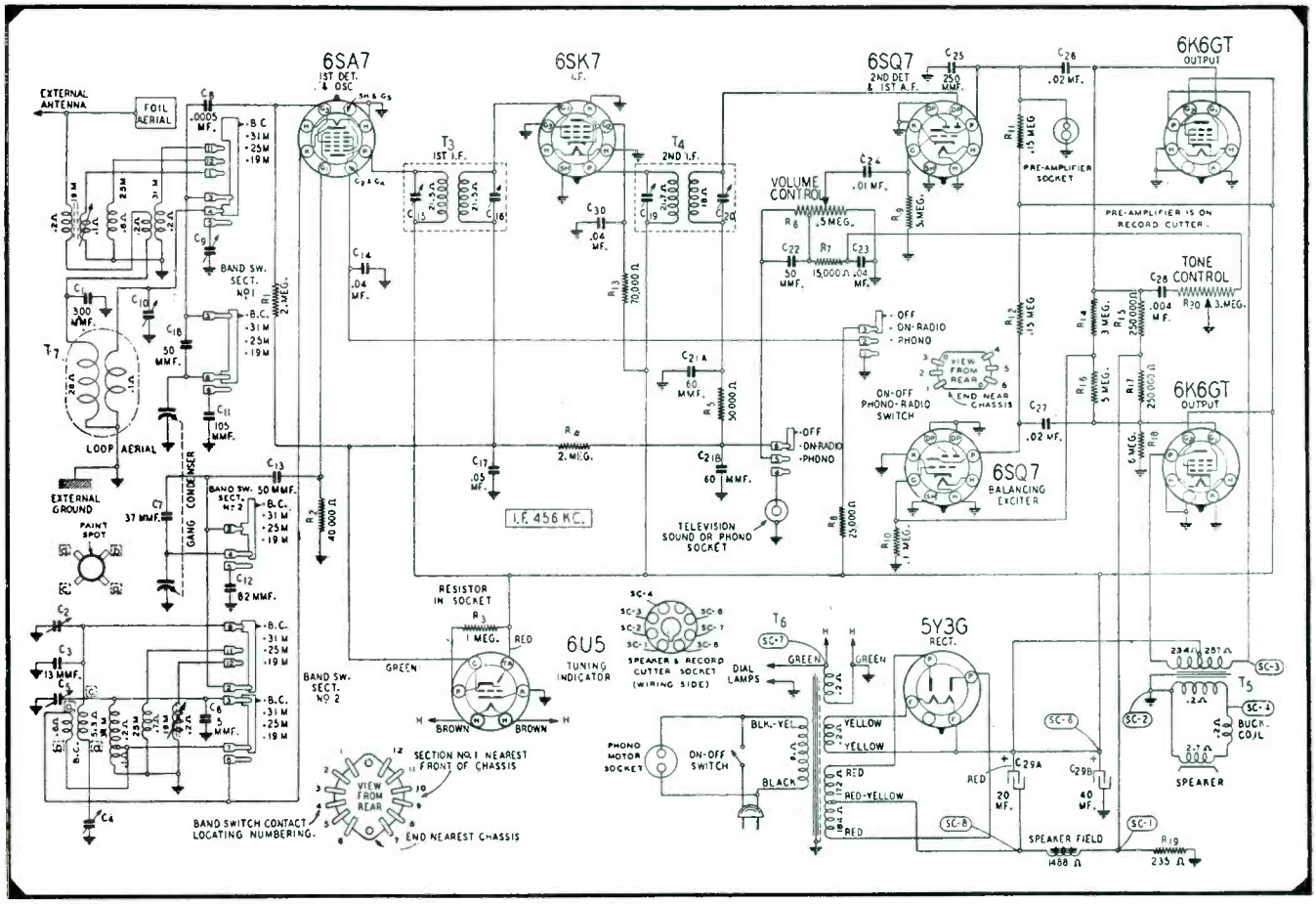
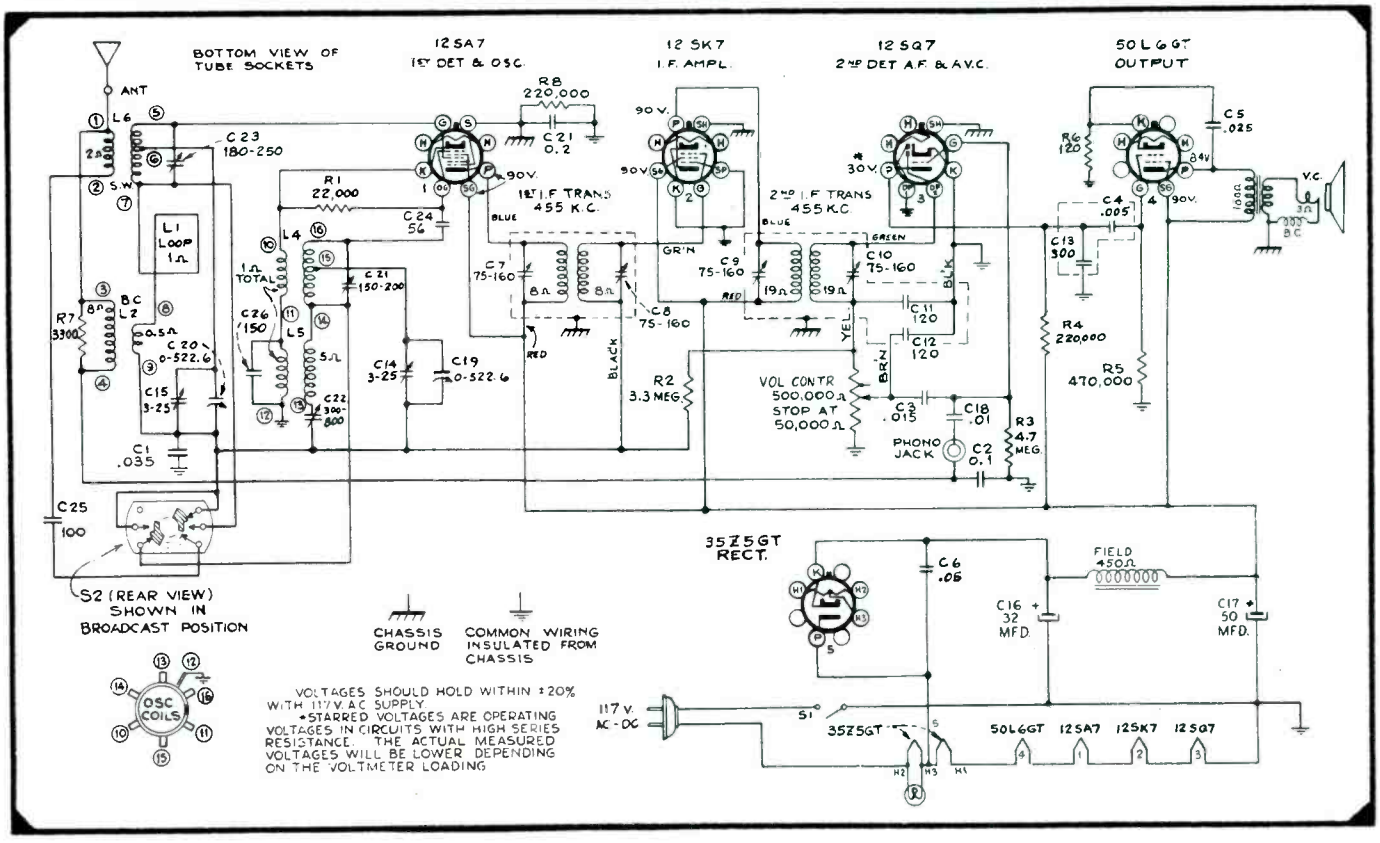


Fig. 8. Airline 14WG-808, 8-tube, 4-band record changer receiver, using a foil antenna.

Fig. 9. Westinghouse WR-12X8, using loop between broadcast and short-wave antenna transformers.

condenser of 620 mmfd in the antenna tuning circuit; a 485 mmfd fixed condenser in the first detector tuning circuit relies on only a shunt trimmer to keep the oscillator in step on the short-wave band. These series capacitors are shorted in the broadcast position.

The plate of the r-f amplifier as well as the grid of the first detector is reversed, and separate r-f transformers are used. A 10 mmfd shunt



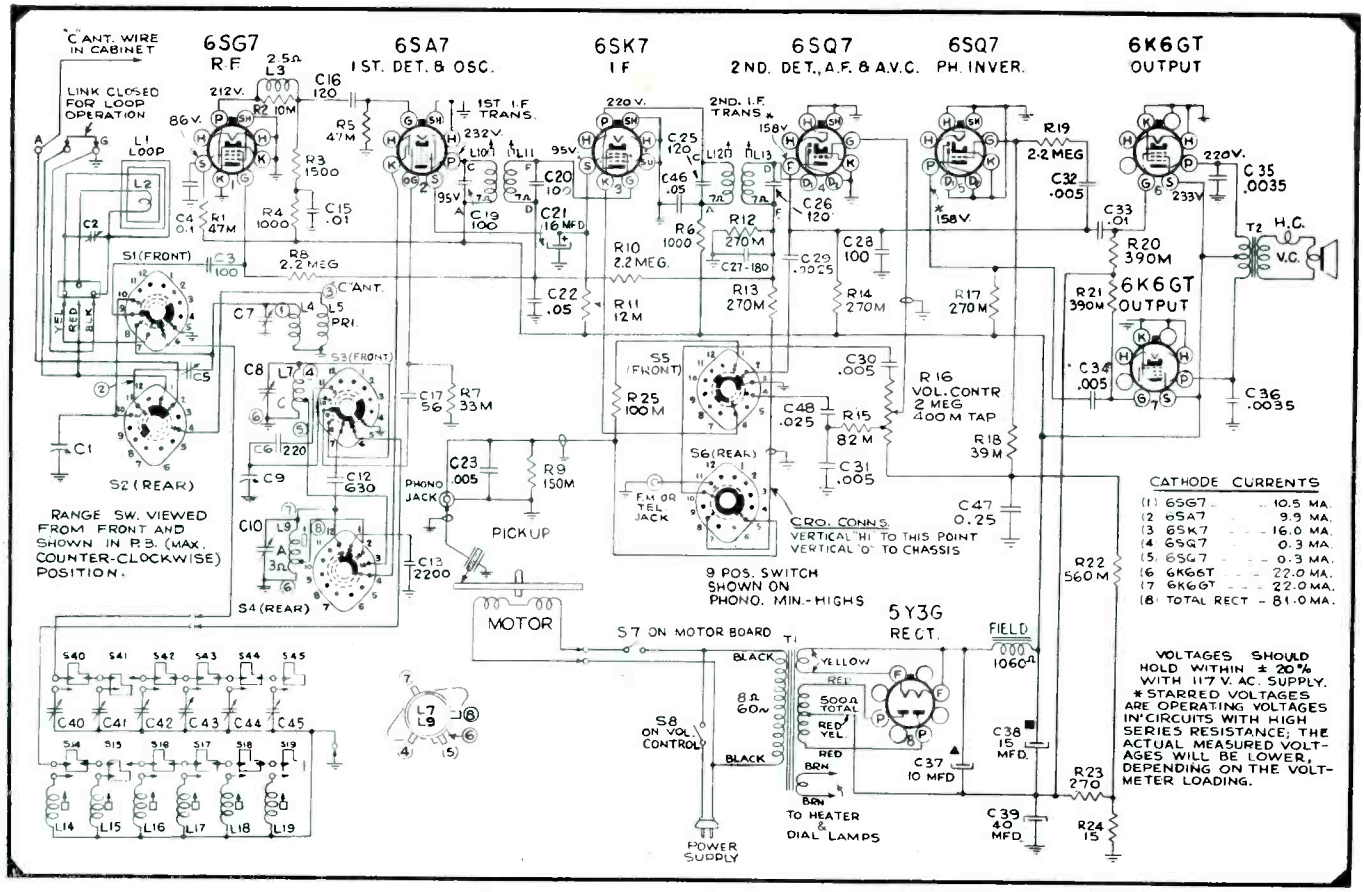


Fig. 10. Westinghouse WR-42X5 with a well-filtered supply and resistance-capacitance anti-coupling circuits.

condenser is used on the primary of the low frequency transformer. This seems too small to cause resonance anywhere in the broadcast band. Thus it must be used as an equalizer to reduce the r-f gain at the high frequency end. The short-wave transformer combines capacitive and magnetic coupling to get those weak signals through. Note the .0005 mfd from r-f plate to detector input.

This receiver uses a plug-in ballast resistor with an *A* voltage dropping element and a line resistor for obtainign the 35 volts needed by the 35Z5 heater. A 30-ohm economizer resistor is included in the 9 volt *A* battery circuit. The audio coupling condenser is only .002 mfd, but the load impedance of the first audio is also very high because of the 1-megohm plate resistor and 3-megohm grid leak. Hence the .002 mfd condenser passes as much a-f as a .01 mfd unit with the usual values of plate loads.

Wells-Gardner 5B17-1

Fig. 7 shows another battery receiver, Wells-Gardner model 5B17-1, with resistance-coupled i-f stages. Note the 250 mmfd bypass condenser from external antenna to chassis ground. The purpose of this condenser is to reduce the intensity of signals at the high-frequency end of the band to prevent jamming or broad tuning.

To obtain better high frequency response, the value of the molded condenser in the plate circuit of the 1H5GT first a-f tube was decreased from 250 mmfd to 100 mmfd. The value of the tubular condenser in the plate circuit of the 1A5GT output tube was reduced from .005 mfd to .002 mfd.

To improve the stability of the oscillator at the high frequency end, the 200,000-ohm grid leak resistor in the oscillator grid circuit of the 1A7GT first detector tube was decreased to 150,000 ohms.

Airline 14WG-808

An 8-tube, 4 band record changer job with a novel coil switching system is shown in Fig. 8. The foil aerial, aided by any external antenna, feeds an iron core primary of the 19-meter transformer, a combination primary for 25 and 31 meters and the broadcast loop primary, shunted by a .0003 mfd bypass. Fixed series condensers, 50 mmfd in the detector and 37 mmfd in oscillator, are used for spreading the short-wave bands. On the 31-meter band, shunt condensers are used as well; 105 mmfd in the detector and 82 mmfd in the oscillator. The detector-tuned circuits are capacity coupled to the input grid through a .0005 mfd condenser.

The phono switch removes positive potential from grids *2* and *4* of the 6SA7 converter and grounds them to stop signal leakage into the amplifier. Note the low value .04 mfd screen bypass capacitors. A pre-amplifier socket is provided for adapting a recorder. Instead of feeding into the volume control and to the first audio grid, the pre-amplifier feeds directly to the push-pull power stage from the first a-f plate. The tone control operates from a network from the tapped volume control and, simultaneously, from the push-pull grid. An unbalanced grid-to-grid potentiometer of 3 and 5 megohms with a 1-megohm to ground provides audio excitation for the inverter tube.

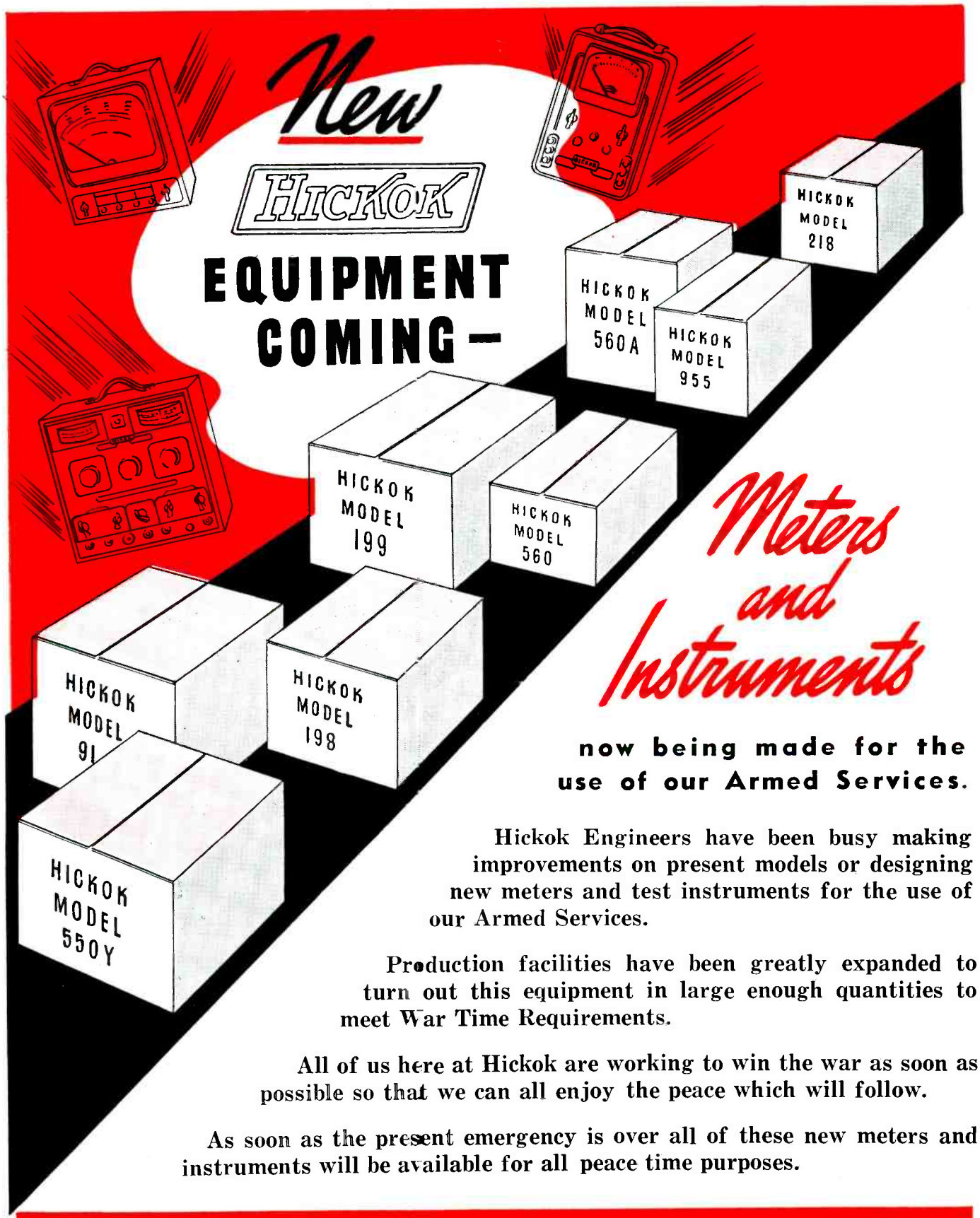
On issue *B* chassis, wax is applied to the wiring side of the speaker plug as a safety measure to prevent contact with the speaker plug prongs.

Oak Automatic Record Changer Data

The oak automatic record changer used on Wells-Gardner receivers can be identified by the three plastic slide buttons used to set the record changer mechanism for the type of operation desired. These buttons will be found at the front, right corner of the record changer panel.

If the changer mechanism does not operate properly, it should first be determined if the records used are in good condition. Records that are warped, chipped, have edges that are

(*Continued on page* 23)



now being made for the use of our Armed Services.

Hickok Engineers have been busy making improvements on present models or designing new meters and test instruments for the use of our Armed Services.

Production facilities have been greatly expanded to turn out this equipment in large enough quantities to meet War Time Requirements.

All of us here at Hickok are working to win the war as soon as possible so that we can all enjoy the peace which will follow.

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AN ALL-WAVE TEST OSCILLATOR

By FREDERIC U. DILLION

PROBABLY ONE OF the most important instruments in the shop is the test oscillator. And since today it is so difficult to purchase one, we have to resort to building them ourselves. A test oscillator that has proven quite effective is shown in Fig. 1. This oscillator covers a frequency range of from fifty to twenty thousand kilocycles or the equivalent of six thousand to fifteen meters on fundamentals. And by the use of harmonics the range can be extended to below five meters.

In the circuit we have an electron coupled r-f oscillator. The output voltage may be either motulated or unmodulated and covers a wide microvolt range.

Three Types of Output Signal

There are three types of output signal available. First, we have the unmodulated r-f signal that may be had by throwing the modulation switch to the *off* position. Second, we have an r-f signal modulated by a four-hundred cycle audio note. A separate audio oscillator consisting of a 76 and the associated parts is used to modulate the r-f signal. This tube is completely controlled by the switch on the front of the panel marked *modulation*. A dial regulates the percentage of the amount of modulation. The engraved bakelite scale indicates the amount being used. The reaction of the modulation on the stability of the r-f is slight and no change in frequency is noticed. The third type includes a four-hundred cycle audio signal that is made available through the terminals marked *a-f*. This feature will be found very useful in checking a receiver, since the audio end may be checked independently to insure its proper functioning, before proceeding with the testing of the r-f end. It is also useful in testing audio amplifiers and speakers. In addition, it may also be used as the input of an external source of modulation voltage such as a beat frequency oscillator or a phonograph amplifier. The percentage control dial also regulates the amount of output or input through these terminals.

This oscillator is a-c operated and accordingly does not drift and vary like the a-c/d-c units.

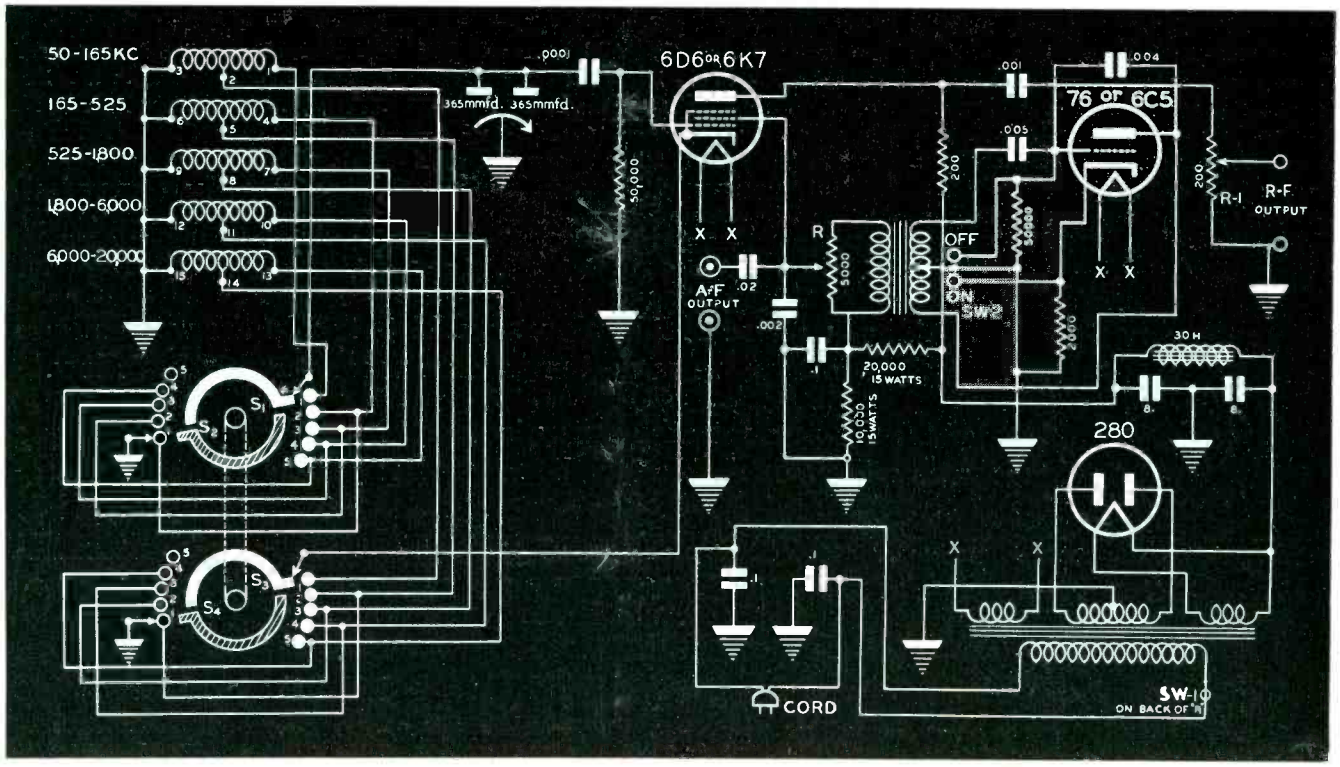
All resistors have a three to one safety factor. The condensers are all held to a five per cent tolerance, and the remainder of the parts are of the highest quality obtainable.

In the mechanical layout, the r-f, audio, and power supply are segregated to prevent coupling and interaction with the other sections. This is a feature which adds much to its satisfactory performance.

In using this oscillator to check receivers with avc, it is necessary to have some form of resonance indicator. The indicator used by the author was a milliammeter connected in series with the cathode of the i-f or r-f stages. When a signal is impressed upon the input of a receiver with avc, the bias developed by the controlling tube decreases the plate current of the controlled tubes proportionately to the input signal. Thus a milliammeter inserted in the cathode will indicate resonance by its deflection of minimum current reading. The range of the meter used was ten milliamperes. This is sufficient for most

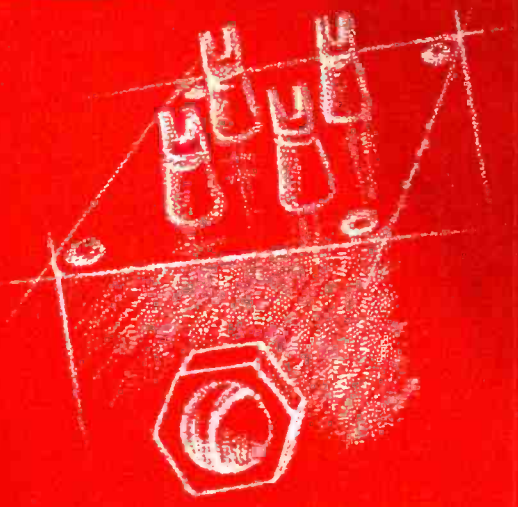
(*Continued on page 28*)

Fig. 1. Schematic of test oscillator. Coils used are standard types available from most manufacturers.

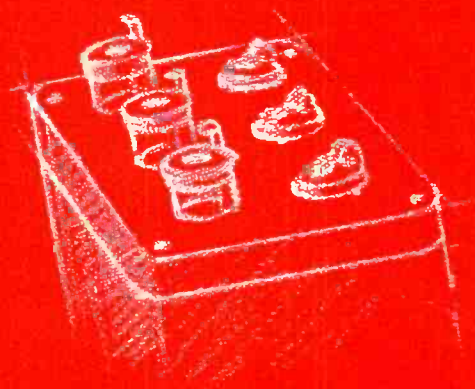


Designs for War . . . Transformers

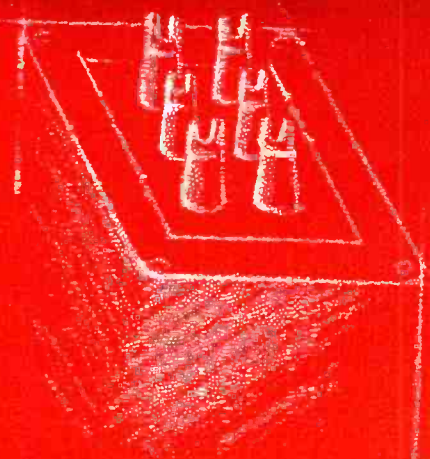
The requirements in war transformers differ considerably from those of commercial units. The UTC engineering staff has pioneered many of the design features which make possible modern war transformers. A few typical designs are illustrated.



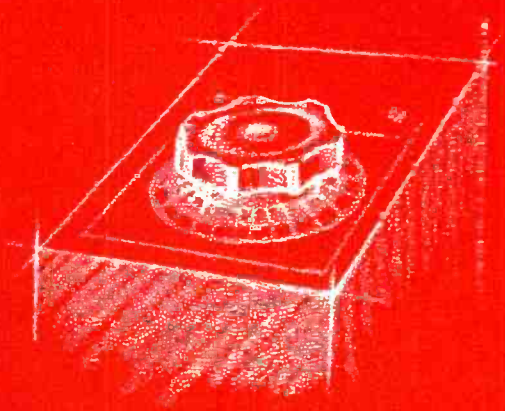
This transformer is tunable . . . ideal for signal frequency amplifiers.



This oil filled transformer is hermetically sealed with glass high voltage terminals solder-sealed to case.



Designed for minimum amplitude distortion . . . this unit has distortion under .01% for a power range of 100 : 1 . . . Q over 150.



This Varitran supplies fixed filament and bias voltages, as well as variable plate voltage all in one unit.

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ELECTROLYTIC AND PAPER CONDENSER TEST METHODS

By T. R. CUNNINGHAM

ONE of the most common faults in receiver breakdown is incorrect circuit operation caused by a defective condenser. Usually it is an electrolytic or paper type, seldom a mica or air dielectric condenser, that is responsible for the trouble. The methods used for testing do not seem to be standardized, so far as servicing is concerned. For example, it has been said that condensers of the first class should have a leakage resistance of 2,000 megohms per microfarad or over. Others have indicated that the leakage may be 50 megohms or over per microfarad.

This is more reasonable, but it still does not tell the whole story, for leakage may be tolerated in certain circuits to a greater extent than these figures indicate. For example, suppose we have a .1 mfd condenser connected across the terminals of a B supply and the leakage is 500 megohms. The current, naturally, will be infinitesimal. But how practical is it?

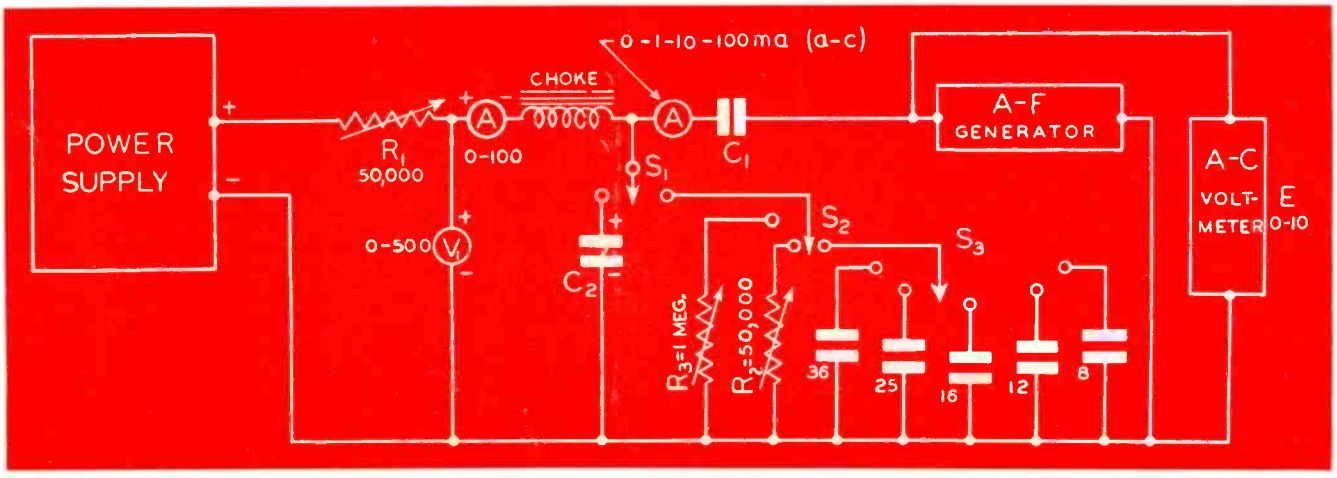
Let us assume the potential of the supply is a maximum of 600 volts and that we can afford to let 1 milliampere go through the condenser. What will be the resistance? Using Ohm's law, 600/.001 gives 600,000 ohms as the top value of leakage resistance. In practical work it is found that for the type of service indicated, a condenser having a capacity rating of .5 mfd to .1 mfd should have a leakage resistance, if in good condition, of 10 megohms or higher. According to the information given in the reference works cited, the leakage would have to be 100 megohms for .5 mfd and 500 megohms for .1 mfd, which is much higher than necessary.

Taking another example, suppose we have a 6F5 tube with 50 volts on the plate working into a grid circuit through a .01 mfd condenser, with a grid circuit resistance of 1 megohm, which are typical values. If the bias on the tube into which we are working is 6 volts, a difference of 5% in voltage will not greatly affect the operation. This would give .3 volt. Now, if we can stand .3 volt leakage across the grid resistor, the ratio of voltages will be 50.3 or about 166. Therefore the leakage resistance would be a minimum of 166x1 megohm or 166 megohms. This would be a rating of 1.66 megohms per microfarad for a critical circuit. It is apparent that careful consideration is necessary in deciding when a condenser is useless on the basis of leakage measurements.

Many Service Men use a rough but practical servicing test in the field, wherein they first disconnect the filter condenser, then short circuit its terminals to remove any residual electric charges. Then they apply the test leads of the ohmmeter which is set on the 2 megohm range. This range is used for electrolytics. As the test leads are applied, the meter needle flicks upward, indicating charge. The amount of kick will be dependent on the capacity and a little experience will indicate the deflection to be obtained for different sizes of condensers and voltage ratings. The red lead of the ohmmeter should be connected to the condenser's negative terminal and the black lead goes to the condenser's positive terminal. Good electrolytics generally have a leakage resistance higher than 200,000 ohms if in good condition, with some as high as 1 or 2 megohms. The best test is to take a number of good units and test them, noting deflections observed. On paper condensers, the leakage resistance should be above 20 megohms for capacities of .01 mfd or lower. The leakage should be above 10 megohms for condensers of .5 mfd to .1 mfd. Bypass condensers between .1 and .01 mfd should have leakage above 15 megohms. Grid condensers in all cases should have leakage above 20 magohms.

One of the simplest and best ways of checking any component is to put another in the circuit and observe its effect on performance. This applies particularly to electrolytic filter condensers, grid condensers and avc condensers, where fading and intermittent operation has been observed. However, a simple dynamic check of a condenser is possible, by merely shunting a new unit across the old one where it is suspected that the original has opened up or developed high series resistance and high power factor. An a-c copper-oxide rectifier type voltmeter, for example, may be connected between plate and cathode of an output tube and set on the 2-volt range to read hum current. A blocking condenser is used to keep d-c out of the meter. Various filter combinations can then be used for minimum hum output and indication on the meter. Another method is to connect the volt-

Fig. 1. Method used to test electrolytics. Polarizing potential is supplied to obtain leakage current through C_2, which is the condenser being tested.



meter directly across the terminals of the condenser being checked with the receiver operating. Another condenser is then shunted across the unit being tested and if the meter reading decreases more than 10%, a new condenser should be installed. An a-c vacuum tube voltmeter is useful for this purpose.

Using an Audio Oscillator

When an audio generator is available, the copper-oxide rectifier voltmeter set on the 0-25 volt or 0-10 volt range, can be used for checking condensers for opens and for making capacity measurements. The capacity may be determined by calculating the current flow in the circuit and dividing it into the source voltage to get the impedance. Then the impedance of a given capacity for the test frequency can be compared with the impedance value of the unit being measured. Reactance of a condenser at various frequencies may be obtained by using a formula or referring to a chart. Impedance and reactance for practical purposes will be the same in paper condensers of good condition. An alternative method is to use a comparison system, noting the deflection on the condenser being tested and on a standard. In certain cases, commercial bridge circuits are used by Service Men and are worthwhile.

Leakage Current Ratings

A standard rating for leakage current in testing electrolytics is, that with rated voltage applied to the condenser, the leakage shall not exceed 0.1 ma per microfarad. The capacitance shall be measured at 70° Fahrenheit, with a d-c polarizing voltage that is 80% of the normal rated voltage. The superimposed rms ripple voltage of 60 cycles-per-second shall be 15 volts for capacitors rated at 100 volts or higher; 3 volts for capacitors rated at 25 to 100 volts, and 2 volts for capacitors rated at 6 to 25 volts. When working voltage is first applied the current may be quite high, tapering off gradually to the minimum value which is observed after about five minutes of "warming up." In practice it may vary from .05 to .5 ma per microfarad and should not be greater than ½ milliampere per microfarad.

The capacity tolerance values are as follows:

Rated D-C Voltage	Tolerance, per cent of rated capacitance
up to 90	— 10 to plus 100
100 to 200	— 10 to plus 50
over 200 (3 mid or less)	— 10 to plus 50
over 200 (3 mid or more)	— 10 to plus 20

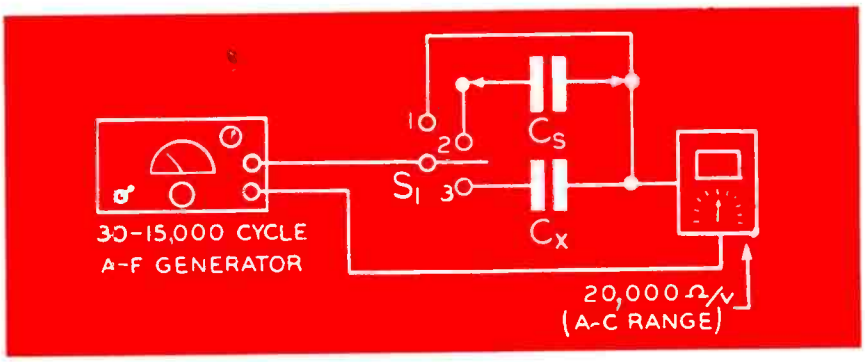


Fig. 2. Paper and small mica condenser test method.

The maximum power factor should not exceed 15% for capacitors rated at 2 mfd or greater with a voltage rating of over 100 volts.

In the accompanying illustrations a number of practical test circuits are sketched.

Testing Electrolytics

In testing electrolytics (Fig. 1), a polarizing potential is supplied to obtain leakage current through C_2 which is the condenser being tested. The choke may have a value of about 30 henries and rating of 100 ma. Ammeter *A* reads leakage current. Leakage resistance in ohms can be obtained by throwing switch S_1 to R_2 or R_3, adjusting for the same current value that was obtained in C_2. R_2 and and R_3 are calibrated in ohms per degrees rotation. Different standard calibrating capacities may be selected by switch S_3. Condenser C_1 has negligible reactance at the test frequency and blocks d-c, being about 2 mfd in value (paper type). The test frequency may be any convenient value to give readable indications on the meter. It is desirable to use paper condensers as standards, large capacities being built up in shunt arrangements. For example, an 8 mfd unit can be made by using four 2 mfd condensers in parallel. The choke should have a low resistance.

In the paper and small mica condenser test method, illustrated in Fig. 2, C_s is the standard condenser. The unknown capacitor is identified as C_x. The meter resistance R_m is, of course, an important factor in determining the capacity of the unknown unit. It is therefore prudent to secure instruments whose ohms-per-volt characteristic is not only a known factor, but an accurately measured one.

Either the mathematical method or comparison method may be used, predicated on the inclination of the Service Man. Of course, the mathematical system can be stated as being most reliable in view of possible instrument deviations. If reliable instruments are used, this problem should not exist.

Below appears a table showing the leakage of electrolytic condensers, and their current values in milliamperes under normal working voltages.

Cap. (Mfd)	Max.	Min.
30	15	1.5
25	12.5	1.25
16	8.0	.8
12	6.0	.6
8	4.0	.4
4	2.0	.2
2	1.0	.1

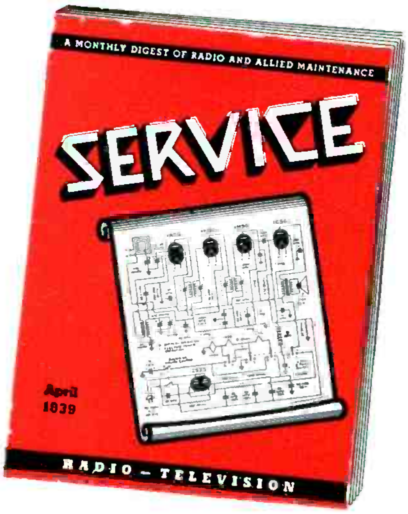
Since we know that all types of condensers are not as plentiful now, these test methods assume an unusual degree of importance. For it is possible to not only maintain a check on the efficiency of the capacitor, but also provide for alternates or substitutions when the defective capacitors cannot be replaced with exact duplicates.

In the new[1] Victory line of capacitors, recently announced, only nine fixed paper dielectric capacitors will be available. These range in size from .25 to .00025 mfd. Their working voltages at d-c is 600 and capacitance tolerances are quite broad. For instance, the .25 mfd condenser has a tolerance of — 20 and + 30, while the .00025 mfd unit has a tolerance of — 20 and + 80. This, of course, provides a wide working range of capacity.

In the dry electrolytic capacitors we have the same broad tolerances. In the 40 mfd condenser, for instance, with a rated working voltage of 450 d-c, the tolerance is — 15 and + 100 while the maximum allowable power factor is 15%. The 100 mfd condenser with a rated working voltage of 25 d-c has a tolerance of — 15 and + 200, while the maximum allowable power factor is 25%.

Of course, these broad tolerances may mean that it is not always possible to correct all faults as quickly as heretofore. However, by substituting the closest capacity and using bridging or series links where necessary, the most effective capacitance can be secured.

[1]March, 1943, SERVICE.



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SER-CUITS

(*Continued from page* 16)

not round or are not of standard thickness may prevent proper operation of the changer mechanism.

Records that are warped, chipped, have edges that are not round or are not of standard thickness, as mentioned above, should be played *manually only*. Do not play this type record with the automatic record changer, as the changer mechanism may be damaged.

To eliminate jamming of records, when the record changer is in a change cycle, the selector blade (upper plate of selector assembly) should first contact the lower record slightly above the center.

If contact is not made at this point, carefully bend the selector blade slightly with a pair of pliers, so that the blade will properly separate the lower record from the stack. The blade should be covered with cardboard or cloth to prevent scratching the finish with the pliers.

The selector blade should not have too sharp or too dull an edge. If the blade has a razor-like edge, it should be buffed to eliminate sharpness. A blade that has become dull may be filed, but should be replaced.

The turntable spindle should be checked for true center position, taking care that it is not bent in any direction. If the selector blade sticks or lacks play, oiling with a fine oil will allow blade to move freely.

Westinghouse WR-12X8

Westinghouse model WR-12X8 (Fig. 9), has a simple, yet effective band switching system. The loop is sandwiched in between the shortwave and broadcast antenna transformers, the tuning condenser being permanently connected to a tap on the shortwave secondary. The fact that this tap is somewhat removed from the first detector grid, has negligible effect on broadcast tuning, but makes bandspread possible on the short-wave position. The same discussion holds for the oscillator tuning condenser.

Westinghouse WR-42X5 and WR-42X15

Westinghouse models WR-42X5 and 42X15 (Fig. 10), feature a well-filtered supply with resistance-capacitance anti-coupling circuits provided for the push-pull output stage, first audio and phase inverter. It will be noted that the blocking condenser between the first a-f and output stage is a .01 mfd unit, while the similar condenser between

(*Continued on page* 24)

SER-CUITS

(*Continued from page 23*)

phase inverter and output is only .005 mfd.

RCA Victor VHR-212

In the RCA Victor VHR-212 recorder unit (Fig. 11), the 6U5 indicator tube is used in the standard manner as a tuning indicator and in the same way as the other recorders as a cutting level indicator. Voltage for the latter function is obtained from a tap on the high impedance winding of the output transformer and rectified by one of the diodes of the 6Q7 microphone amplifier.

The microphone amplifier is biased with a bias cell rather than from the voltage divider. Being a rather high gain amplifier, troubles from hum and feedback are thus avoided. A separate 500,000-ohm volume control is used between the preamplifier and 6SJ7 first audio. Since no switch is used in this circuit, the volume control must be turned down when the microphone is not in use. The crystal cutter is supplied from a high impedance winding on the output transformer through an equalizer consisting of three elements in parallel, shown in the diagram next to the plug and socket. A special attenuator consisting of a choke and shunt resistor is used for muting the speaker when in use as a monitor for recording.

Zenith Receiver Notes

The Zenith 50Z7 can be substituted for 50Y6 by cutting off pin 6 on the 50Z7. The 5Y3 can easily be substituted for the 80, as well as for each other. To do this, remove the old base from the 80, then solder leads to the filament and plate terminals of the 5Y3 or 5Y4. Then insert them in the pins of the old 80 base. Naturally, substituting the 5Y3 for the 5Y4, or vice versa, is accomplished in the same manner.

The sapphire cartridge 142-54 can be installed in place of the other cartridges of similar shape by placing the shims between the back and the tone arm housing so as to bring the needle far enough out to rest on the record.

Speaker 49AG324 can be used in a number of radio sets as a substitution speaker. To do this, grind off the stamped bulging screw support on the right hand lower corner, so as to permit the mounting surface to be flat. Remove the choke and break off the choke mounting flange. The choke can be now substituted for the speaker field in all the 510 and 610 series. There is sufficient room under the chassis for the installation of this choke.

Speakers 49-414 substitutes nicely for 49-304, likewise 49-456 substitutes for 49-304. Speakers 49-438 and 49-505 will replace 49-389; 49-451 and 49-409 will replace 49-403; 49-421 will replace 49-412; 49-304 and 49-456 are interchangeable with 49-414; 49-460 will work in place of 49-438; 49-466 cone will fit 49-442; 49-485 will replace 49-445; 49-389 will substitute for 49-505.

Condenser part 22-1081 will answer nicely for 22-1026, likewise 22-1073 for 22-1059, and 22-1272 for 22-1187.

The 63-1010 volume control can be substituted for 63-997, and 63-1074 and 63-1075 are interchangeable. Simply leave off the tone tap. Also 63-1035 and 63-115 are interchangeable, and 63-1121, 22, 23, are all interchangeable with 63-1026 or 63-1030.

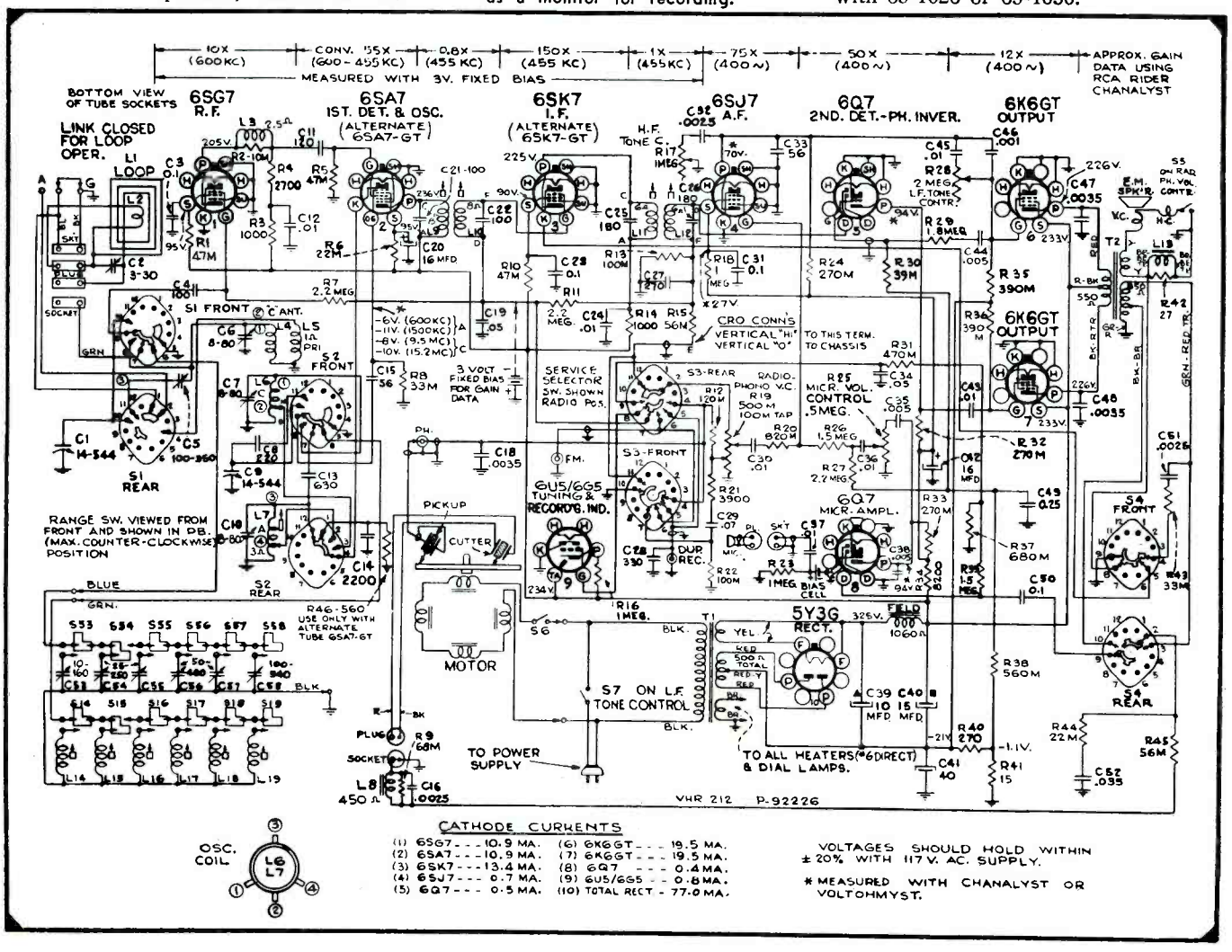


Fig. 11. RCA-Victor VHR-212, featuring a complete recording system. Note special attenuator for muting speaker when in use as a monitor for recording.

ANALYSIS OF RADIO INTERFERENCE PHENOMENA

Character, Cause, Type Receivers Affected, Where Prevalent, and Service Remedies

Type of Interference	Character of Interference	Cause	Type Receivers Affected	Where Prevalent	Suggested Service Remedies
IMAGE RESPONSE	Heterodyne whistle or second signal when tuned to certain stations	Strong signal at a frequency 2xIF above desired station.	Superhet only. (1) With limited number tuned circuits ahead first detector. (2) With low impedance, high frequency resonant antenna primary circuits.	Locality strong BC stations near high end of band. Vicinity 1610-1750 Kc. Police Stations. Vicinity 1700-2000 Kc. amateur band.	(1) Wave trap tuned to interfering station. (2) Band elimination antenna such as RCA Magic Wave. (3) Re-align I-F.
HARMONIC OF I-F	Heterodyne whistle when tuning a station having same frequency as a harmonic of the I-F.	Second harmonic of station combines with oscillator fundamental forming a spurious I-F.	Superhet only. Selectivity does not affect.	Vicinity of station operating at twice I-F.	(1) Wave trap tuned to station. (2) Wave trap tuned to station second harmonic in mixer grid circuit. (3) Re-align I-F.
DIRECT I-F RESPONSE	Non-tunable code with intensity increasing toward low frequency end of band.	Commercial shore-to-ship code signal having frequency in I-F range, reaching input to I-F system.	Superhet only. (1) With limited selectivity ahead of I-F input and relatively high I-F gain. (2) With high impedance, low frequency antenna system.	Coastal areas near location of commercial stations.	(1) RCA Magic Wave antenna. (2) I-F wave trap. (3) Re-align I-F. (4) Orient loop for minimum.
HARMONICS OF OSCILLATOR	Reception of short wave code or broadcast signals at points in standard broadcast band.	Oscillator harmonics combine with short wave signals producing the required I-F. Especially prevalent on loop receivers due to secondary resonances of loop.	Superhet only. (1) With loop antenna. (2) Having oscillator rich in harmonics.	Rurally or where SW signals of proper frequency are intense.	(1) Use wave trap on interfering station. (2) Orientation of loop. (3) Re-align loop circuit. (4) Reduce oscillator excitation.
COMBINATION OF I-F	Whistle or second station(s) heard on practically all carriers.	Difference in frequency of two strong stations equal to I-F of receiver; the two stations mixing within receiver to form a constant spurious I-F.	Superhet only; having limited selectivity ahead of first detector.	Metropolitan areas, generally.	(1) Check by tracking of RF and antenna circuits. (2) Reduce size or effectiveness of antenna. (3) Install wave trap and tune to frequency of one of interfering stations. (4) Shift I-F.
HETERODYNE OSCILLATOR RADIATION	Whistle on a particular desired station, disappearing or changing frequency at random.	Radiation of receiver's heterodyne oscillator, due to oscillator strength, unusual coupling, resonant antenna, or transmission via power line.	Superhet only. (1) Without good shielding. (2) Without R-F stage.	Metropolitan areas, generally.	(1) Filter power line. (2) Use RCA Magic Wave antenna. (3) Reduce oscillator grid leak. (4) Shift I-F.
CROSS MODULATION WITHIN RECEIVER	Second station(s) appearing in background when tuned to desired station.	Strong interfering station modulating carrier of desired station within a non-linear circuit or element of the receiver; or pickup and detection taking place in audio system.	TRF and Superhet. (1) With limited or no selection ahead of first tube. (2) With exposed grid circuits and wiring associated with early tuned stages. (3) Without variable-mu input tubes.	Metropolitan areas. Vicinity of very strong stations.	(1) Wave trap in antenna tuned to station causing trouble. (2) Filter power line. (3) Install RCA Magic Wave noise reducing antenna. (4) Shield exposed grid leads and wiring of first stages.
CROSS MODULATION EXTERNAL TO RECEIVER	Second station(s) in background on or between other stations.	Detection within, and re-radiation from as power lines, telephone lines, and other aerial metallic structures.	All types of receivers are affected regardless of selectivity or design.	Vicinity of unusually strong stations, especially where open-wire power lines are prevalent. Generally changes with weather.	(1) See that power line and telephone grounds are secure. (2) Ground conduits solidly. (3) Use RCA Magic Wave antenna. (4) Orient loop antenna for minimum interference.
SAME CHANNEL BEAT	Flutter, waver, or growl heard in background when tuned to desired station.	Second station assigned to same channel, but differing very slightly in carrier frequency.	Receivers with high sensitivity and extended bass response.	In areas remote from a usable assortment of strong stations. Wherever signals of two stations on same channel are comparable in strength.	(1) Use directive or loop antenna. (2) Reduce sensitivity of set. (3) Reduce bass response.
ADJACENT CHANNEL BEAT	Steady 10,000 cycle note or whistle.	Adjacent channel carrier beating with carrier to which receiver is tuned.	TRF and Superhet; especially those with limited selectivity and wide range of audio response.	Localities where adjacent channel station is strong compared to desired station.	(1) Suppress adjacent station with sharply tuned wave trap. (2) Re-align receiver carefully. (3) Reduce high-frequency response. (4) Use directive antenna.
MONKEY CHATTER	Unintelligible modulation superimposed upon desired station, having character of "inverted speech"	Side band of adjacent channel overlapping side band and combining with carrier of desired station. Also caused by harmonics from over-modulation of adjacent station.	TRF and Superhet; having wide band selectivity and audio response.	Localities where adjacent channel station is strong. Also aggravated by extended high frequency response of transmitter.	(1) Precisely re-align receiver to make more selective. (2) Reduce high frequency audio response.

NEWS

WILSON NOW OPERADIO S-M

Fred D. Wilson was recently appointed sales manager of the commercial sound division of the Operadio Manufacturing Co., St. Charles, Illinois. His entire efforts are being devoted exclusively to the application of music and voice paging as a medium of manpower conservation.

* * *

STROMBERG-CARLSON CHANGES NAME

The Stromberg-Carlson Telephone Manufacturing Company will hereafter be known as the Stromberg-Carlson Company.

Dr. Ray H. Manson, vice-president and general manager, announced the change of name.

* * *

SOLAR WINNER OF "E" AWARD

The Solar Manufacturing Company, Bayonne, New Jersey, was recently awarded the Army-Navy "E" for excellence in war production.

The presentation was made in the grand ballroom of the Waldorf Astoria Hotel in New York City, before an assemblage of employees, executives and Army and Navy officials.

* * *

VOICE PAGING SYSTEM DATA

In a four-page bulletin, released by Bell Sound Systems, Incorporated, 1183 Essex Ave., Columbus, Ohio, unit-designed voice paging systems are described.

The systems utilize remotely located amplifiers, each amplifier capable of operating up to fifteen speakers. The system can also be used for transmission of recordings.

* * *

AEROVOX OPENS NEW PLANT

A second plant devoted exclusively to the manufacture of mica capacitors, was recently opened by the Aerovox Corporation, New Bedford, Massachusetts. The new plant is located close by the Aerovox plant.

* * *

SCOTT MAKES UNIQUE DEMONSTRATION

The new Scott receiver used on U. S. merchant ships and employing Thordarson transformers was recently demonstrated to the employees of Thordarson by E. H. Scott, inventor of the receiver.

Thordarson employees displayed an unusual interest in this demonstration, revealing as it did, the importance of their work in the war effort.

RCP INSTRUMENT CATALOG

The latest additions to the RCP line of instruments appear in a new bulletin No. 127 just released by the Radio City Products Company, Incorporated, 127 West 26th Street, New York City.

The bulletin describes the new model 703 signal generator, 419 master multitester in three models, 416 and 418 pocket multitesters and 446A a-c/d-c multitester.

* * *

NEDA NEWS

District chapters of the National Electronic Distributors Association, are quite active these days, according to George D. Barbey, president. At Philadelphia, for instance, the Keystone Chapter of NEDA met recently at the Ben. Franklin Hotel. In attendance were . . . Mrs. Eugene G. Wile, Morton Moskowitz, John Stern, Morris Green, Philadelphia; Carl G. Wetzel, Lancaster; Mr. and Mrs. Glenn O. Zimmerman, Hagerstown, Md.; Mr. and Mrs. John Bagliani, Baltimore, Md.; Ralph M. Peffer, Harrisburg; Ed. Tilton, San Francisco, Calif.; H. M. Carpenter, Tampa, Fla.; Wm. Flemming, St. Mary's, Pa., and Mr. and Mrs. George D. Barbey and Miss Florence R. Cutler, Reading, Pa.

The Tri-State Chapter of NEDA met recently at the Roosevelt Hotel, Pittsburgh, Pa. Emmett Tydings, who sold his distribution business to the John Marshall Company, to organize a crystal manufacturing concern, tendered his resignation as NEDA director, and Robert Kline, Winteradio, Cleveland, Ohio, was elected the new director. Byron Cracraft now connected with Chemcity Radio & Electric Company, Charleston, West Virginia, was re-elected sec'y-treas. Discussion centered on tubes, victory parts and the PD-1X. The following attended the meeting . . . Robert L. Kline, Cleveland; James Ross, Youngstown; N. DiRosso, Steubenville; R. C. Lonys, Toledo; W. H. Taylor, Charleston, W. Va.; Burke C. Hill, Uniontown; Henry Trenton, Morgantown; Chester Donisson, Clarkesburg; J. A. Gettman and Byron E. Cracraft, Charleston, W. Va.; William M. Schuster and John Duncombe, Erie; A. G. Wertz, Johnstown; E. J. Tydings, Samuel Zionts, J. T. Rose, A. A. Bauer, M. V. Mansfield, E. C. Lips, Sam Applebaum, Pittsburgh, and George D. Barbey of Reading.

* * *

RCA ISSUES WAR EDITION TUBE GUIDE

A revised seventy-two page edition of the RCA Guide for Transmitting Tubes, designed especially for radio engineers and technicians in the armed service and war industries, has just been published and is available through all RCA power tube distributors.

* * *

R. S. LAIRD OHMITE V-P

Roy S. Laird, sales manager of the Ohmite Manufacturing Company, Chicago, has been named vice-president.

* * *

USED TUBES WANTED

Nelson E. Logan. Mitchell, South Dakota, will buy, sell or trade used tubes in good condition. Send him a list of what you have available and your price.

VIC MUCHER SERVING WPB

Vic Mucher, Clarostat Manufacturing Company, Incorporated, 285-7 North Sixth Street, Brooklyn, New York, has been appointed as a consultant to the Radio and Radar Division of WPB.

* * *

GARNER OPENS NEW PLANT

Fred E. Garner Company has opened a new plant in Chicago at 1100 West Washington Street. The engineering staff will be located in the new offices while the general executive group will remain at the old address, 43 East Ohio Street, Chicago.

* * *

KEN-RAD EXPANDS

An extensive new plant has been opened by the Ken-Rad Tube and Lamp Corporation, Owensboro, Kentucky. The new plant which is in Kentucky will provide manufacturing facilities for many important commercial developments.

Additional plant facilities in Indiana will also soon be in operation.

* * *

SHAKEPROOF SCREW BULLETIN

A recent release by Shakeproof, Incorporated, 2501 North Keeler Avenue, Chicago, showing the microscopic qualities of No. 1 Shakeproof thread cutting screws has recently been released. This bulletin is available to those who write in on their business letterheads.

* * *

NATIONAL UNION COMMENDED FOR RED CROSS WORK

A certificate for conspicuous achievement, was awarded recently to the National Union Radio Corporation, Newark, New Jersey, for their outstanding contribution to the war fund drive of the American Red Cross.

* * *

HIT RECORDS

New releases have been announced by Classic Record Corp., 2 W. 46th Street, New York City. They are—*Let's Get Lost* and *There Will Never Be Another You* recorded by Mal Hallet and his orchestra. A complete album of Strauss Waltzes has also been released under the Concertone label.

(*Continued on page* 28)

32-VOLT PLATE SUPPLY

(See Front Cover)

ENGINEERING A RECEIVER for a 32-volt supply without using a vibrator for *B* supply presents some interesting considerations. In the Wells-Gardner 7T5 models, this type of operation from 25 to 40-volt d-c supplies prevails. In these 7-tube, 2-band units, the only reasonable method of getting any audio power at all is via the use of a class B amplifier. Hence, the 6N7 output stage. A 25A6 class B driver is used as a pentode to provide plenty of gain. The total current drain is 1.6 amperes at 36 volts input. This gives 170 milliwatts undistorted (0.4 watt maximum) power output and a sensitivity of 6 to 8 microvolts.

A 3-gang condenser is used without an r-f stage, the third section being used for additional selectivity on the broadcast band only. Two tuned i-f stages produce most of the gain. Screen regeneration is used in both stages and the tricky 3rd i-f transformer. The plate is tapped down on the primary. The secondary is untuned and a 50 mmfd condenser is included for capacity coupling.

A 6J5G oscillator is coupled to the 6SA7 converter by tying the grids together.

R-F INPUT CIRCUITS

(Continued from page 8)

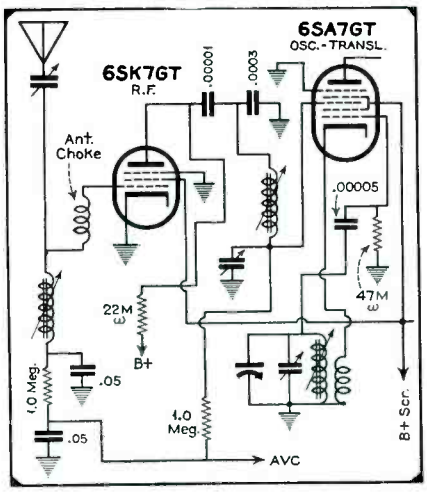
short-wave secondary for bandspread and is left there for broadcast. The 3900-ohm resistor across the broadcast primary prevents excessive coupling due to resonance.

Fig. 10 shows a receiver which uses an antenna plate, or foil aerial which feeds two short-wave primaries and the loop primary. Again, a .0005 mfd condenser is used to couple the tuned circuits to the grid. Bias is obtained from the avc bus only. Since avc bias is produced only when a signal is strong enough to produce rectified i-f, some other source is usually used. Individual cathode resistors are often used, or the avc bus may be biased from a *C* voltage divider, from contact potential of a diode, or from the oscillator grid which is always negative while oscillating.

Any discussion on input circuits would not be complete without a few words about auto radios which have antenna circuits of unique design. Some sort of ultra-high frequency choke is usually included to attenuate ignition interference which is strongest at these frequencies, such as we see in Fig. 11.

Here, a 3-gang permeability-tuned system is used, with the detector in a capacity-coupled series tuned arrangement. This method is used in the Silvertone 7093, a 6-tube auto-radio receiver, using push-button tuning.

Fig. 11. Auto-radio receiver with an u-h-f choke in the antenna input circuit.



NEWS

(*Continued from page 26*)

STANCOR TRANSFORMER CATALOG

A new catalog, No. 140, has just been issued by the Standard Transformer Company, Chicago, Illinois.

The new catalog contains detailed specifications on the Stancor line of transformers and chokes for replacement and general purposes. Featured is a handy classified and numerical index.

* * *

NATIONAL UNION PROMOTES J. J. CLUNE

J. J. Clune, who has been serving as assistant sales manager of National Union Radio Corporation, Newark, New Jersey, has been selected as Director of War Service. Mr. Clune has been with National Union since 1931.

NEWS OF THE REPRESENTATIVES

At the annual election of officers recently held by the Mid-Atlantic Chapter, L. D. Owery, was elected president. N. M. Sewell was named vice-president, and J. A. Maguire, Secty-Treas.

The following members of the Representatives are now in the service of their country . . . Henry W. Burwell, Atlanta, Ga.; Leroy G. Moss, Greeley, Colo.; Marvin Roye, New York, N. Y.; Arnold M. Sinai, San Francisco, Cal.; Robert Ford Taylor, Chicago, Ill.

A past president of the national body of the Reps, Earl S. Dietrich, who left our ranks to become sales manager for Raytheon, has left that post and is back on the roster of the Buckeye chapter.

N. I. Allen of the New England chapter is now located at 163 Summer St., Somerville, Mass., and Leo Freed of the New York chapter is newly installed at 420 Lexington Ave., New York.

* * *

SIGNAL CORPS INFORMATION LETTER DISCONTINUED

The Signal Corps *Information Letter* (unrestricted) will no longer be published by the War Department, Office of the Chief Signal Officer, Washington, D. C. Letter No. 2, Volume II, distributed in February, 1943, is the last issue that will be sent to those on the mailing list.

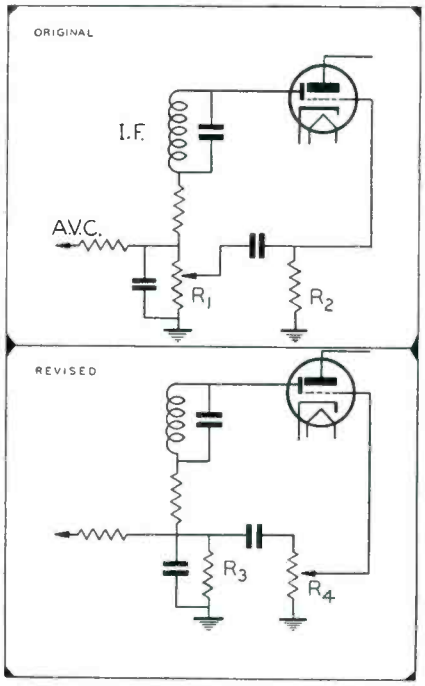
* * *

Our country is at war. On the home-front, it is your obligation, small enough surely, to keep your industry functioning smoothly "for the duration".

VOLUME CONTROLS

THERE are many receivers which employ volume controls as diode loads. Circuit changes may be made as shown below.

In the original circuit, R_1 is a control having a resistance of some value between 100,000 ohms and 1 megohm, depending on the receiver. Resistor R_3



in the revised circuit has the same value. The volume control resistance is the same as R_2 in the original circuit. The two volume control resistances may be very different in value without affecting operation of the receiver. When R_2 is ten megohms or higher than 1 megohm, R_4 may be 1 megohm. If R_2 is ½-megohm or ¼-megohm, replacement R_4 should be the same value.

T. R. Cunningham.

* * *

ALL-WAVE OSCILLATOR

(*Continued from page 18*)

instances. The author made up a set of adaptors of four, five, six, seven and eight-prong tubes with a pair of pin jacks on each. They were connected so that the meter could be plugged in and would be in series with the cathode bias and the cathode prong of the tube.

For receivers that do not have any avc a copper oxide rectifier type of a-c voltmeter may be used and connected across the voice coil. This type of indicator is tuned for maximum reading for resonance. Do not attempt to use this type of meter in an avc circuit, as it will not give an accurate indication.

The modulation control dial varies the amount of audio modulating voltage applied to the r-f oscillator. Provision is made to vary modulation percentage P from zero to over one hun-

dred per cent. For all ordinary purposes this control should be set at approximately *35*, at which point the unit is operating at its most efficient and selective modulated level. If a sharper signal is desired rotate this control towards zero and towards *100* for a broader signal. When using the method described above for balancing avc receivers, little or no modulation is required.

To test an audio amplifier, connect the output of the oscillator marked *A-F* to the input of the amplifier to be tested. Set the modulation dial to the desired level. The speaker and each individual stage may be checked in rotation by connecting to each tube's plate. The d-c path is blocked by a tubular condenser in the oscillator, so connected that connection may be made direct to the plate of the tube. The ground lead goes to ground on the amplifier. On a-c/d-c circuits the ground is often above chassis.

To use an external source to modulate the r-f signal, connect the output of the external source to the audio output on the oscillator and regulate the modulation control in the same manner as when using an internal modulator.

To align a t-r-f set, it is necessary to connect the oscillator's r-f output terminals to the antenna and ground of the receiver. If the set's dial is calibrated in kilocycles set it at 1,500 kc; if not set at the extreme high frequency end, or when the rotor plates are fully out. Set the test oscillator at 1,500 kc, turn the set on and the oscillator *on;* allow a few minutes for both to warm up, then rotate the set's dial until you hear the oscillator's signal in the speaker. It should be picked up close to the full out position of the dial. The signal should come in somewhere between 0-15 on a dial marked 0-100. If it doesn't, then set the receiver's dial at 10, turn the modulation control on full and adjust the trimmer condensers on the top of the gang condenser, starting with the detector stage first, for maximum signal. Now turn the modulation control down until you can just hear it in the speaker, readjust the trimmers in the same order. If the outside plates of the rotors are split, set the oscillator at 600 kc and tune the receiver until this signal is picked up. This should be around 85-95 on the dial. It may be necessary to bend the plates of this section in or out as the case may be to increase the signal.

To align a superheterodyne, connect the test oscillator to the control grid of the first detector tube or converter tube and ground. Then, with both the set and the oscillator *on,* tune in the frequency of the i-f amplifier which is usually marked on the i-f transformers or the chassis somewhere. If it is unknown, then tune the oscillator until a signal is heard. Check the oscillator dial reading with your calibrated curve. Align it to the nearest frequency by setting the oscillator to the standard that is to be used and adjust the i-f trimmers, starting with the second detector input and working back to the first detector for maximum signal. Be sure the volume control on the set is full on. Next connect the oscillator as in a t-r-f, starting at the high frequency end or 1,500 kc. Adjust the r-f trimmers for maximum signal. If the rotors have split plates set the oscillator at 600 kc and adjust for maximum signal, adjusting the oscillator padder in the set for maximum signal. All procedures should be repeated at least twice as a check against any errors. When aligning short-wave receivers it is best to follow the directions given by the manufacturer.

To calibrate this instrument, another test oscillator with known standards and an all-wave receiver should be used. Proceed as if you were going to align it, checking all settings with the known instrument.

DESIGN CHARACTERISTICS OF "V" LINE POWER AND AUDIO TRANSFORMERS AND REACTORS

THE detailed characteristics of the[1] *V* line of power and audio transformers and reactors, just announced, include many interesting design factors.

In the specifications concerning leads, for instance, the standards specify that all windings except the secondaries of output transformers shall terminate in leads extending five inches plus or minus one-half inch from the enclosure or frame. These leads must be stripped for a distance of at least three-eighths inch from the end and treated to facilitate soldering. If the coils are wound with twenty-gauge wire or larger, these leads may consist of a suitably insulated extension of a winding wire. The leads for the primary and high voltage winding of power transformers and for any winding wound with wire smaller than the twenty type, shall terminate in flexible stranded insulated leads equal to or larger than the solid wire to which they are attached. They should be at least the equivalent of twenty-two wire.

Color Coding

The color coding of leads is also an important factor in the standardized design. In the primary input circuits *black* leads are used. Where the transformer is designed for high voltage input as for export use, there are two primaries with the *black-red* and *black*, and *black-blue* and *black-green*, as the outside windings. The tapped windings are identified as *black-yellow* for the top winding, and *black-brown* for the bottom. In the rectifier filament winding, the two outside leads are colored *yellow*, while the center tap is *yellow-blue*. The outside windings of the high voltage side are colored *red*, while the tap is *red-yellow*. Provision for two-filament windings, is also made. The first one has its outside windings colored *green* and the tap, *green-yellow*. The second one has its outside windings colored *brown*, and the tap, *brown-yellow*.

Export Transformers

The primary windings on the export-type transformers are for 120-volt input, so designed that they may be placed in parallel for 120-volt operation and in series for 240-volt operation. The taps provided permit operation at 90, 150, 180 and 210 volts.

Audio Transformers

Two types of audio transformers are provided for, one with a single secondary and another with a split secondary. The color coding of the primary beginning at the *start* point, is *brown, red, blue,* and *yellow-blue*. The *red,* and *blue-yellow* terminals are taps. On the tapped secondary, the *start* lead is colored *yellow* for the grid. The tap is *black* for the return, and the end of the winding is colored *green,* for the grid. The split secondary has its *start* lead, identified as *yellow* and the end of this winding as *yellow-black*. The beginning of the next section of this secondary is colored *green-black,* and the end of the winding is colored *green*.

Impregnation

Impregnation is covered quite completely in the standard specifications. All units, say the specs, shall be thoroughly impregnated with a suitable wax compound or varnish. The compounds and processes used shall be such as to provide complete impregnation and protection against deterioration of the coil when subjected to the specified service or test conditions. A compound shall not have any injurious effect upon any part of the transformer with which it comes in contact,

[1]March, 1943, SERVICE.

either in the state of its original application or as the result of aging under service conditions. It shall preserve the electrical characteristics of the insulation to which it is applied by the exclusion therefrom of moisture. It shall not drip from power transformers maintained at a temperature of 105 degrees Centigrade (221 degrees Fahrenheit) or from reactors and from audio transformers maintained at a temperature of 82 degrees Centigrade (180 degrees Fahrenheit) for 24 hours, nor shall it crack if maintained at —20 degrees Centigrade (—4 degrees Fahrenheit) for 24 hours. All audio transformers shall have a supplementary wax seal or flash dip in addition to their original impregnation.

Casings

The specs also say that power transformers shall be completely enclosed by use of two fireproof half shells, bolted to the core. One shell shall be provided with grommet holes for the leads.

Audio transformers and filter reactors shall be of open type frame construction (exposed coil with channel frame or bracket for mounting purposes). And shells, channel frames, etc., shall be suitably protected against corrosion.

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WARTIME SERVICE HINTS

AUTOMATIC push-button assemblies invariably get noisy after a time. The average Service Man will attempt to clean them with carbon tetrachloride which is often inadequate, or use some abrasive on the contacts which wears off the silver plating. It is then impossible to ever really make the unit satisfactory for use. The use of a very small sliver of rubber eraser fastened in a convenient handle is very useful. Incidentally, a draftsman's inking pen is very useful for this, as the rubber can be clamped between the jaws. All the oxidation can be removed this way without injuring the plating. The use of lubriplate is recommended to prevent further oxidation and to properly lubricate the contacts. This, also, is very effective on the change-over switches from a-c to battery operation on the portables, and the phonograph switches, or any other sliding contact switches used.

The burning out of the power transformer in the sets using the 6X5 tubes has been kept at a minimum by wiring in a dial light in each plate lead of the secondary of the transformer. These should be of the ¼-amp. or .15 amp. size depending on the drain of the set. They glow very slightly under normal conditions but will burn out immediately upon the short circuiting of either of the rectifier tubes. Some Service Men located in the rural districts have even put in sockets for these panel bulbs making it possible to replace them without removing the chassis and enabling the owner to replace both the rectifier tubes and the bulbs in case of trouble. These panel bulbs work much better than fuses either in the primary or high-voltage circuit as they stand temporary overloads without burning out and yet will open the circuit when shorted out.

Distorted or fuzzy reception on stations tuned in on automatic pushbuttons has been traced to the leads to the pushbutton assemblies which, when properly dressed, will clear it up. This was noticed on the No. 10B1 chassis and, undoubtedly, would apply to other sets. Also on this same chassis, lack of response on the radio organ control has been traced to condenser C10 on the circuit diagram.

On the 12B1 chassis, fading of stations tuned in on the automatic pushbuttons can be caused by the 22-858 condenser (C-9 on the diagram) even though it shows to be all right on tests (intermittent).

—*Zenith Wartime Service Hints.*

INTERCOMMUNICATION

(*Continued from page* 11)

been aware of this and have been taking advantage of the opportunity for ready sales. One enterprising dealer recently completed the installation of a new system, making a sale which ran over $1,500.00. He had had no previous experience with *i-c* units.

While many installations run to only a few stations, there have been others where several hundred master and speaker stations are used. These units are connected in smaller groups, of course. A very unusual handling of an *i-c* system was made by Paul Fernald, of Geneva, Ill., at a large plant in Illinois. Here 24-station units are used, and there are a total of more than 40. Twenty-four, of course, are all that can intercommunicate in individual systems, so one unit is installed at the telephone switchboard, and when the operator is called, she will plug in another bank of stations, to further extend the system.

School systems were attaining great popularity before Pearl Harbor pushed schools into the background, in favor of industry. These, of course, differ considerably from the ordinary *i-c* system, as a separate amplifier is used, installed in a remote location, and the features of an intercommunication system are combined with a paging, or school broadcasting system. A radio tuner and a phonograph turntable are also used with most school systems. A small master control unit is located on the superintendent's desk. With this unit he can reach every room singly, or the entire school; he can listen in on school activities, receive reports from the teachers, and can be called by the individual class rooms when they desire. Radio rebroadcasts can also be sent to the various rooms in the school.

One of the most far reaching intercommunication systems of which we have knowledge, was installed in Minneapolis a few years ago, by the *Minneapolis Star*. A microphone, preamplifier, and a phonograph turntable, in the office of the *Star*, were connected through a master station, over leased telephone wires to 45 outlying carrier stations. These stations, small metal houses where the boys got their papers, had another speaker installed in them.

When the boys go for their papers in mid-afternoon, data are received over the system on new deals for obtaining new subscriptions. Pep talks may be given. Information on new contests, the latest news, talks by well-known speakers who visit Minneapolis, etc., are also heard. Carrier station managers can report back to headquarters promptly, and reporters have often sent news in much quicker than by ordinary telephone.

Intercommunicating systems units have also become highly popular in other countries besides the United States, having been exported in recent years to almost every civilized nation. An early installation was made in Iolani Palace, Honolulu, connecting all of the various departments in the government building. At first it was quite a novelty to be able to speak instantly to any department in the building, but it was soon found that the efficiency of the stenographic and legal departments had shown a meteoric rise. Everyone had a hand at trying the new "gadget" and of course some mistakes were made. There was an incident, for instance, when a news reporter thought he was spoofing the girls in the stenographic department. He punched a button and said, "You girls are not making enough noise in there; quit reading magazines and start pounding those typewriters." He realized he had urgent business elsewhere when he heard the Attorney General, Judge Kemp, boom out through the speaker, "What was that?"

As a practical and important piece of business equipment, the intercommunication system has become indis-

pensable in thousands of large and small industrial concerns, in government offices, including the White House itself, and in fact, wherever two or more people must communicate. It has often been said that there can be no production without the three M's—*men, material,* and *machines.* Both industrial concerns who need them and the government agencies who regulate priorities, have rightfully classed the intercommunication systems, with other productive machine tools which increase efficiency of the worker. Now, Service Men, is the time to use your ability and experience in the promoting, installing and servicing of *I c* systems, as a means of securing additional income.

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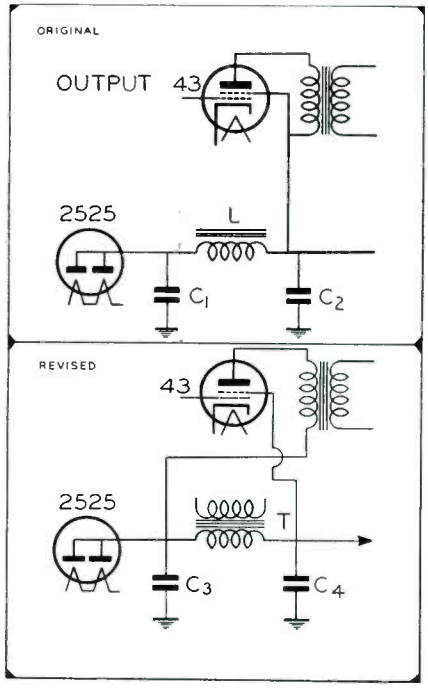
OUTPUT TRANSFORMERS AS FILTERS

MANY receivers have defective speakers which in former years would be thrown away. The output transformers in some cases serve very well as filter inductances. Referring to the sketch, we note that the screen of the output tube is connected to the same point as the plate return. If the choke



burns out, an old output transformer substitute can be used by connecting the plate return to the rectifier cathode. The high resistance winding of the output transformer is connected as a choke. It may be necessary to slightly increase the value of C_3, making it larger than C_1, while C_4 could be slightly smaller than C_2. In some cases this would mean merely reversal of the positive leads to the filter condenser.

T. R. Cunningham.

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Buy United States War Savings Stamps and Bonds for Victory

SLIPPING DIAL CORDS

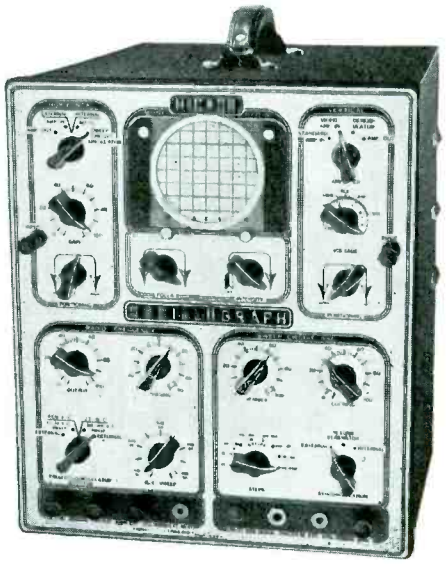
FOR several years we have been using belt dressing on dial cords with only mediocre results. It's quite a waste of time to have to pull the set out of the cabinet to apply the belt dressing. Now, however, we have found a satisfactory repair, which in many cases does not take more than five minutes. It is only necessary that we take an ordinary medicine dropper to your neon sign friend and have him make you a duplicate about eight inches or one foot long. Then take an ounce of denatured alcohol and sufficient powdered rosin to make an over saturated solution (my supply cost fifteen ents). Put the rosin in the alcohol bottle, give it an occasional shake. Now take the slipping dial cord, whose cord is still in good condition, and apply with the jumbo medicine dropper, a few drops of the alcohol-rosin solution. Move the cord along until its entire moving length is saturated. The cord will still slip, but after the set has been put aside for 15 minutes the cord will set. Caution the set owner not to force dial beyond limit of travel, for after the cord has dried, it will be found to grip so securely, that it may now be broken.

R. G. Chrouch.

NEW PRODUCTS

HICKOK OSCILLOGRAPH

For checking both r-f and i-f stages, for single or consecutive stage-by-stage trouble shooting, from antenna post to



speaker in frequency modulated, amplitude modulated and television receivers, the Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland, Ohio, have developed the RFO-5 oscillograph.

It has a self-contained wide band (100 to 900 kc sweep) frequency modulated oscillator (basic frequency 23 mc) for frequency modulated and television servicing. This wide-band frequency modulated oscillator can be modulated from an external frequency source such as a phonograph pickup, microphone or audio frequency oscillator. It has a narrow band (10-30 kc sweep) frequency modulated oscillator (basic frequency 1000 kc) for visual alignment on amplitude modulated receivers, demodulators, etc. Other features are . . . self-contained mixer circuit, demodulator, video amplifiers, signal tracer, visual a-c vacuum-tube voltmeter 0.2 to 1000 volts, calibrated screen, fuse protection, phasing control. The instrument measures 11" x 13" x 15¼" and weighs nearly 50 pounds.

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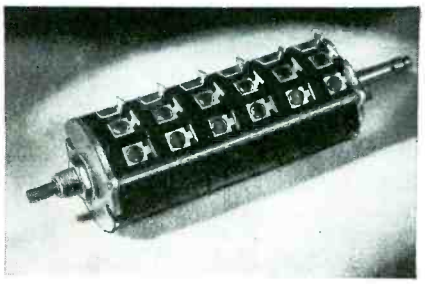
TANDEM CONTROLS

A plurality of circuits, up to two dozen if desired, can be controlled by the single shaft of the 42 series control developed



by Clarostat Mfg. Co., Inc., 285-7 N. 6th St., Brooklyn, N. Y.

This new control was developed to meet certain radio and electronic requirements calling for the single control of several circuits.

The new design of case for each unit permits the nesting and locking of all units into a compact stack. The metal end discs and tie rods hold the cases together and provide further rigidity. A single shaft passes through and locks with each rotor in the stack. All units of the control of course pass through the same degree of rotation as the single shaft is rotated. Individual units can be of any standard resistance, taper, taps and hop-offs to meet individual circuit requirements.

These controls are necessarily made on special order only, since the number of sections and the values vary from one application to another. Units with as many as 20 sections are being produced for critical applications.

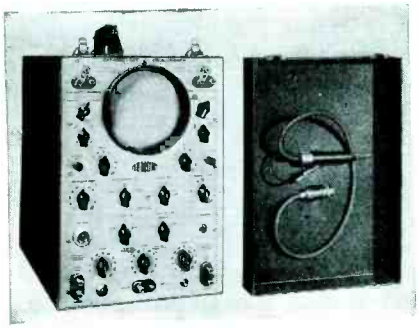
* * *

5-INCH OSCILLOGRAPH

Larger screen size together with the inclusion of a Z-axis amplifier to modulate the beam with any signal applied to its input terminals or with a return trace blanking impulse produced by the linear-time-base generator, are features of the new type 241 Du Mont 5-inch cathode-ray oscillograph.

This oscillograph is said to have a uniform Y-axis or vertical deflection response from 20 cps to 2 megacycles, offering a comparably faithful square and sinusoidal wave response. The X-axis or horizontal deflection amplifier is said to have a uniform characteristic from 10 cps to 100 kilocycles. Provision is made to connect signals directly with the deflection plates when frequencies to be observed are beyond the useful limits of the amplifiers

A removable test probe, held inside the cover by clips, consists of a compensated 10:1 attenuator mounted in an insulated probe and supplied with a 3-foot length



of coaxial cable and connector. This feature permits connections to relatively high impedance circuits without serious loading while minimizing stray pickup.

Self-contained, it operates directly off a 60-cycle 115-volt a-c line. This instrument weighs 65 pounds and measures 17½" high, 10¾" wide, 21" deep.

* * *

PLASTIC PIPE SEAL PLUGS

Plastic pipe seal plugs for protection for threads of units in storage or in transit are being made by American Molded Products Company, 1644 North Honore St., Chicago, Ill.

The molded plastic pipe seals are available in five sizes: ⅜, ½, ⅝, ¾ and 1 inch.

INVISIBLE WATERPROOF CHEMICAL

An invisible "raincoat" which can be formed on cloth, paper and many other materials by exposing them to chemical vapors from a new compound known as *dri-film*, thereby making them water-repellent, has been developed in General Electric research laboratory at Schenectady, N. Y., by Dr. Winton I. Patnode.

One of its most important uses so far is the treatment of ceramic insulators for radio equipment. It is said to be about nine times more effective than the wax used at present as a water repellent, and its results are permanent.

Dri-film is a clear liquid composed of various chemicals which vaporize at a temperature below 100° C. Articles to be treated are exposed, in a closed cabinet, to the vapors for a few minutes. Then they are taken out and, if necessary, are exposed to ammonia vapor. This is to neutralize corrosive acids which may collect during treatment. With this treatment the insulators are said to maintain their high insulating properties, even under adverse conditions.

* * *

SPRAGUE PLUG-IN DRY ELECTROLYTIC

A new plug-in type of dry electrolytic condenser ,for the elimination of low frequency ripple (2—100 cycles) has been developed by Sprague Specialties Co., North Adams, Mass. It is small in size and light in weight.

ELECTRONICS AND IONICS

By DR. JOSEPH SLEPIAN

Associate Director of Research, Westinghouse Electric & Mfg. Co.

(*Continued from March*)

TO consider a few specific instances, let us regard first the homely electric switch. In the mid 1920's the expansion of the electrical power systems was threatened with an impasse because the limit in interrupting capacities of the circuit breakers then available had been reached. The arcs formed between the separating contacts in switches in these large current high voltage systems could not be extinguished by the available means. Then in 1928 one of the first of a series of revolutionary developments was announced by an electrical equipment manufacturer under the name Deion, thus bringing out into the open that the switch was now an electro-ionic device, and that its future progress depended on the contributions which would be made to it by electronic science. The conductivity of the electric arc was recognized as due to presence in the gas space of free electrons and ions. The problem of the proper extinction of the arc at the proper moment, was the problem of de-ionizing, or making disappear at the proper moment, and sufficiently rapidly, the free electrons and ions which the arc itself engendered. The development of de-ionizing means, while guided by electronic theory, is still largely empirical. In the future much of this empiricism may be removed by electronic science.

The ignition is another example of how modern electronic science revolutionized an older electro-ionic device. The mercury arc rectifier was invented by Peter Cooper-Hewitt in 1903. Cooper-Hewitt did not talk of free electrons, and their emission from the cathode, but spoke of a vague "cathode reluctance" to explain the rectifying effect he had found. This was his way for describing the fact that emission of free electrons from the cathode is a necessary part of conducting current through mercury vapor, and that by providing one electrode from which electrons are freely emitted, and another from which such emission is lacking, a rectifier of alternating current is obtained. A cathode-spot, initiated by breaking contact between the mercury pool cathode and an auxiliary electrode, was Cooper-Hewitt's method of producing electron emission from the cathode.

About 1930, the use of stainless steel and light metals was rapidly expanding, particularly in transportation equipment, and methods for rapid electrical welding were devised. For welding of such metals it is necessary to use a rapid sequence of accurately measured pulses of electric current, accurately timed. Mechanical switches, because of their inertia, were not practical for controlling these current pulses. It was very natural by this time to turn to electronic science for the answer, and because of the large current involved, an electro-ionic type of tube was indicated and particularly the mercury arc tube, with its indestructible mercury pool cathode made electron emissive by means of a cathode spot.

However, the only reliable means for starting a cathode spot known at that time was that of mechanically breaking a circuit comprising the mercury pool and an auxiliary electrode, and again mechanical inertia introduced insuperable difficulties. What was wanted was a purely static means for initiating the cathode spot at great frequency and under perfect control.

Electronic science gave a beautiful solution to this problem. A rod of high resistance material was stuck down into the mercury, and current passed down through the rod into the mercury. Analysis of electrical conditions at the junc-

WHEN YOU CHANGE YOUR ADDRESS

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tion of the rod with the mercury indicated that there would be there a large concentration of current, and an intense field, just the conditions for starting a cathode spot. Experiment bore out this expectation. Sure enough, when a few amperes passed down the resistance rod, a cathode spot appeared on the adjacent mercury. This could be done as quickly and repeatedly as desired. The small current for thus initiating the cathode spot could be readily handled by a more usual thermionic, grid-controlled, electro-ionic tube. After the cathode spot was formed, thousands of amperes needed by the weld would pass through the mercury arc tube. Thus the ignitron was born. It immediately found wide application for electronically controlling the welding of these new materials.

It was then found that the use of this gift of electronic science, the mercury-arc ignitor, permitted a radically new design of the high-power mercury-arc rectifier with a better efficiency and greater reliability than had been attained before. Hence we find that in the great expansion of production of aluminum and magnesium occasioned by the war, the tremendous direct currents needed for electrolysis are being supplied by the new ignitron mercury arc rectifiers.

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FARM BATTERY RELIEF PROMISED BY WPB

The Consumers' Durable Goods Division of the War Production Board states in a current release issued through the Office of War Information that some measure of relief in the current farm radio battery shortage can be anticipated through readjustment and rescheduling of battery production.

"Such rescheduling," the release states, "depends on a temporary lag in other battery requirements which would permit a transfer of facilities and materials to production of farm radio batteries.

"Lack of radio batteries," the statement continues, "has been most acute in those farm areas where radio reception depends solely on battery sets. In some sections of these areas, reports have indicated that as many as one-third of the farm battery radios have been inoperative due to a lack of batteries. Even the extension of rural electrification on a large scale during the last decade has not diminished the total demand for and use of farm battery radios. Replacements of battery-operated sets by electric sets in areas supplied with electric power have not matched the increased use of battery types in non-electrified regions.

"Aggravating this increased demand for farm radio batteries has been the increased time of operation of farm sets during the last two years. An increase in average daily listening time from three to five hours has been reported, intensifying the need for radio batteries and at the same time imposing an additional drain on them. War, weather, and farm informational news have accounted for increased use. In addition, increasing farm income has resulted in a greater volume of purchases of battery-type radios.

"Diversion of materials to war-essential uses," the release states further, "has largely accounted for decreased production of radio batteries. Shortages of materials and facilities for civilian production have held radio battery production down to a monthly rate of less than 200,000 during the last several months."

The release estimates that battery-operated radios on farms have increased in number from a pre-war 2,200,000 to a present total of 3,200,000. Pre-war production of radio batteries approximated 4,500,000 sets of batteries, sufficient to supply about two sets of batteries per year per radio.

INSTRUMENTS WANTED

The Signal Corps, Aircraft Radio Laboratory, Wright Field, Dayton, Ohio, and associated critical war industries, have need of meters and test equipment for use in training programs.

Write stating type, condition of equipment, and price desired to

Director, Aircraft Radio Laboratory,

WRIGHT FIELD, DAYTON, OHIO

OUR MEN NEED ★ BOOKS ★

SEND ALL YOU CAN SPARE

GIVE A BOOST WITH A BOOK—Good books, in good condition, are wanted by the 1943 VICTORY BOOK CAMPAIGN for men in all branches of the service. Leave yours at the nearest collection center or public library.

JOTS & FLASHES

Two new plants for war production opened by KenRad. . . . Zenith employees just purchased over $18,250 in war bonds and stamps in drive to replace cruiser Chicago lost in Pacific . . . that's the spirit . . . Leo Freed, well-known New York Sales rep now located at 420 Lexington Ave. . . . orchids to Congressman Karl Stefan of Nebraska for his plea before Congress in behalf of battery set owners who have been unable to secure replacement batteries. . . . Army-Navy "E" production awards to following concerns in our industry this month. . . . National Union Radio Corp., Farnsworth (Marion, Ind., plant), General Ceramics & Steatite Corp., Thordarson Electric Mfg. Co., International Telephone & Radio Labs., F. W. Sickles Co. . . . congratulations . . . Philco awarded white star to add to Army-Navy "E" pennant . . . we like the new Allied Radio Corp. catalog . . . write for your copy to 833 W. Jackson, Chicago . . . glad to welcome Hallicrafters, General Industries and Meck Industries advertising in SERVICE . . . Bob Henry, one of country's largest distributors of communications receivers, appointed to the Radio Procurement Division of Bureau of Ships, U. S. Navy . . . Aerovox opens brand new plant . . . additional facilities needed to meet war requirements for mica capacitors . . . Dr. Irving Langmuir, associate director G-E Research Laboratory, elected to honorary membership in the Institute of Metals, London, England . . . demands for war production equipment necessitate opening of second Clarostat factory . . . Harry Boyd Brown of Philco states that television should be one of greatest post-war industries reaching volume of $1,000,000,000 annually . . . Don Dulweber, head of Supreme Instruments Corp., Greenwood, Miss., killed April 6th by accidental gunshot . . . deepest sympathy . . . we like *Micro Topics*, bi-weekly house organ of Universal Microphone Co.—P. S. W.

SERVICE MEN IN SERVICE

How about dropping us a line or two, supplying such information as you can relative to your progress and activities in the armed services. We'll try to print your letters in SERVICE. They should prove very interesting to radio Service Men still functioning commercially and maintain your contact with your industry. You fellows on the home front, why not write us about your developments which should interest the boys now fighting for Uncle Sam.

NOTICE

Inductions into the armed forces and demands of war production industries have created shortages of labor necessary in the printing, handling and mailing of publications.

If your monthly copy of SERVICE should be late in reaching you — remember that the delay is due to war conditions and the war effort must come first.

Please bear with us.

Thank You!

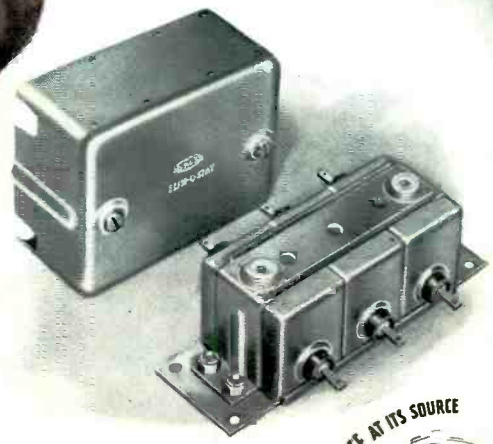
Index to Advertisers

Radio Noise SABOTAGES COMMUNICATIONS unless...

Like so many demons, the crashes and crackles of unwanted radio noise can play havoc with communications. They blot out words—vital words broadcast from plane to plane, from ship to ship, from command car to jeep or tank. They endanger the lives of fighting men—they sabotage communications—*unless* the proper suppression filter system is installed.

Solar Elim-O-Stats suppress interference *right where it starts.* They absorb interference from generators, motors, contacts and other sources. Thousands of these compact filters protect the lives of our land, sea and air fighters. They prevent the blotting out of vital communications in radio-directed combat.

Pioneers in capacitor manufacture and electronic research, Solar engineers probe the rapidly-expanding future of radio development. In post-victory cars, ships and planes, Solar war-proven Capacitors and Elim-O-Stats will safeguard civilian communications, just as they are safeguarding military operations today. Solar Manufacturing Corporation, Bayonne, New Jersey.



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