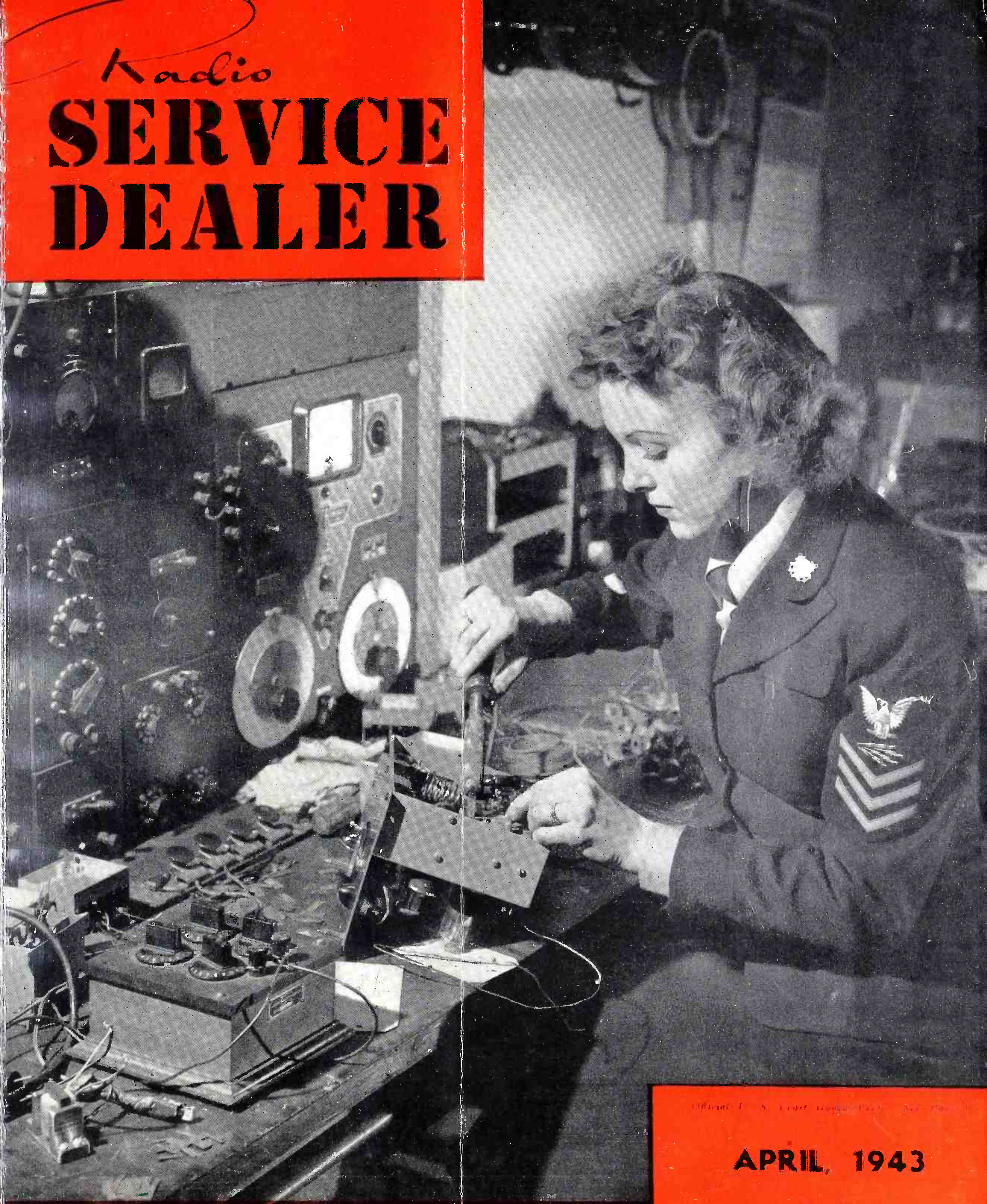
Radio SERVICE DEALER



APRIL, 1943

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Don't buy Mallory Approved Precision Products—or radio parts of any make—unless it is an absolute necessity! The materials used in their construction are needed urgently for war effort.

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Vol. 4, No. 4 ★ April, 1943

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Cover Picture

"SPAR RADIO TECHNICIAN"

(Official U. S. Coast Guard Photo, Exclusive to "RSD")

Relieving trained radiomen for combat duty is just one of the jobs handled efficiently by the new female branch of the Coast Guard—SPARS. Our cover photo is a Spar Radioman. Nice, eh? Openings with opportunity to win ratings and commissions are available to young women. They receive regular Coast Guard pay and training, the latter of valuable aid in the war effort now and later when the field of electronic maintenance will open to competent ladies.

RADIO SERVICE DEALER, published monthly at 34 N. Crystal Street, East Stroudsburg, Pa., by the Cowan Publishing Corp., Executive and Editorial Offices at 132 W. 43rd Street, New York, N. Y. Subscription rates—United States and Possessions, $2.00 for 1 year, $3.00 for 2 years; elsewhere $3.00 per year. Single copies 25c. Printed in U.S.A. Entered as Second Class Matter October 3, 1941, at the Post Office at East Stroudsburg, Pa., under the Act of March 3, 1879.

editorial . . . .

Educational Complacency Is Dangerous!

• Mr. Ernest R. Breech, president of Bendix Aviation Corp., addressed the Illinois Mfgr's Costs Ass'n at Chicago March 30th. Portions of his speech are worth quoting as the context will have bearing upon radiomen in the Post-War Era. Said Mr. Breech, ". . . the element of human error must be wholly removed from an airplane in order to accomplish the desired result of mass sales to the public. There may be those of you who do not have the confidence in the safety of commercial flying that you would like to have. You may remember milling around in a fog waiting your turn to come in for a landing on the beam. It is not a comfortable feeling. Often we have said, 'When commercial airlines can complete their flights with regularity regardless of weather conditions at the point of destination, I'll fly', or, you may have said, 'When the pilot can see the mountains through a fog at night, flying will be safe'. Well, I am happy to announce to you tonight that through a startling development during this war, these hazards of blind flying, day or night, have been conquered. These developments are so broad in the scope of their application for military purposes that I cannot hint to you how this has been accomplished. I can tell you that it is no longer experimental and I can give you positive assurance that after the war fog, even at night, will join the long list of weather hazards conquered by Man in his desire to fly".

Radiomen know that the "wonder device" alluded to by Mr. Breech, with such an air of secrecy, is a type of radio apparatus (or call it an electronic device, if that suits your vanity better), that has long been in the experimental stage, while actually corrupt or "premature" versions of the device have been sold under the common-place name of Cathode-Ray equipment or Television.

Commercial television uses the higher-frequency channels but admittedly great vistas in the super-ultra high frequency spectrum as yet have not been opened for commercial enterprise. They will be at the war's conclusion, if the Allied Nations win. So, all phases of future radio will be more advanced than those of the present. Perhaps a simile would explain our intent and we venture with this—X (Mr. Breech's "secret device") will be as like present-day Television as Infra-red pictures (those taken in utter darkness), are to the common box-camera snapshot. Yes, this is a Radio Age and we find our goal is Optimum, not mere acceptable radio reception.

We concur in all that Mr. Breech says, and we predict further uses for the "secret device" in fields closer to us than mere commercial flying. What think you of static-less, fool-proof television reception? Or, what of a combination television-telephone receiver-transmitter in every home that is telephonically equipped? It can happen here! Which brings us to the point of this editorial; to wit, the radio service-dealer of the future must possess the right kind of technical information or he will not be competent enough to service what will be "ordinary" radios in the Post-War Era.

Stated more simply, civilian radio technicians cannot be educationally complacent, smug in the belief that they will have an edge on radiomen now out of competition, engaged in the war effort as soldiers. The opposite is true. Civilian radiomen have a finger on the present-day pulse while military radiomen are learning how to diagnose radio diseases unknown to laymen, and these new ills are the ones that will have to be cured in the days that follow the war. Unfortunately, as publishers of a technical journal, we like Mr. Breech are not permitted, due to military restrictions, to divulge many new, startling circuits and devices now utilized solely by the military but due to be in the public domain after the war. We stress that all our readers should learn and relearn what they can about basic radio circuit theory and particularly all that can be absorbed on the subject of cathode-ray tubes and oscilloscopes. To that end we launch the first of a series of refresher courses in basic theory and advanced courses in C-R usage with this issue.

A–B–C– (Assist, Barter, Cooperate)

• 'Tis said that "Good men and true live by the Golden Rule"—which in effect means that they are willing to live and let live, make sacrifices and lend aid to their fellowmen. The radio servicing industry needs practitioners of the Golden Rule as never before, and it will for the duration of the war.

The few of us who remain in this business must stick together, for better or worse—pooling our knowledge, tricks-of-the-trade—swapping our excess and unneeded stocks of tubes, parts and instruments—so the war effort may be best served and the nation's set owners be afforded the fullest possible continued use of their radios.

We again urge our readers to A-B and C with their contemporaries and competitors. Let us have your "tricks-of-the-trade" (which we pay for) and publish as "Shop Notes". Also try to swap and barter all unneeded parts and equipment for items that you do need. As our mutual contribution towards Victory let's all try to make the little we have go as far, and do as much good, as possible. We haven't tried to kid anyone. The so-called "Victory" or "War" lines of tubes and parts that we have said so much about are still in the blueprint or planning stage, and you can't repair sets now with tubes or parts you may not get for months or years to come.

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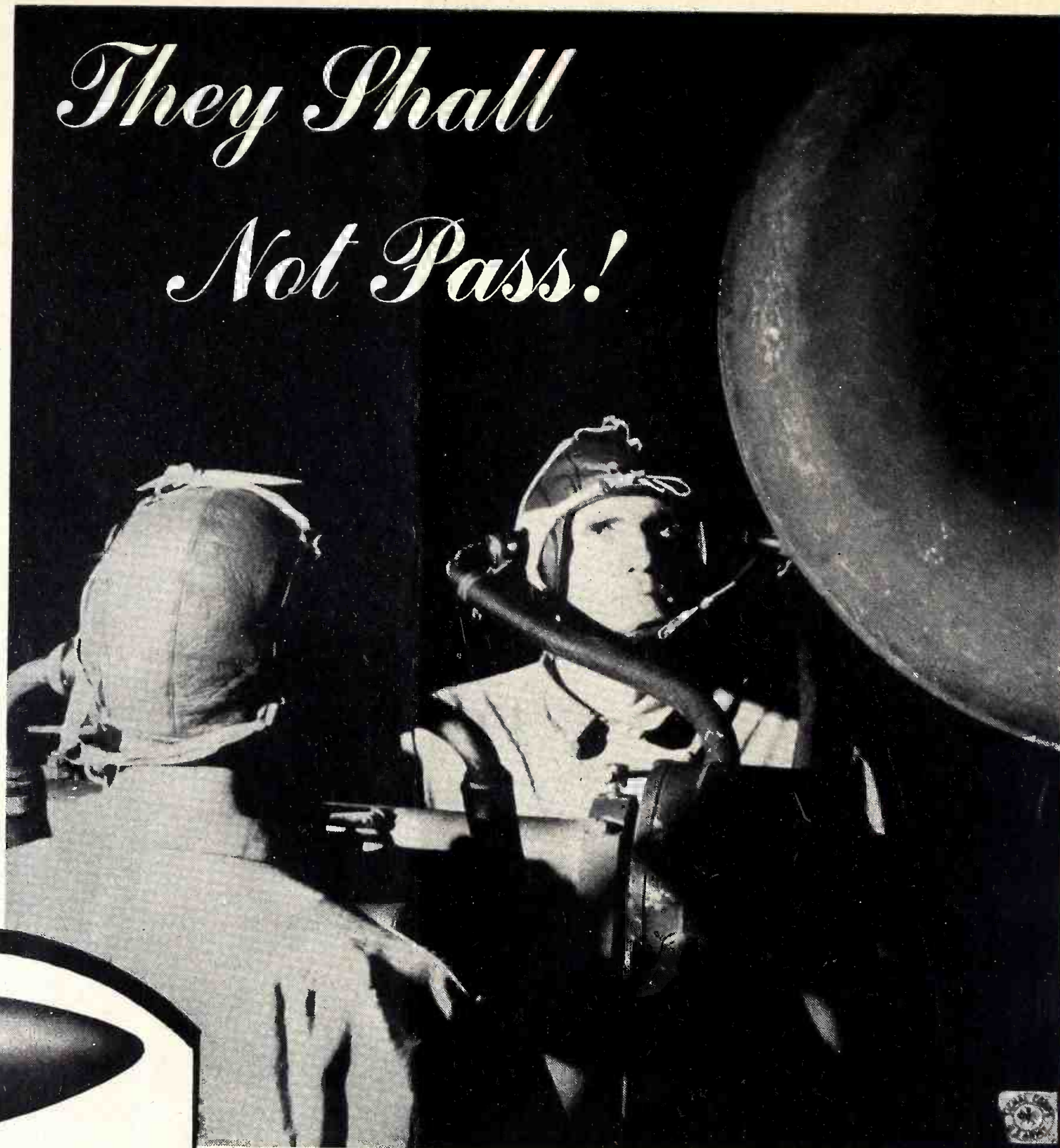
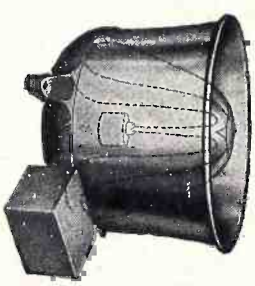
176-B2



Official U. S. Signal Corps Photo.

AIRCRAFT RADIO ANTENNA HOUSING

9 UNIT AEROPLANE HORN



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RACON

INTERMITTENTS WITH NOISE

By H. F. Gulliver

ANOTHER type of intermittent trouble encountered in receivers, is that condition in which some type of noise accompanies the intermittent cycle, or where the noise occurs at times without any change in volume. We are not considering noise from RF oscillation.

In most respects noises are the most easily located of all intermittents, since the noise signal may be quite easily distinguished from the desired signal. Time may be saved if the noise is heard, as well as measured, while hunting it and a small amplifier or headphones to listen to the signal being measured by the signal tracing equipment will be found very helpful. Most signal tracing equipment is provided with a monitoring jack for that purpose. Usually no signal need be fed to the set since we expect the noise to be present while we are testing, and this noise will be all the signal necessary. However, there are certain cases where it *will* be necessary to feed an unmodulated signal into the set, to increase or stimulate the noise. This is particularly true when the noisy component is located where RF normally circulates through it. RF coils, coupling condensers, resistors, and band switches are a few of the items in this class.

We may isolate the noise into either audio or RF portion of the set by turning down the volume control and noting whether the noise decreases. If it does decrease, the noise ENTERS through the RF end. We say ENTERS (perhaps "detected" might be a better word), in the RF end, but the noise may be generated almost anywhere and transferred to the more sensitive RF circuits and amplified as it passes through the following tubes.

Noises from Sparking or Arcing Within the Set

To better understand the test methods about to be outlined, let's consider the cause of these "static" type noises. Probably all will agree that the source of such noises will be found in some small arc, where the current is bridging a break in some circuit, or where two circuits are shorting and arcing. The arc supplies the radiation which we hear as noise.

Back in the old days of arc and spark transmitters, we learned that an arc, or spark, radiated energy of practically all frequencies, audio, IF and broadcast—and even into the high frequency region. Indeed, one of the simplest of test instruments consists of a high-frequency buzzer which operates like a multivibrator, to supply a signal of all frequencies from audio to shortwave.

THIS SOURCE OF NOISE WE COULD DO WITHOUT

"You and I—we sweat and strain—belly all aching and racked with pain!"

Since we want to locate the arc itself, so it may be eliminated, we propose that it may often be best to search for the arc directly, and not try to isolate it into some block of the receiver. This procedure is suggested because, once the noise enters the RF tuned circuits, it may be detected almost anywhere and gets progressively stronger through each tube, but no particular stage may be pointed out as at fault, except the circuit where the noise first enters. That circuit probably is the first one, since it is the most sensitive.

The trouble in all probability does not lie in that circuit at all, but may originate almost anywhere else. Such components as ac switches, filter condensers, tube filaments, line filter condensers are common sources of such noises.

Yes, there are plenty of cases where the noise actually originates in the RF end, but we want first to consider the noise which only *seems* to be in the RF end, but isn't.

Consider an arc creating a noise in some part of the power supply or power distribution system of the receiver. This might be a tube filament, noisy filter condenser, power transformer arcing internally — or any of many similar troubles. *Fig. 1* shows the receiver in block form, with the actual noise distribution below, and the amplified noise above. It may be readily seen that there is no definite indication of the noisy block of the receiver, as represented by the tuned signal. However the actual noise distribution does show one block having a much greater noise signal than any other block.

This noise, we know, covers a very wide frequency band, so it may be detected or measured by either audio or RF equipment. The frequency at

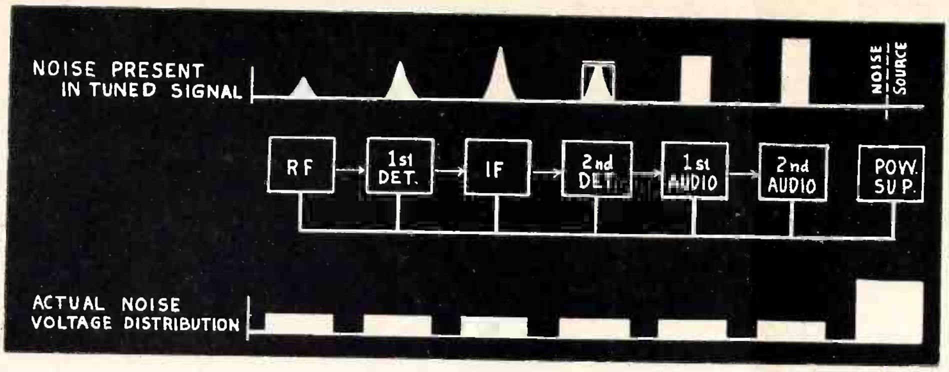

Fig. 1. Receiver in block form. Actual noise distribution is indicated below while the amplifier noise level is shown above. Here the noise source is the power supply.

which tests are to be made, will be governed by the portion of the set under test. We will not want the IF signal or audio voltage to show on the test meter. We want to trace the noise signal only, not the tuned or amplified signal. A noise originating in the power supply, would call for use of the TRFVTVM. (Since we have considerable ac ripple present, we will have to rule out the audio meter.)

By setting the TRFVTVM on a sensitive scale, and listening from 100 KC to 1600 KC, some frequency will be found where the noise is most pronounced. That frequency should be the test frequency, as long as it does not fall on the IF frequency of the receiver By moving the test prod about near the wiring, it may be possible to detect some very "hot" leads. Further checking the noise voltages of component attached to such leads will usually determine the noise source. How far down a circuit a noise will travel, is determined to a great extent by the condensers shunting the arc proper, and the circuits directly connected with it.

In any circuit where no audio voltage normally exists, we can use the audio VTVM. Such circuits are the dc plate, screen, and control grid supply circuits, after filtering. In the RF portion of the set, either the audio or RF instruments may be used, with the RF meter usually the most satisfactory. Keep in mind that the RF meter should *not* be set at the resonant frequency of the circuit under test. *Any other* frequency will do.

In dc circuits, a check of the voltage may indicate the trouble spot, since the voltage across an arcing spot will fluctuate. It must be borne in mind that a varying current to just one tube may cause a simultaneous but decreased variation to several other tubes. An arcing speaker field, for instance, may cause every B voltage in the set to vary.

Noise Source In RF.

Consider now a noise originating in an RF component. Say such a case is a noisy IF plate coil. (An unmodulated RF signal fed into the antenna may increase the noise, and help locate it). Every stage after the noisy one will be contaminated with noise, and possibly the stages ahead may have some noise transferred to them.

By referring to *Fig. 2* we see that signal tracing methods will probably indicate the correct source of the noise since there is a great deal more noise present in the IF circuit than in the first detector. However, the clearest and most positive indication is present in the lower line which indicates the actual noise voltage, as distributed throughout the receiver. This would be measured, as stated above, either at audio or RF frequency, whichever is the most convenient to use. The TRFVTVM is suggested, since it is usable in any circuit. 100 KC seems to be a good test frequency.

Audio Circuits

Locating noisy audio components may be accomplished by exactly the same process as used for RF or power supply noises. The TRFVTVM is still a good instrument for use in the audio circuits, when looking for noises. Next time you get an output transformer which is suspected of arcing over, or if you find a voice coil rubbing and shorting to the frame, try the TRFVTVM to prove the location of the trouble. Such troubles make a terrific clatter in the TRFVTVM. The audio voltage itself is NOT heard in the test instrument if the audio circuit is operating properly. Only the RF component of any arc will be heard. It is interesting to note that certain types of tube distortion, particularly from Class "B" amplifiers will be heard at RF frequency. If tubes and circuit are OK, nothing will be heard at RF frequency.

In audio circuits, as in RF, a good share of the troubles can be isolated by the signal tracing method, but there is a great deal to be said for the POSITIVE INDICATION afforded by measuring the noise voltage directly.

You may have had an experience like this: Where ever the chassis was tapped, a rattle resulted. Any tube seemed to act the same. Turning the control down stops the noise. Just where the noise will actually be is anyone's guess. But the next time it happens, swing the TRFVTVM test prod around next to suspected parts and wiring and tubes. Chances are the noisy area will be quickly located. If the RF meter does not show the trouble, try the audio meter with plenty of amplification. The results are frequently quick and positive. Noisy tubes may be located very quickly, particularly noisy rectifiers set in the field of the loop or first coil.

General Test Instrument Requirements

As in any intermittent tracing we require, as outlined last month, sensitive vacuum tube type instruments

(Continued on page 30)

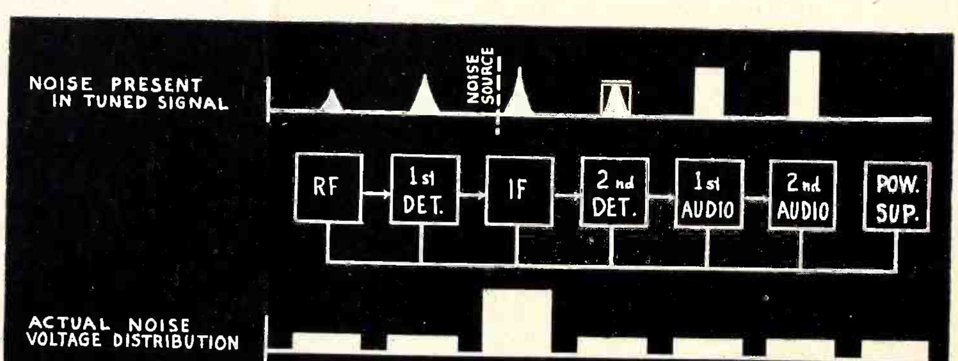

Fig. 2. Signal tracing indicates that the highest noise level is in the IF section so the basic trouble must originate there.

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FOR SALE—S-W 3 D.C. 3-tube set; Supreme fidelity amplifier, 9 tubes with mike and speaker, also Triplett combination, all for $60. Wilfred Pombriant, 75 Birch St., Biddeford, Me.

FOR SALE—5½' cabinet rack with ⅛" steel standard panels (one missing) with lock and key. Cash or trade for a good V.O.M., ac-dc. Anthony Pusateri, 1101 Fleming St., Coraopolis, Pa.

MULTIMETER WANTED—Describe fully and name best price. Clayce Morris, P.O. Box 241, Salem, West Virginia.

FREQUENCY STANDARD FOR SALE—Hallicrafter model HT7. What is your best offer? W. Kuss, 261 Main St., Hackensack, N. J.

FOR SALE—Sterling 2 meter tube tester, includes octals, $6; Engineers Manual by Hudson, 2nd edition, $1.50; Official Radio Service Handbook, 1008 pages, $2.50; Radiomans Guide, now, $3.00; Signal Generator, Superior model T-37 $10. W. F. Onder, Rt. 1, Box 389, Kimmswick, Mo.

FOR SALE OR TRADE—10 tube chrome-plated Scott F-M Tuner in walnut table model, like new, cost $119, will sell for $80 or best offer; new Scott 15" high fidelity speaker, cost $39, sell for $25; Jensen 10" dynamic speaker, $2; Jensen 8" P.M. speaker, $2; 100 DB Hi-Gain Universal input pre-amplifier, uses 1½ volt dry cell filament supply, diagram included, $5; Shure crystal mike and cable, $3; 10 years complete Radio News, Radio Craft, Service, etc. Want signalist oscillator. Henry Bal, 20 South 13th St., Newark, N. J.

TEN 50L6GT TUBES TO SWAP for ten 35Z5GT tubes. Western Auto Associate Store, Louisiana, Missouri.

WANTED FOR CASH—Good used Vibroplex; 300 watt universal mod. transformer; Thordarson 6878 transformer or equal. J. F. Walker, 414 Black Ave., Springfield, Ill.

INSTRUMENTS WANTED—want late model tube checker; volt-ohm-mill meter; also signal generator. Will pay cash. R. C. Willette, 114 E. 4th St., Blue Earth, Minn.

RECORDER FOR SALE—Federal Symphonic, 16" professional portable, two channel, TRF tuner, excellent condition. Will sell for best offer over $225. Lt. H. J. Shirley, 720 N.E. 6th St., Ft. Lauderdale, Florida.

AMPLIFIERS WANTED—Want small ac-/d-c amplifiers for record players, also pickups and cutters. State condition and price. S. W. Radio Labs, 30 Ridge St., New York, N. Y.

PARTS FOR SALE OR TRADE—Misc. radio parts incl. coils, condensers, resistors, tubes, transformers and speakers and several sets. Write for details. Want phono oscillator, test instruments, or what have you. Have Motorola auto radio to trade. M. L. Radio Service, Palmyra, Pa.

PRE-SELECTOR WANTED—to increase volume for short-wave reception. Must be in good condition. M. Galitello, Litchfield Road, Torrington, Conn.

SIGNAL GENERATOR FOR SALE—Precision model E-200, range 90 k.c. to 88 m.c., 400 cycle, 100 volt peak audio. Can be used either portable or panel. Price $45. Will buy tubes and parts. Send list and lowest price. Bob Goetz, 137-23 71st Ave., Kew Gardens, Long Island, New York.

WANTED—Rider's Manuals Vols. 11-12-13 with index; also 6 and 32 volt "B" eliminators, or any used power unit of a discarded radio of 6 and 32 volt type. Prefer vibrator type. State make and models and best cash prices. John W. Reigel, Annville, RD. #2, Penna.

URGENTLY NEEDED—HIGH PRIORITY—Two #806 transmitting tubes or equivalent, new or used. High priority supplied. Industrial Electric Supply Co., 1839 Peck St., Muskegon, Mich.

AMPLIFIERS FOR SALE—Used 100-watt Montgomery Ward amplifier and 60-watt Bell amplifier for sale at $50 each, or will trade for test equipment, or new or used table model radios or steel parts cabinets. Carl Wolf, 2024 Penn St., Evansville, Ind.

RECORD PLAYER FOR SALE—RCA Model VA-20 wireless type, slightly used as demonstrator. In original packing case. Guaranteed OK. First $12 takes it. Truitt Radio Service, Novinger, Mo.

FOR SALE OR TRADE—National S.W.3 Short-wave receiver with 4 sets of coils; one antenna changeover relay; one 6-16 volt relay; 838 and 35T transmitting tubes; "B" supply and amplifier using 210 tube; battery charger from one to 12 batteries at a time; condenser microphone built-in pre-amplifier; bound volumes of QST from 1922 to 1939; 9002 u-h-f tube; 500 watt variable transmitter condensers. Will sell or trade any of above. Want portable 5- to 10-meter receiver, or converter for car use or cash. Need code machine. V. C. Howerdel, 102 Hancock Ave., Jersey City, N. J.

CLOSING MY STORE—Have tubes, parts and equipment to sell. Send post card for details. Austin Electric & Radio Shop, 406 S. Laramie Ave., Chicago, Ill.

FOR SALE OR TRADE—Meters, transmitting and receiving power supply parts; vibrator supply parts; A and B eliminators; dynamic speakers and headphones; H. V. dynamotor; receiving and transmitting tubes; quartz crystals; home-made VTVM; hand key; speech amplifier parts and other misc. equipment. Write for list. A. K. Zambakian, Jr., 1259 Gaylord St., Denver, Colorado.

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

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

TUBES & MANUALS TO SELL OR TRADE—Have Rider's Manuals Manuals Nos. 9, 10, and 11 for sale or trade, also a few 35Z5 tubes. Want 6 volt speaker fields, or speaker complete. William Lofstrom, 1302 West Hill Ave., Valdosta, Georgia.

FOR SALE—Key & buzzer practice set; Walker multi-unit; two complete late model desk stand dial-type telephone sets with ringers in boxes. Make offer or write for details. Also have a few new and partially used tubes and misc. parts. Will send list. H. W. Schendel, 518 W. Main St., Sparta, Wisc.

CHANNEL ANALYZER FOR SALE—Have Superior channel analyzer in A-1 condition for sale—or will trade for a 2" Supreme oscilloscope in good condition. Ted Hamilton, Whatcheer, Iowa.

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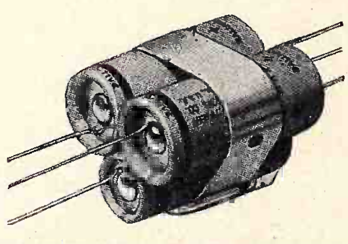

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GENERAL OSCILLOSCOPE AND

At first glance the title of this article might lead readers who are highly skilled technicians and thoroughly versed in all phases of cathode-ray oscilloscope usage to believe that it might be too elementary to be of great value. Such is far from the case. In subsequent articles author Carlson will explain all ramifications of 'scopes and how to use them. It is our considered opinion that a vitally important, highly technical and relatively new subject such as this requires the most thorough treatment possible, despite the many books on the subject—and on that basis we proceed.

Thousands of C-R Oscilloscopes now lie idle in service shops and laboratories because their owners never learned how to properly use them. We attempt to correct this sad condition and in the doing we will aid those who should have but cannot buy their own 'scopes for the duration.—ED.

CATHODE Ray tubes are based on the theory that electrons in a vacuum can be gathered into a narrow beam which, striking a chemical coating at the end of the tube, cause a spot of light due to the fluorescent quality of that material when "bombarded" by electrons at high velocities. This electron beam may be considered as a narrow beam, or "pencil," of negatively charged particles moving at extremely high velocities.

Because of the close analogy that exists between the path of the electron beam in electric or magnetic fields and the path of light rays through lenses or other media of varying index of refraction, the electron beam may be focused to a fine concentration by means of electric or magnetic fields similar to focusing of light through glass lenses.

The cathode ray tube as we know it today is not a product of the inventive genius of any one man but is rather the culmination of the discoveries and research of many men over a period of over a hundred years. Over a hundred years ago, Sir William Hamilton showed a direct relationship between the path of a ray of light through a refracting medium and the path of a particle through conservative fields of force. In 1870 Sir William Crookes found that if two wires were sealed in an air exhausted glass container, a current would flow through that tube if a large enough voltage were impressed across the wires. A fluoresence was then noted in the tube and proved to be due to the rays originating from the negative electrode, or cathode. It was discovered that these *cathode rays* could cast shadows of material objects held in their path and they followed other rules for light.

Sir J. J. Thompson ascertained the speed of travel of these "cathode rays" in 1897. And so over a long period of time discoveries accumulated to finally result in the cathode ray tubes as we know them, from the one inch tube to the large 20 inch diameter demonstration tubes.

Principles of the "Electron Gun"

The heart of any cathode ray tube is the "electron gun," shown in *Fig. 1*. It consists of an indirectly heated cathode which is of a tubular shape, having a flat emitting surface covered with a preparation of barium and strontium oxides. Only the flat end of the emitter facing the tube screen is covered by the emitting surface. The heater is a tungsten wire, non-inductively wound and insulated from the cathode by means of a heat resisting material located inside the tubular cathode.

This cathode acts then as an electron source and a cloud of electrons forms around the emitting surface thus constituting a negative charge

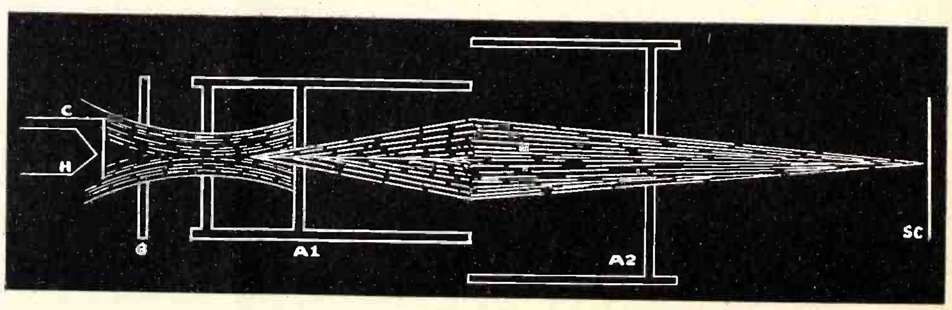


Fig. 1. The progress of an electron stream. Heater H warms cathode C from which negative electrons flow. G is the grid controlling spot intensity. Anodes A1 and A2, being positive, accelerate and draw electrons from C. A1 controls size of spot, A2 its velocity. The focused beam strikes screen SC from which readings are made.

CATHODE RAY TUBE THEORY

by Oscar E. Carlson

which is attracted by the positive voltage on anode *A1*. This is a cylindrical anode with one end open and the other end closed except for a small hole in the center. The negative electrons are attracted to this anode and gather velocity from that attraction. A small portion of the electrons pass straight through the small hole and form a narrow beam travelling at high speed. Thus varying the amount of positive charge on this anode makes it possible to control the "volume" of the electron stream. It is therefore usually called the focusing anode.

Leaving the hole in anode *A1*, the beam has a tendency to spread in a manner much like the rays projected by a flashlight. In this form, the beam would have no practical use because the spot on the screen would be large and blurred. Anode *A2* is used in such a position with respect to anode *A1* that it prevents the beam from spreading. The potential applied to *A2* is usually three or four times that of *A1*. This voltage accelerates the negative beam to such speed that the part of the beam passing through the hole in this anode impacts upon the screen with enough force to make the coating glow brilliantly. Anode *A2* is therefore called the accelerating anode.

The fourth element of the "electron gun" of the cathode ray tube is the so-called grid, placed between the cathode and anode *A1* for the purpose of controlling the beam intensity. The grid is *always* negative and its negative bias determines the spot intensity on the screen.

The focusing of the beam and the intensity of the spot, if the second anode voltage is fixed, are controlled by variation of first anode and control grid voltage. The sharpness of focus of the beam is accomplished by varying the ratio between the first and second anode voltages. The size and intensity of the spot may be varied by variation of the control grid voltage. Decreasing the negative control grid voltage increases the second anode current, increases the spot size, and the intensity. Thus when the intensity is increased by decreasing the negative grid bias the second anode voltage should be readjusted to focus and bring the spot back to the desired diameter. The functions of the components of the "electron gun" may then be summarized as follows:

1. *Cathode—Electron source.*
2. *Grid—controls spot brilliancy or intensity.*
3. *Anode number one—controls size of spot.*
4. *Anode number two — controls velocity of beam forming the spot on the luminescent screen.*

The electron gun provides the components necessary to cause an electron beam to travel down the axis of the tube. The tube would, however, be of little worth with just these components. The function of the tube in any of its varied uses is to act as an instantaneous voltmeter over a period of time so arranged that the instantaneous values of voltage over that time are graphically portrayed and observable on the screen of the tube. We can deflect the beam by the application of electrical or magnetic forces as shown in *Figs. 2* and *3*.

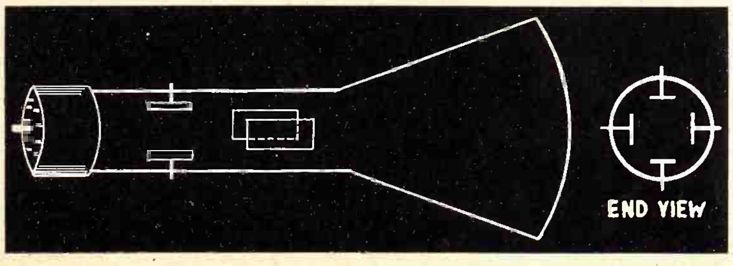


Fig. 2. The most commonly used deflection method is by means of deflection plates. One set is in the horizontal plane and the other set is in the vertical

Purpose of Deflection Plates

If a dc voltage is applied across the vertical deflection plates, nearest the electron gun, then the plate which is positive will attract the beam, while the plate which is negative will repel the beam. The spot will then be seen to move upward, or downward, a certain distance from the normal center position. These vertical deflection plates are in the horizontal plane of the tube causing the spot to move vertically. This is termed *electrostatic deflection* and is used the same for horizontal deflection except for the placement of the horizontal plates in the vertical plane and toward the face of the tube from the vertical plates.

One of each pair of deflection plates is connected to the second anode and the second anode is grounded. The free deflection plates all connect back to the second anode through resistor networks providing

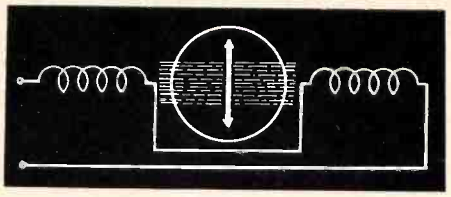


Fig. 3. Only Vertical Deflection Coils Shown

a leakage path to prevent accumulation of electrons on the deflection plates. All deflection plates are thus maintained at the same dc potential as the second anode and the positive high potential point of the power supply is grounded. The negative side of the circuit being at high potential above ground.

It is possible to deflect the beam with a magnetic field produced by two coils located one on either side of the tube. The deflection produced is at right angles to the direction of the field as shown in *Fig. 3*. Because a charge that moves in a magnetic field experiences a force at right angles to the field and to its direction of motion, the spot which is the result of electron beams striking the fluorescent screen moves at the same right angle to the direction of the magnetic field.

Magnetic Deflection

When an ac voltage is applied between a pair of deflection plates, each succeeding electron in the cathode ray stream arrives between the plates when the phase of the applied voltage has changed slightly. Therefore the deflecting voltage will be different in magnitude for the different electrons. This results in different deflections so that the electrons instead of striking one spot on the screen will spread out, the image on the screen being a straight line as shown in *Fig. 4*. The eye cannot detect the individual rain of electrons on the screen but due to the screen retentivity and persistence of vision we see the integrated result of the voltage variations, a straight line whose length represents the peak-to-peak variation of the applied ac voltage.

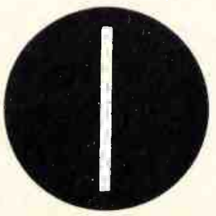


Fig. 4. Indication Caused by AC Voltage on Vertical Plates With No Sweep

Calibrating the Screen

The oscilloscope screen can be calibrated with either dc voltage or measured 60 c.p.s. ac and that same calibration used for other ac measurements up to the highest frequency allowed by the flat frequency response of the amplifiers. In the case of the RCA 305B Oscilloscope, this upper limit is 10 megacycles and the cathode ray tube is a nine inch tube. On the usual scope this upper limit is 100 to 150 kilocycles. However, if measured directly by putting the input to the tube plates the deflection sensitivity is independent of frequency up to about 10 megacycles also, since the time of passage of the electrons between the deflection plates is in the order of 10^{-8} second.

Electrostatic deflection sensitivity is the ratio of the distance which the electron beam moves across the screen to the change in potential difference between the deflection plates and is usually expressed in millimeters per volt. The sensitivity varies inversely with the beam voltage at the point of deflection.

Magnetic deflection sensitivity is the ratio of the distance which the electron beam moves across the screen to the change in the flux density producing the motion. The sensitivity may be expressed in millimeters per gauss, but due to the difficulty in the determination of flux density, it is more often practical to express the sensitivity in millimeters per ampere turn, or more simply millimeters per ampere. It varies inversely as the square root of the beam voltage at the point of deflection.

Sweep Circuits

To view an actual ac voltage through its variations over a time period we must supply a linear sweep voltage which will cause the horizontal spot to move across the screen while at the same time the voltage under investigation is applied across the vertical plates. This voltage must have a saw tooth waveform with the return time negligible with respect to sweep time. Since the spot will be varied from side to side of the screen at a speed faster than the eye can follow at some multiple frequency of the observed frequency, the screen retentivity and visual persistence will show a pattern of the instantaneous value over a time duration. In short, the sweep provides a base for our observations so that we may observe a phenomena embracing time for its amplitude variations during that time.

The sweep voltage may be produced by several methods. One of the simplest is a Relaxation Oscillator employing a gaseous triode such as the RCA 884 and 885. These tubes are actually grid controlled gaseous rectifiers. With fixed plate voltage and large negative bias, no current flows. If the negative grid bias is slowly reduced a point will be reached at which the plate current flows and ionization of the gas takes place. After ionization takes place further variation of the grid bias in either direction has no effect on plate current and the plate current can be stopped only by removal or very great reduction of plate voltage.

Another method of operation is as follows: starting with a fixed negative bias and zero plate voltage, the plate voltage is made positive and slowly increased. Ionization occurs and a large plate current will flow. As explained above, plate current can be stopped by large reduction in plate voltage. The critical voltage at which ionization starts is a function of the negative grid voltage. In the 884 this ratio is about 10:1. That means with negative bias of 20 volts, ionization starts with 200 volts plate potential. This is the method used to produce the sweep voltage. *Fig. 5* shows the most simple form of sweep circuit oscillator.

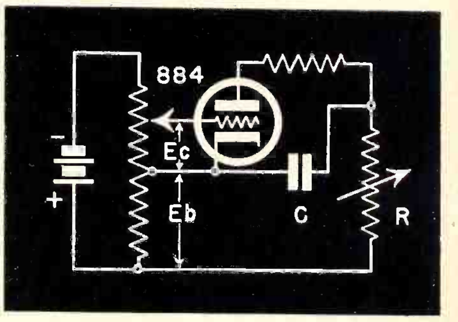


Fig. 5. Sweep Circuit Oscillator

With bias adjusted to some predetermined value by means of R_1, a voltage E is applied across C through R. At this instant the tube is blocked. Current flows through R charging C. The plate potential of the 884 rises with the voltage across C as C charges. When C is charged to the point where the plate voltage is approximately 10 times the negative bias voltage, Ec. Ionization takes place and C discharges suddenly through the low resistance of the ionized tube. The condenser discharge through the tube removes the plate potential from the tube and the plate current ceases. The operation then repeats. The time required for the voltage across C to reach the tube breakdown point is determined

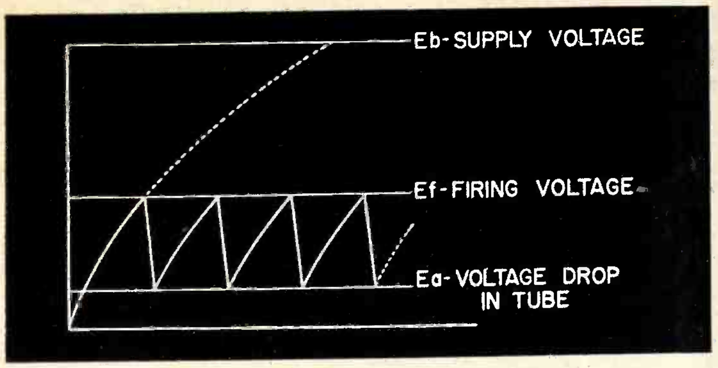


Fig. 6. Wave Form for Oscillator of Fig. 5.

primarily by the capacity of C and the resistance of R. Increasing either C or R will increase the charging time and thus lower the frequency of the oscillation. The waveform of the condenser voltage in *Fig. 5* is shown in *Fig. 6*. The frequency of oscillation, assuming negligible condenser discharge time in comparison to charging time is:

$$F = \frac{1}{RC \log_e \frac{E_b - E_a}{E_b - E_f}}$$

Where: E_b *is supply voltage*
E_a *is voltage drop in tube*
E_f *is tube firing voltage.*

The oscillator frequency of *Fig. 5* can be made any desired frequency by the use of proper components. The circuit however has a very serious disadvantage. The sweep is dependent upon the non-linear condenser charge and is also non-linear, since the current through R is not constant during the charging period. This can be corrected only by replacing R with some constant current source. A Pentode tube is such a device. For any given grid voltage nearly constant plate current over nearly all the plate voltage range may be obtained. Thus by adjusting the pentode grid bias the charging rate may be made any desired value within the limits of the tube and this is equivalent to adjusting R in *Fig. 5*. If the pentode negative bias is increased, I_p is decreased as is the oscillator frequency.

The frequency of oscillation is then:

$$F = (I/E_f - E_a)C$$

The oscillator frequency adjustments obtained above are far from precise. The capacities of the condensers at C will vary with use, the plate current will vary in the pentode with line variations and tube life. It is therefore necessary to exactly synchronize the sweep frequency with the voltage under test in order to hold the image stationary on the tube screen.

To Attain Synchronization

To accomplish synchronization a portion of the desired sync voltage is impressed across the primary of an audio transformer shown in *Fig. 7*. This is then impressed across a potentiometer and in series with the gas tube bias. As the charge on C approaches the critical value a positive alternation is applied in series with the gas tube bias, decreasing the bias and causing ionization and condenser charge before the critical voltage of C is reached. C again starts to charge, approaches the critical value, and is again discharged at the instant the combined decrease in the grid bias and the increase in gas tube plate potential are sufficient to start ionization. Thus, although adjustment of the natural period of oscillation is only approximate, it is pulled into positive and exact synchronization by the action of the small synchronization voltage applied to the gas tube grid.

It is felt that we need not here discourse upon the amplifiers for oscilloscopes. They are conventional in nearly all commercial oscilloscopes except in those designed for extremely wide frequency ranges such as the RCA 305B and Radio City Products Co. model 555, and The Dumont Type 224. The latter two have flat frequency response up to 2 megacycles while the former has a flat response to 10 megacycles. Oscilloscopes of this nature require low gain wide range amplifiers and for a thorough understanding of such amplifiers it is suggested that the reader review resistance-capacity coupled amplifiers and peaking circuits.

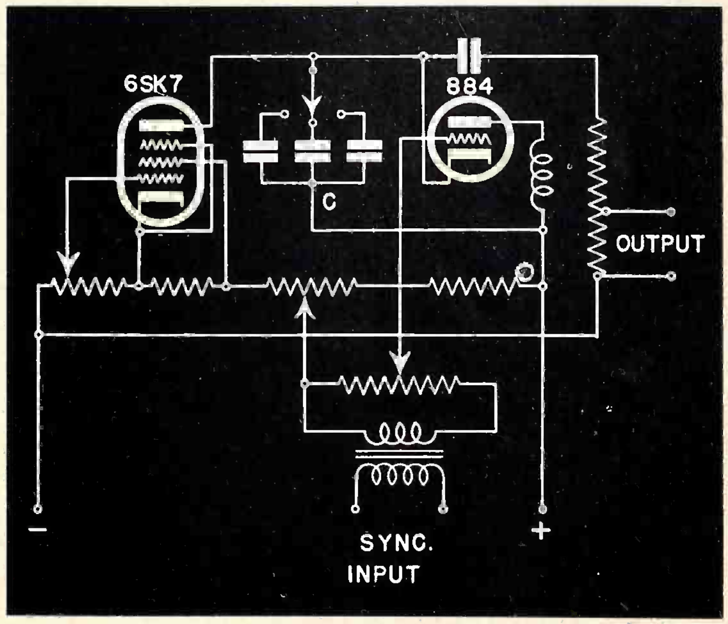


Fig. 7. Sweep Circuit Oscillator With Linear Sweep.

'Scope Power Supplies

Power supplies for oscilloscopes are slightly more complicated than usual due to the fact that the high voltage anode of the Cathode Ray Tube is grounded and all power supplied to the tube is negative. The amplifiers of course need positive potentials. Consequently, two rectifiers must be used. Either two power transformers or a specially wound composite transformer is needed. Four filament windings are necessitated for proper circuit isolation. A typical power transformer for a 5 inch oscilloscope is shown in *Fig. 8*.

(Continued on page 20)

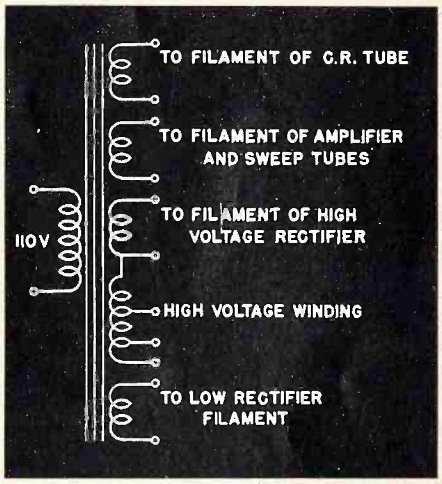


Fig. 8. Power Transformer for 5" 'Scope.

TECHNICAL SERVICE PORTFOLIO

SECTION XXIX

MATCHING COILS AND CONDENSERS

TIME was when getting almost any desired replacement part meant merely a trip or phone call to the nearest jobber or distributor. And what we got was an exact replacement for the ailing component, one which could be installed without any machine work on the chassis and with a minimum of fussing around making adjustments afterward. For many replacement parts, these days have passed; others are becoming scarcer. Keeping up a service business means spending more and more time hunting for suitable replacement parts, and often not finding them. Those of us who used to condemn others for wasting time trying to modify or adapt unsuitable parts to fit a job for which they weren't designed are finding that we, too, must do the same when we're stuck for a hard-to-get part. At least, however, we can make the best of it—we can choose methods of testing and adjusting which will cut to a minimum the amount of time to be spent in making such adaptations.

Many service-dealers are already preparing for much of this sort of work by accumulating and dismantling discarded receivers of all types. The coils and transformers are sorted out and properly identified for easy substitution when the occasion arises. Those components which deteriorate more rapidly, such as filter and bypass condensers, are discarded . . . it isn't fair to the customer to use such components, but parts such as wire-wound resistors, mica and variable condensers, r-f coils, chokes, etc., normally have a far longer life than those previously mentioned and therefore serve as useful replacements.

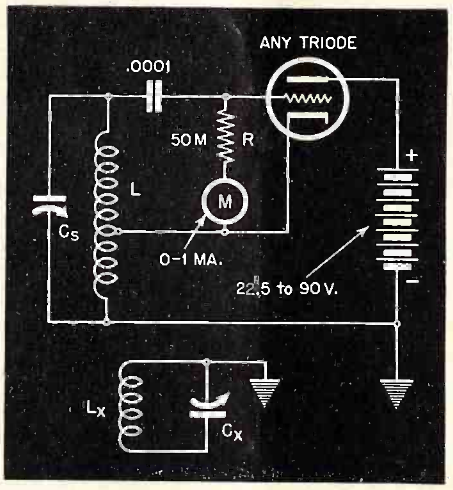


Fig. 1. . . The grid-dip oscillator circuit shown was formerly a favorite in service shops, for checking and matching coils and condensers. When the coupled circuit, Lx-Cx, is tuned to the oscillator frequency, the meter reading dips.

Rewinding Coils

In this article we are concerned primarily with coils and tuning condensers, especially the former. In the early days of radio, it used to be the practice to rewind r-f coils, when replacements became necessary. This is no longer practical because of the special machine windings now employed, which cannot be duplicated by hand. However, it is still possible to make minor adjustments in coils, so as to improve tracking when installed in a receiver for which they were not designed. And in fact, with a little practice, you will find that many coils may be peeled down to cover ranges for which they were not originally intended. We do not recommend that extensive changes be tackled, however, except in an emergency, because such jobs are difficult and time-consuming.

The grid-dip oscillator, shown in *Fig. 1*, is one of the earliest service shop tools for matching coils. It operates on the principle that a resonant circuit, when tuned to the same frequency as that of the oscillator, will absorb power from the oscillating circuit to which it is coupled.

The decrease in oscillator power is indicated by a decrease in the current reading of a milliammeter or microammeter connected in series with the oscillator grid leak. Thus, in the circuit shown, the oscillator circuit is formed by the coil *L*, shunted by its tuning condenser *Cs*. Normally the current through the oscillator grid leak will be of the order of 0.1 to 0.8 ma, depending upon the type of tube used, the amount of B supply voltage and the Q of the coil and condenser circuit. When another coil, *Lx*, is coupled closely to the oscillator coil *L*, and is tuned to the same frequency as the oscillator by means of the tuning condenser *Cx*, some of the oscillator energy will be drawn away from the oscillator circuit. Therefore less current will pass through the oscillator grid meter and the reading will decrease. The maximum amount of energy will be consumed in the coupled coil when it is tuned to exactly the same frequency as the oscillator coil. Therefore the minimum reading of the grid meter indicates that the coupled coil *Lx* is tuned to the oscillator frequency. If all adjustments are then allowed to remain the same, and another coil is substituted for *Lx*, the second coil may be matched by *Lx* by removing or adding turns until the oscillator grid meter again dips to a minimum reading at the same frequency.

This is all right if we have only one frequency to worry about. Unfortunately, in the case of r-f coils, we have to be sure that coils match not only at one frequency, but also at other over the tuning range of the receiver. Thus it is possible for one coil to have greater distributed capacity than another, in which case we would have to peel off more turns to bring its inductance down below that of the coil to which it is to be matched, because the distributed capacity combines with the tuning capacity to lower the frequency, and this can be offset only by decreasing the inductance of the coil. When this is done, the coils are matched at only one frequency. If the distributed capacity of the coil and circuit is low with respect to the tuning capacity, it doesn't matter much, because the change in tuning capacity will be the governing factor in the ultimate frequency. But when the tuning capacity is small, as occurs when tuning near the extreme high-frequency end of a band, the change in frequency for a given change in condenser setting will not be the same if the distributed capacity in each tuned circuit is not the same.

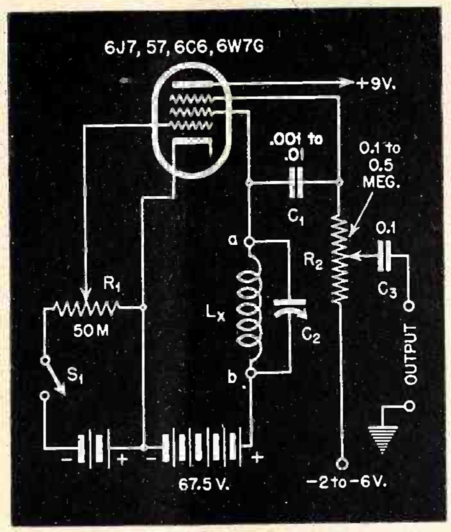


Fig. 2. . . . This modern Transitron oscillator circuit requires no tapped coil and simplifies matching of coils and condensers.

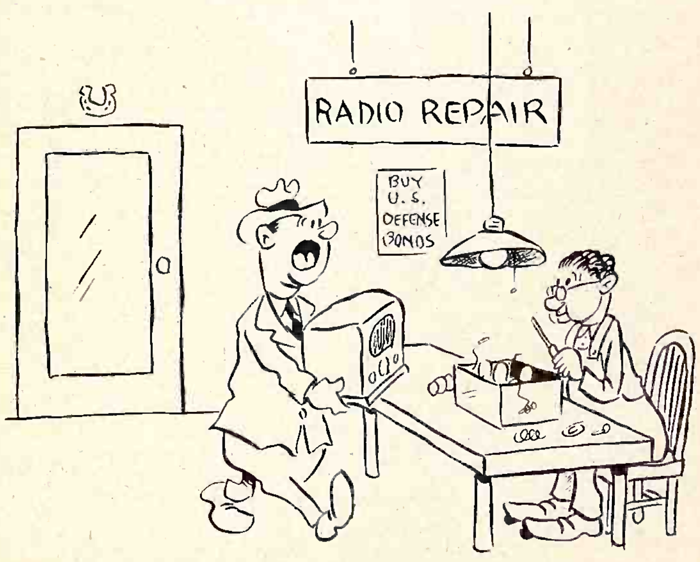
For example, let us assume that the distributed capacity of one coil, along with its associated circuit wiring, is 40 mmf, and that of the tuning condenser section, at one setting, is 30 mmf. The total shunt capacity is thus 40 plus 30 or 70 mmf. Now if the condenser setting is changed to 20 mmf, representing a definite frequency change as indicated by the dial calibration, the total shunt capacity will be reduced to 60 mmf. The change in dial calibration of frequency is proportional to the square root of the change in capacity. If correctly calibrated, then, the frequency change would be equal to the square root of the ratio of 70 to 60—about 1.08 to 1. Thus if the original frequency with 70 mmf in shunt were 1000 kc, the frequency with 60 mmf in shunt should be 1080 kc. The dial calibration would be in accordance with these figures.

However, if the distributed capacity of the coil and circuit were 50 mmf, necessitating peeling off turns to reduce the inductance so that the desired frequency would be reached with the same gang condenser shunt capacity, the total shunt capacity would be 80, instead of 70, mmf as in the first instance. Now if we again change the gang condenser setting by the same amount, 10 mmf, we will have reduced the total shunt capacity to 70 mmf. The change in frequency will be the square root of the ratio of 80 to 70, or 1.06 to 1. Thus in this instance the resonant frequency would be 1060 kc where, with the first coil considered, it was 1080 kc. The two circuits, if ganged together, would be badly out of line.

Compensation

While a difference of 10 mmf in total circuit capacitance is not unusual, it must be understood that the distributed capacitance of the coil alone will be only a portion of the total, so that other factors, such as wiring, tube capacitance, sockets, etc., also must be taken into consideration if proper matching of circuits is to be secured. Because all leads for all circuits cannot be made exactly the same length, and the same distance from the chassis, there will always have to be methods of compensation, such as trimmers or variable iron cores, to make up for small differences in distributed capacity. A very important point in this regard is the fact that too much dependence cannot be placed upon trimmer adjustment to equalize cir-

"Every cent I had went for my taxes. Will you give me four hundred bucks for the 4 good coils and 2 good tubes in this set?"



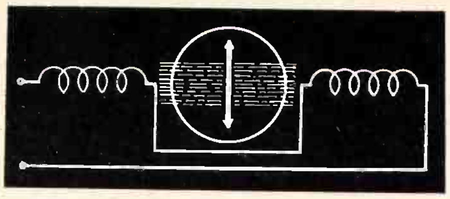


Fig. 3. Only Vertical Deflection Coils Shown

a leakage path to prevent accumulation of electrons on the deflection plates. All deflection plates are thus maintained at the same dc potential as the second anode and the positive high potential point of the power supply is grounded. The negative side of the circuit being at high potential above ground.

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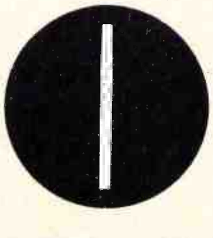

Fig. 4. Indication Caused by AC Voltage on Vertical Plates With No Sweep

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The sweep voltage may be produced by several methods. One of the simplest is a Relaxation Oscillator employing a gaseous triode such as the RCA 884 and 885. These tubes are actually grid controlled gaseous rectifiers. With fixed plate voltage and large negative bias, no current flows. If the negative grid bias is slowly reduced a point will be reached at which the plate current flows and ionization of the gas takes place. After ionization takes place further variation of the grid bias in either direction has no effect on plate current and the plate current can be stopped only by removal or very great reduction of plate voltage.

Another method of operation is as follows: starting with a fixed negative bias and zero plate voltage, the plate voltage is made positive and slowly increased. Ionization occurs and a large plate current will flow. As explained above, plate current can be stopped by large reduction in plate voltage. The critical voltage at which ionization starts is a function of the negative grid voltage. In the 884 this ratio is about 10:1. That means with negative bias of 20 volts, ionization starts with 200 volts plate potential. This is the method used to produce the sweep voltage. *Fig. 5* shows the most simple form of sweep circuit oscillator.

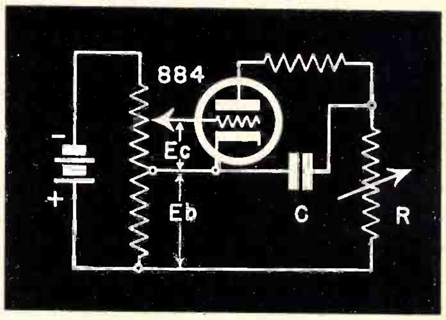


Fig. 5. Sweep Circuit Oscillator

With bias adjusted to some predetermined value by means of R_1, a voltage E is applied across C through R. At this instant the tube is blocked. Current flows through R charging C. The plate potential of the 884 rises with the voltage across C as C charges. When C is charged to the point where the plate voltage is approximately 10 times the negative bias voltage, Ec. Ionization takes place and C discharges suddenly through the low resistance of the ionized tube. The condenser discharge through the tube removes the plate potential from the tube and the plate current ceases. The operation then repeats. The time required for the voltage across C to reach the tube breakdown point is determined

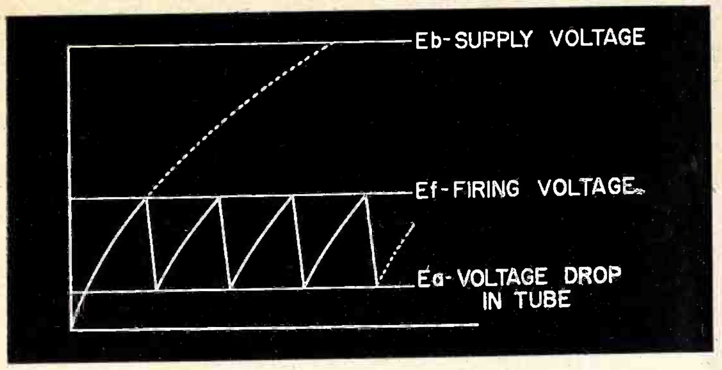


Fig. 6. Wave Form for Oscillator of Fig. 5.

primarily by the capacity of C and the resistance of R. Increasing either C or R will increase the charging time and thus lower the frequency of the oscillation. The waveform of the condenser voltage in *Fig. 5* is shown in *Fig. 6*. The frequency of oscillation, assuming negligible condenser discharge time in comparison to charging time is:

$$F = \frac{1}{RC \log_e \frac{E_b - E_a}{E_b - E_f}}$$

Where: E_b *is supply voltage*
E_a *is voltage drop in tube*
E_f *is tube firing voltage.*

The oscillator frequency of *Fig. 5* can be made any desired frequency by the use of proper components. The circuit however has a very serious disadvantage. The sweep is dependent upon the non-linear condenser charge and is also non-linear, since the current through R is not constant during the charging period. This can be corrected only by replacing R with some constant current source. A Pentode tube is such a device. For any given grid voltage nearly constant plate current over nearly all the plate voltage range may be obtained. Thus by adjusting the pentode grid bias the charging rate may be made any desired value within the limits of the tube and this is equivalent to adjusting R in *Fig. 5*. If the pentode negative bias is increased, *Ip* is decreased as is the oscillator frequency.

The frequency of oscillation is then:

$$F = (I/E_f - E_a)\,C$$

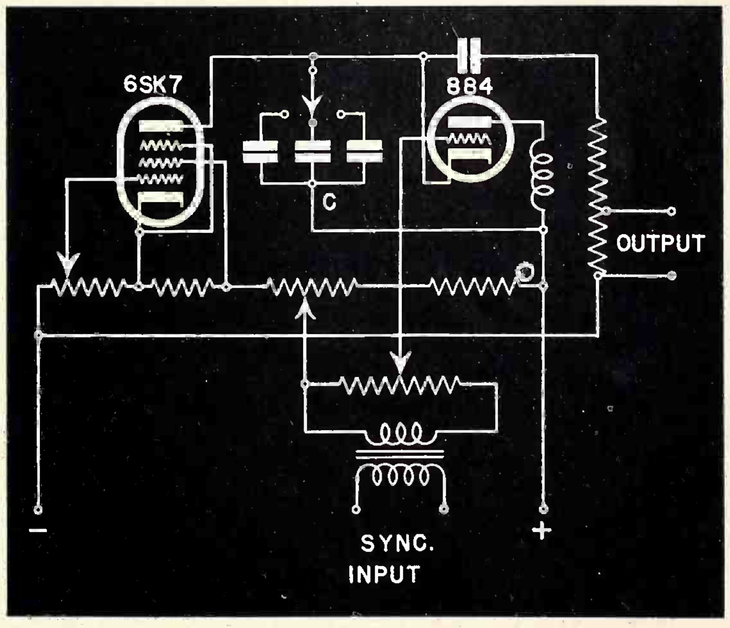
The oscillator frequency adjustments obtained above are far from precise. The capacities of the condensers at C will vary with use, the plate current will vary in the pentode with line variations and tube life. It is therefore necessary to exactly synchronize the sweep frequency with the voltage under test in order to hold the image stationary on the tube screen.

To Attain Synchronization

To accomplish synchronization a portion of the desired sync voltage is impressed across the primary of an audio transformer shown in *Fig. 7*. This is then impressed across a potentiometer and in series with the gas tube bias. As the charge on C approaches the critical value a positive alternation is applied in series with the gas tube bias, decreasing the bias and causing ionization and condenser charge before the critical voltage of C is reached. C again starts to charge, approaches the critical value, and is again discharged at the instant the combined decrease in the grid bias and the increase in gas tube plate potential are sufficient to start ionization. Thus, although adjustment of the natural period of oscillation is only approximate, it is pulled into positive and exact synchronization by the action of the small synchronization voltage applied to the gas tube grid.

It is felt that we need not here discourse upon the amplifiers for oscilloscopes. They are conventional in nearly all commercial oscilloscopes except in those designed for extremely wide frequency ranges such as the RCA 305B and Radio City Products Co. model 555, and The Dumont Type 224. The latter two have flat frequency response up to 2 megacycles while the former has a flat response to 10 megacycles. Oscilloscopes of this nature require low gain wide range amplifiers and for a thorough understanding of such amplifiers it is suggested that the reader review resistance-capacity coupled amplifiers and peaking circuits.

Fig. 7. Sweep Circuit Oscillator With Linear Sweep.



'Scope Power Supplies

Power supplies for oscilloscopes are slightly more complicated than usual due to the fact that the high voltage anode of the Cathode Ray Tube is grounded and all power supplied to the tube is negative. The amplifiers of course need positive potentials. Consequently, two rectifiers must be used. Either two power transformers or a specially wound composite transformer is needed. Four filament windings are necessitated for proper circuit isolation. A typical power transformer for a 5 inch oscilloscope is shown in *Fig. 8*.

(Continued on page 20)

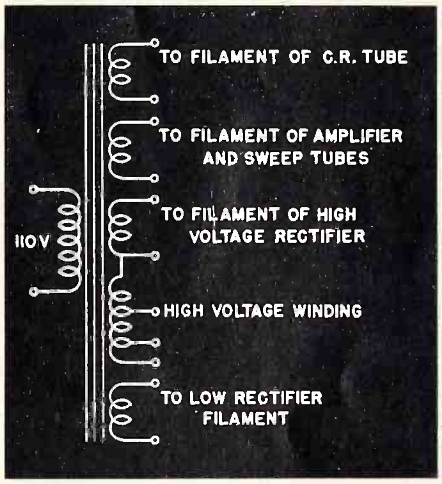


Fig. 8. Power Transformer for 5" 'Scope.

TECHNICAL SERVICE PORTFOLIO

SECTION XXIX

MATCHING COILS AND CONDENSERS

TIME was when getting almost any desired replacement part meant merely a trip or phone call to the nearest jobber or distributor. And what we got was an exact replacement for the ailing component, one which could be installed without any machine work on the chassis and with a minimum of fussing around making adjustments afterward. For many replacement parts, these days have passed; others are becoming scarcer. Keeping up a service business means spending more and more time hunting for suitable replacement parts, and often not finding them. Those of us who used to condemn others for wasting time trying to modify or adapt unsuitable parts to fit a job for which they weren't designed are finding that we, too, must do the same when we're stuck for a hard-to-get part. At least, however, we can make the best of it—we can choose methods of testing and adjusting which will cut to a minimum the amount of time to be spent in making such adaptations.

Many service-dealers are already preparing for much of this sort of work by accumulating and dismantling discarded receivers of all types. The coils and transformers are sorted out and properly identified for easy substitution when the occasion arises. Those components which deteriorate more rapidly, such as filter and bypass condensers, are discarded . . . it isn't fair to the customer to use such components, but parts such as wire-wound resistors, mica and variable condensers, r-f coils, chokes, etc., normally have a far longer life than those previously mentioned and therefore serve as useful replacements.

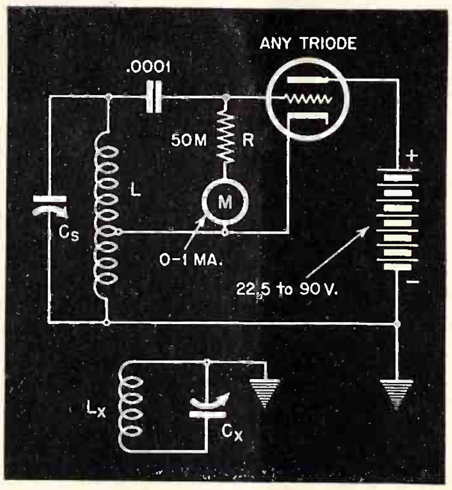


Fig. 1. . . The grid-dip oscillator circuit shown was formerly a favorite in service shops, for checking and matching coils and condensers. When the coupled circuit, Lx-Cx, is tuned to the oscillator frequency, the meter reading dips.

Rewinding Coils

In this article we are concerned primarily with coils and tuning condensers, especially the former. In the early days of radio, it used to be the practice to rewind r-f coils, when replacements became necessary. This is no longer practical because of the special machine windings now employed, which cannot be duplicated by hand. However, it is still possible to make minor adjustments in coils, so as to improve tracking when installed in a receiver for which they were not designed. And in fact, with a little practice, you will find that many coils may be peeled down to cover ranges for which they were not originally intended. We do not recommend that extensive changes be tackled, however, except in an emergency, because such jobs are difficult and time-consuming.

The grid-dip oscillator, shown in *Fig. 1*, is one of the earliest service shop tools for matching coils. It operates on the principle that a resonant circuit, when tuned to the same frequency as that of the oscillator, will absorb power from the oscillating circuit to which it is coupled.

The decrease in oscillator power is indicated by a decrease in the current reading of a milliammeter or microammeter connected in series with the oscillator grid leak. Thus, in the circuit shown, the oscillator circuit is formed by the coil *L*, shunted by its tuning condenser *Cs*. Normally the current through the oscillator grid leak will be of the order of 0.1 to 0.8 ma, depending upon the type of tube used, the amount of B supply voltage and the Q of the coil and condenser circuit. When another coil, *Lx*, is coupled closely to the oscillator coil *L*, and is tuned to the same frequency as the oscillator by means of the tuning condenser *Cx*, some of the oscillator energy will be drawn away from the oscillator circuit. Therefore less current will pass through the oscillator grid meter and the reading will decrease. The maximum amount of energy will be consumed in the coupled coil when it is tuned to exactly the same frequency as the oscillator coil. Therefore the minimum reading of the grid meter indicates that the coupled coil *Lx* is tuned to the oscillator frequency. If all adjustments are then allowed to remain the same, and another coil is substituted for *Lx*, the second coil may be matched by *Lx* by removing or adding turns until the oscillator grid meter again dips to a minimum reading at the same frequency.

This is all right if we have only one frequency to worry about. Unfortunately, in the case of r-f coils, we have to be sure that coils match not only at one frequency, but also at other over the tuning range of the receiver. Thus it is possible for one coil to have greater distributed capacity than another, in which case we would have to peel off more turns to bring its inductance down below that of the coil to which it is to be matched, because the distributed capacity combines with the tuning capacity to lower the frequency, and this can be offset only by decreasing the inductance of the coil. When this is done, the coils are matched at only one frequency. If the distributed capacity of the coil and circuit is low with respect to the tuning capacity, it doesn't matter much, because the change in tuning capacity will be the governing factor in the ultimate frequency. But when the tuning capacity is small, as occurs when tuning near the extreme high-frequency end of a band, the change in frequency for a given change in condenser setting will not be the same if the distributed capacity in each tuned circuit is not the same.

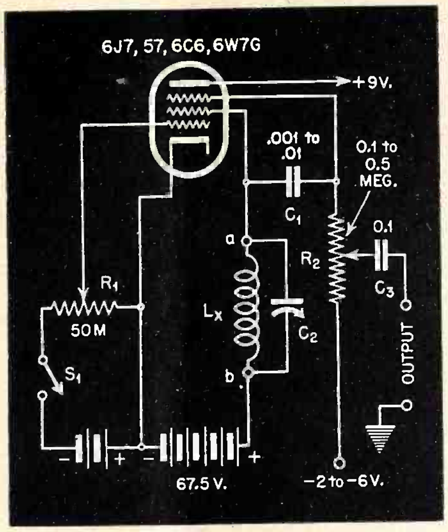


Fig. 2. . . . This modern Transitron oscillator circuit requires no tapped coil and simplifies matching of coils and condensers.

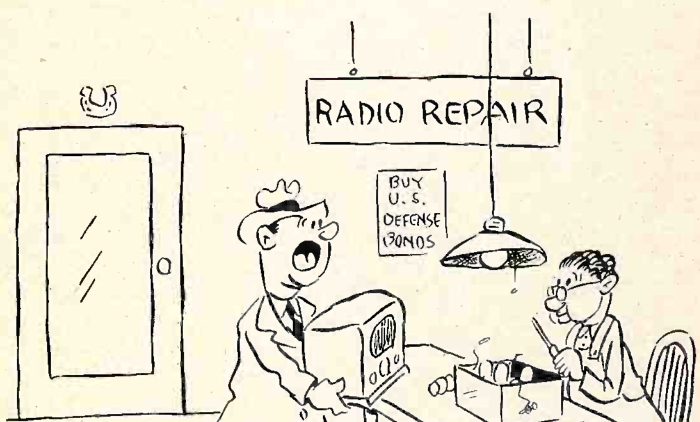
For example, let us assume that the distributed capacity of one coil, along with its associated circuit wiring, is 40 mmf, and that of the tuning condenser section, at one setting, is 30 mmf. The total shunt capacity is thus 40 plus 30 or 70 mmf. Now if the condenser setting is changed to 20 mmf, representing a definite frequency change as indicated by the dial calibration, the total shunt capacity will be reduced to 60 mmf. The change in dial calibration of frequency is proportional to the square root of the change in capacity. If correctly calibrated, then, the frequency change would be equal to the square root of the ratio of 70 to 60—about 1.08 to 1. Thus if the original frequency with 70 mmf in shunt were 1000 kc, the frequency with 60 mmf in shunt should be 1080 kc. The dial calibration would be in accordance with these figures.

However, if the distributed capacity of the coil and circuit were 50 mmf, necessitating peeling off turns to reduce the inductance so that the desired frequency would be reached with the same gang condenser shunt capacity, the total shunt capacity would be 80, instead of 70, mmf as in the first instance. Now if we again change the gang condenser setting by the same amount, 10 mmf, we will have reduced the total shunt capacity to 70 mmf. The change in frequency will be the square root of the ratio of 80 to 70, or 1.06 to 1. Thus in this instance the resonant frequency would be 1060 kc where, with the first coil considered, it was 1080 kc. The two circuits, if ganged together, would be badly out of line.

Compensation

While a difference of 10 mmf in total circuit capacitance is not unusual, it must be understood that the distributed capacitance of the coil alone will be only a portion of the total, so that other factors, such as wiring, tube capacitance, sockets, etc., also must be taken into consideration if proper matching of circuits is to be secured. Because all leads for all circuits cannot be made exactly the same length, and the same distance from the chassis, there will always have to be methods of compensation, such as trimmers or variable iron cores, to make up for small differences in distributed capacity. A very important point in this regard is the fact that too much dependence cannot be placed upon trimmer adjustment to equalize cir-

"Every cent I had went for my taxes. Will you give me four hundred bucks for the 4 good coils and 2 good tubes in this set?"



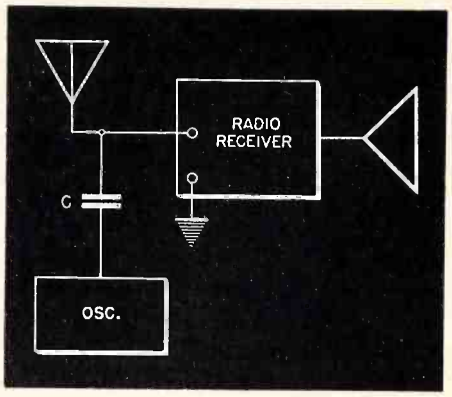


Fig. 3. . . . By beating the oscillator signal against that of a broadcast station to which a receiver is tuned, any slight variations in frequency may be detected, making more precise matching possible.

cuits. For, as has been shown, if there is an appreciable difference in the distributed capacitance of two circuits, proper tracking cannot be obtained when using gang tuning condensers of identical capacity. This means that the utmost care must be taken to keep leads dressed properly in position, as intended in manufacture, so that variations in distributed capacitance are not thus introduced. This applies also to the use of any of the coil-matching or condenser-matching operations to be described—leads to coils under test must be kept the same length (preferably short) and in the same position for all tests.

The circuit of *Fig. 1,* while useful for rough checking, is not sufficiently precise in operation for proper coil matching in modern receivers of the superheterodyne type. In order to get an appreciable dip on the meter, it is necessary to couple the coil under test fairly closely to the oscillator coil. When this is done, the dip extends over a rather broad range as the condenser is tuned, so the resulting match is far from exact. It is better to use some arrangement which does not require close

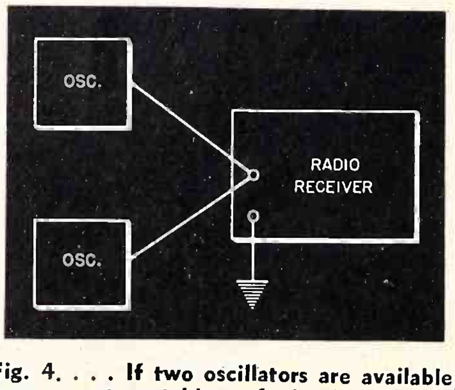


Fig. 4. . . . If two oscillators are available, more exact matching of circuits is made easier. The receiver is used to detect differences in the beat resulting when both oscillators are operating at nearly the same frequency.

coupling, yet which gives great sensitivity.

Transitron Osc. Circuit

One such method is shown in *Fig. 2.* This is the negative conductance, or transitron, oscillator circuit which was introduced about five years ago and which has many uses in any service shop or laboratory. The coil need not be tapped to make the circuit oscillate, so it is possible to connect the coil under test directly in the oscillator circuit, using a receiver or other device to check the oscillator frequency. Note that the screen voltage is higher than the plate voltage. Actually, the two tube electrodes which directly cause oscillation are the screen and suppressor, the control grid serving merely to vary the amplitude of oscillation as its bias is varied. The plate potential is not at all critical and about the sole precaution necessary is to keep it about one-third or less than the screen voltage. In operation, the control grid voltage is first set to zero (connected to cathode by adjustment of *R1*). When the coil under test is connected to the terminals *a-b,* oscillation takes place. This oscillation may be picked up by a sensitive receiver if the oscillation frequency is within its range, or of a lower frequency than the receiver tuning range. Usually we will know the approximate frequency, or at least the frequency band, over which the coil is supposed to operate. Then it is simply a matter of tuning the receiver to some point within this range and then adjusting the oscillator frequency, by means of the shunt condenser *C2,* until the signal is picked up by the receiver. Because the signal is unmodulated, it is better that the receiver be equipped with a tuning eye, to indicate resonance, though the thump or swish which occurs when an unmodulated signal is being received will serve to show the proper point has been reached.

Determining Frequency of Unmarked I-F's

For intermediate frequencies, the oscillation frequency may be determined by means of harmonics. This is useful in determining the operating frequency of i-f transformers which are unmarked or which have been reclaimed from some defunct receiver. To do this, insert the tuned winding, either primary or secondary, between the terminals *a-b* (*Fig. 2*) and omit the tuning condenser *C2.* The oscillator will now function at the operating frequency of the i-f coil. Now tune the radio receiver until this signal is picked up at some point near the low-frequency end of the dial. Note the frequency. Then retune the radio receiver carefully and slowly to a higher frequency until the i-f signal again is picked up. The difference in frequency between the point at which the signal was first picked up and the next higher frequency at which the signal is received is equal to the i-f operating frequency of the coil. Thus, if the i-f coil is operating at 280 kc, harmonics will be picked up at 560 kc (2nd harmonic) and 840 kc (3rd harmonic) and the difference in frequency between these two harmonics is equal to the intermediate frequency at which the coil functions. Of course, other harmonics will appear at every consecutive 280-kc point over the tuning range and any two of these points may be chosen for reference, if desired. Usually, however, the calibration is more accurate for the lower frequencies on receiver dials.

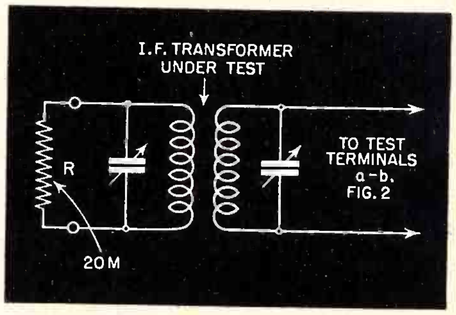


Fig. 5. . . . I-F transformers may easily be pre-tuned before installation by connecting each winding, in turn, in the oscillator circuit and adjusting it to the required frequency. The resistor R is shunted across one winding to prevent a double peak being obtained.

This method, as outlined above, also serves to provide a ready means of pre-tuning i-f transformers to any desired frequency before installing as a replacement. This saves much time otherwise wasted in "finding the way," which always occurs when transformers considerably off frequency are used.

The adjustment of *R1* in *Fig. 2* controls the amount of plate and screen current, and therefore the strength of oscillation. For best wave form, the strength of oscillation should be very low. This occurs when a high negative bias is applied to the control grid, so that the circuit barely oscillates. When so adjusted, the frequency may most readily be duplicated. We need strong oscillations and bad waveform, however, when tuning to harmonics is required, as in the application just described.

The suppressor grid should receive a negative bias to avoid grid current, which would cause distortion in the output wave and also broaden the tuning, thus making careful matching of coils rather difficult. *R2* is made variable so that, when direct coupling of the output to a receiver, amplifier or v.t. voltmeter is required, the signal level may be adjusted as desired. In general, a receiver is used for i-f and r-f signals, and the v-t voltmeter or audio amplifier and output meter for audio frequencies.

This oscillator functions over a frequency range extending from the lowest audio frequencies to 10 or 15 megacycles. The coupling condenser *C1* should be small for r-f and i-f frequencies (.001 or less) and larger for the lower audio ranges. When iron-cored chokes are used in the tuned circuit, variation of *R1* (which changes the control grid bias) affects the current through the choke and, consequently, its inductance. This current value should be maintained constant when checking such coils.

Method of Matching Coils

A most precise method of matching coils is to beat the test oscillator signal, derived from an oscillator of the type shown in *Fig. 2*, against another signal of fixed frequency. A method of doing this is shown in *Fig. 3*. The test oscillator signal is coupled to the antenna post of a receiver, which has been tuned to a broadcast station signal. The test oscillator frequency is then adjusted to approximately zero beat with the broadcast signal. This can be detected in the loudspeaker. When this condition is reached, a change of frequency of only a few cycles can readily be detected in the loudspeaker by a variation in the pitch of the beat. A method similar to this, but involving a standard beat-frequency oscillator, is in general use for production matching of coils.

It is sometimes better to use a slight modification of the method just described. This is done by substituting another oscillator, similar in design to the test oscillator, for the broadcast signal. This arrangement is shown in *Fig. 4*. The advantage is that any drift in oscillator frequency—and it is not to be expected that any simple oscillator is going to be as stable as a crystal-controlled broadcast station signal—will occur in the same direction and be of approximately the same extent if oscillators of similar design and construction are used. For the purposes of service testing, this refinement is hardly necessary, but it is useful in laboratory work. In fact, the proper functioning of a beat-frequency oscillator is based on just such considerations.

We have mentioned the pre-tuning of i-f transformers as one useful application of the coil-matching equipment. In making such adjustments of the coils, the winding which is not being adjusted should be shunted with a resistor so that the effect of its close coupling to the coil being tuned will not cause misleading results. Otherwise a double peak may result, one peak at the frequency to which the winding under test is adjusted and the other at that of the remaining winding. By shunting a resistor of the order of 20,000 ohms across the winding not being adjusted, the reaction due to its being coupled to the circuit being tuned is greatly reduced and no double peak results. If the transformer has three windings, both coupled windings should be shunted by resistors. After each winding has been tuned, no resistor need be shunted across it when tuning other windings because all will be resonated to the same frequency when each adjustment has been completed.

Selecting the Transformer Tap

One problem which faces all of us is that of selecting the proper tap on an output transformer to match that of the voice coil of a speaker, when the voice coil impedance is unknown. Or we may know the impedance of the voice coil but not that of the transformer at the various taps. Occasionally, we won't know either. In any event, a proper match may be secured by connecting the units involved in the simple circuit of *Fig. 6*. As shown, an audio signal, usually 400 cycles, is fed through an audio coupling transformer (which may be any conventional interstage variety) to a speaker voice coil and tapped output transformer, in series. The output is connected to an audio amplifier and output meter, or to a v-t voltmeter, by means of a single pole, double throw switch. When this switch, *S1*, is on *point a* the signal voltage is noted. Then the switch is moved to *point b* and the output transformer tap selected which most closely produces the output signal previously noted with the switch at *point a*. This is the tap which provides the best impedance match.

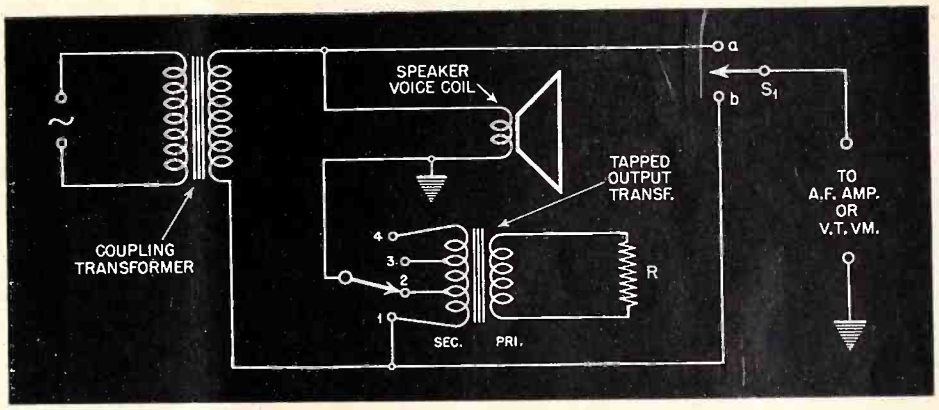


Fig. 6. . . . This simple circuit permits matching output transformers to the speaker voice coil. The speaker field should receive normal excitation.

It is of course possible to use any conventional bridge circuit for matching purposes, but the circuit shown in *Fig. 6* is simple and may be set up with a minimum of effort and requires few components. Bridges are rather scarce these days, and never were plentiful in service shops. However, if you happen to possess such an instrument, it is convenient first to measure the impedance of the speaker voice coil by inserting it into the bridge arm for unknown impedances, making certain that the field is properly excited. Note the voice coil impedance thus measured. Then check the output transformer by substituting it for the voice coil. The same signal frequency is used. The tap on the transformer which provides the same impedance, or the nearest to it, is the one to use. In these tests the speak-

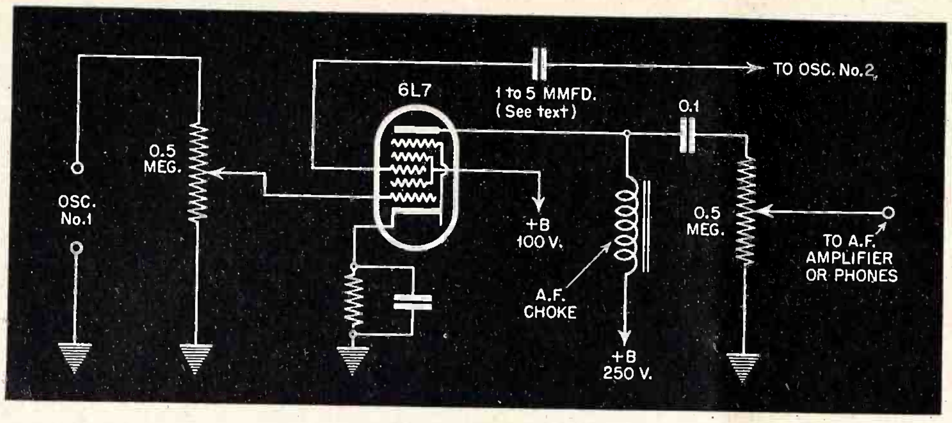


Fig. 7A. . . . A 6L7 can be used as a mixer for two oscillators, thus obtaining beat-frequency operation in the audio range.

er field must receive normal excitation and the primary of the output transformer under test must be loaded with a resistor *R* of a value equal to its rated primary impedance. If a push-pull primary is used, the resistor *R* may be shunted across both windings, leaving the center tap open. *R* should then be equal to twice the rated reflected impedance of each winding. If none of these primary ratings are known, the resistor *R* should be made equal to twice the plate resistance of the output tube with which it is to be used, if a triode, and to one-fifth the plate resistance of the output tube, if a pentode. These values are to be doubled for push-pull operation.

The oscillator circuit of *Fig. 2* may be adapted to beat-frequency audio work by means of a mixer circuit such as is shown in *Figs. 7A* or *7B*. Two oscillators are required, and and they should be carefully shielded from each other. As indicated, the output of one oscillator is fed directly to *grid 1* of the 6L7 (*Fig. 7A*) applying a strong signal to this grid. The signal frequency should be of the order of 100 to 300 kc—no higher. A second oscillator, using identical circuit constants—coil and condenser—is arranged to feed a weak signal to *grid 4* of the 6L7. The strong and weak signals then beat against each other and produce in the output circuit of the 6L7 a variety of signals, but our principle interest is in the difference frequency. Thus if oscillator no. 1 provides a 100-kc signal and oscillator no. 2 gives a 101 kc signal, the difference frequency in the output circuit of the 6L7 will be 1 kc, and this 1000-cycle signal is very useful for test purposes.

Assuming that we have adjusted these oscillators so that a 1000-cycle frequency is obtained, we may substitute coils in one of the oscillators, and when each coil is adjusted so that the 1000-cycle output signal is obtained, all other factors remaining the same, we shall have matched the coils. Similarly, if we substitute condensers instead of coils, two condensers which give output signals of identical frequency will have the same capacitance. This is particularly useful in checking small micas, which may have the wrong values marked or may not be stamped or coded at all. For small condensers, a calibrated variable condenser shunted across the coil in the oscillator enables direct measurement of the capacitance value. If this condenser is first adjusted to say 500 mmf capacitance to produce the reference 1000-cycle beat and another capacity is placed in shunt with the 500 mmf, then the variable condenser setting must be reduced until the same output frequency is again obtained. The amount by which the original 500 mmf must be reduced is thus equal to the value of the unknown capacitance which was shunted across the 500 mmf. For example, if we shunt a .00025 condenser across the 500 mmf variable, the total capacitance would be 750 mmf. By decreasing the 500 mmf to 250 mmf the original 500 mmf is regained and the original output frequency is restored.

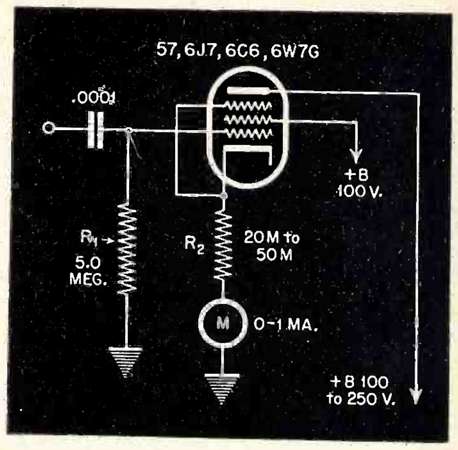


Fig. 8. . . . This simple circuit forms a useful vacuum tube voltmeter which has a wide variety of applications for r-f, i-f and a-f measurements.

Of course, for matching condensers, it is unnecessary to have a calibrated tuning condenser. All we are concerned with as that two or more capacities be alike. They will be identical when each produces the same output frequency when shunted in turn across the oscillating circuit, and they may be checked by substitution as described previously.

Using Dual Triode As Mixer

The circuit of *Fig. 7B* but a dual triode is employed in place of the 6L7. The only essential in any beat-frequency oscillator design, insofar as a nice, clean audio signal is concerned, is that one of the beating oscillator signals be much stronger than the other. For low distortion at low frequencies, the ratio should be at least 10 to 1. This is achieved by a very small coupling condenser in the two circuits shown. In fact, in some designs, coupling is obtained by simply twisting together two in-

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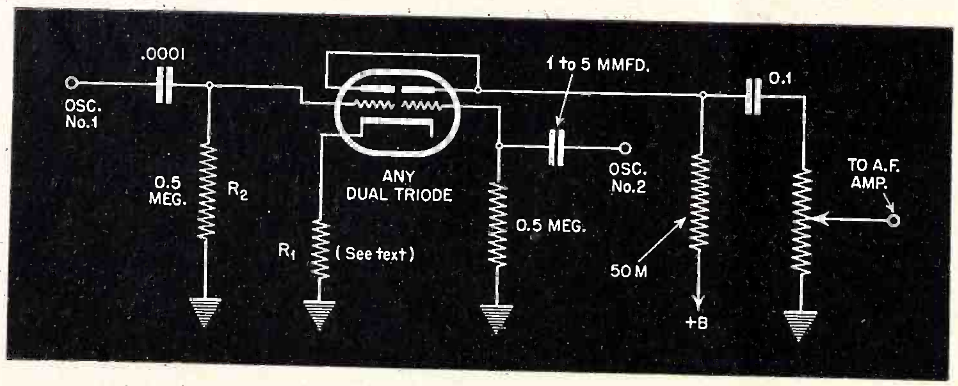


Fig. 7B. . . . It is also possible to use a dual triode as a mixer. The signal strength from one oscillator should be at least 10 times that of the other for good wave form.


stevens

CHAOS FAST APPROACHING

by San D'Arcy

As the editorials of Radio Service Dealer have repeatedly said, the shortage of replacement radio parts and tubes becomes more acute with each passing day. This article is a very frank and accurate coverage of the entire matter.

W.P.B. has not, up to April 10th, provided manufacturers with allocations of materials to be used in fabricating parts for civilian repairs. There's been a lot of publicity given to so-called "Victory" or "War Lines," particularly by the American Standards Association. But the fact remains that no actual production of parts has begun; actually no materials allocations have been made and W.P.B. is not at all reassuring that such allocations ever will be given. It's time we had results, not promises!

That service-dealers have been able to keep in operation thousands of old sets, by means of circuit revisions and parts substitution methods, is a monument to their ingenuity and good faith in their trust. No outsiders or associations should attempt to bask in the glory that is entirely the service-dealers'. How much longer this group of Trojans can do a lot with nothing is a moot question.

Another unwarranted and absolutely unjustified obstacle, which in large measure prevents service-dealers from affording many set owners the service they desire and deserve, is the O.P.A. directive and restriction whereby service-dealers can only obtain "B" gasoline rations. "B" cards allow approximately 470 miles of occupational driving monthly, or 360 miles in gas-shortage areas.

The publisher of "RSD" has frequently cited to O.P.A. that in normal times the average urban service-dealer drove 1200 occupational miles monthly. The war took 50% of the nation's servicing organizations out of the field. Now the average urban service-dealer, statistics show, requires more than 2000 occupational miles of gas monthly for the purpose of servicing non-portable home radios only. Note . . . *non-portables only!* O.P.A. is reasonable in demanding that owners of portables must bring in their own sets for service.

O.P.A. Restrictions Are Apparently Based Upon Erroneous Assumptions or Incorrect Data!

Chief Counsel of O.P.A.'s gas ration section, Mr. W. R. Koerner, wrote a letter on April 7th in which he stated, " . . . *our office has held that radios are entertainment devices, the repair of which is barred from preferred mileage under Order 5C . . . it has been found that the denial of preferred mileage for radio repair will not interfere with the maintenance of sets, since most are portable.*" The first portion of Mr. Koerner's letter to Mr. Cowan (publisher of "RSD") is undoubtedly true, for radios *are* entertainment devices. That they have other functions to aid the war effort which by their very nature *should* make them eligible for gas rations is besides the point. But the next statement of the Chief Counsel is contrary to fact, as Mr. Cowan has advised Mr. Koerner in a letter mailed Apr. 9th. Said Mr. Cowan, "All accurate statistics on the subject, from the reports of the Radio Manufacturers Ass'n down to and including U. S. Gov't figures show conclusively that on Jan. 1st 1941 and again on Jan. 1st, 1942 there were more non-portable receivers in the U. S. than there were portable types."

So, it would seem, the O.P.A. assumed, but wrongly so, that the bulk of home sets are of the type that can be lugged around by the layman. As a matter of fact, statistics show that the bulk of all radio service work now being submitted to service-dealers is in the realm of non-portable types. And because of insufficient gas supplies, these non-portables are not getting the service they should have, thousands becoming inoperative every day. To add to the confusion, small portables, particularly AC-DC types, have gone dead by the thousands because there aren't renewal tubes available and the added strain put on the big, older sets, is a reason for them showing a higher ratio of breakdown than would be normal.

Mr. Koerner also stated that "The continuing critical shortage of rubber makes it unlikely that we shall be able to relax the restrictions on the allowance of gasoline rations for preferred mileage." That was on April 7th! To refute the erroneous O.P.A. assumption regarding the rubber shortage Mr. Cowan replied, "All daily newspapers carried a headline (on April 8th) announcing that Rubber Director Jeffers stated that a big surplus of new car tires is on hand and that 12 million such new tires will be available for distribution in 1943 as against less than 3 and a half million during 1942." So, wouldn't it seem that perhaps O.P.A. is predicating its decisions on erroneous bases? One might even accuse O.P.A. of vacillation, whether intentional or not.

Captious criticism is valueless. The only way to obtain just decisions on questionable points is to submit evidence and let it be judged on its merit. Getting back to W.P.B., that body might be interested in facts to prove how acute the parts shortage is. Perhaps, after reading the following "case histories," and others of similar nature that may come to light, W.P.B. will get going on replacements.

Case Histories on the Acute Parts Shortage

At the turn of the year some rather interesting facts and figures came to light through the good graces of Harry E. Ward who handles public relations for the Radio Technicians Association of Long Beach, California. We had asked Mr. Ward to give us actual case histories and records of the status quo on servicing in his territory so the information could be presented to War Production Board and OPA for their consideration and possible alleviation. Here is a partial tabulation which shows how many typical Southern California service-dealers were faring on December 9th, 1942. The figure under "total" as given below represents the number of non-repairable receivers the respective service-dealers had in stock, non-repairable either because of the tube or parts shortage.

Dealer	Total	Held Up for Tubes	Held Up for Other Parts
Listenwalter & Gough 1163 Pine Ave., L. B.	10	4	6
McNeil Radio 2312 Pacific, L. B.	12	12	..
United Service 535 E. Anaheim, L. B.	12	12	..
Barnett Radio 226 No. Downey Blvd. Downey, California	180	25	155
Fred S. Dean Company 400 American, L. B.	50	15	35
Richardson Radio Service 5431 Dairy Avenue, L. B.	10	10	..
Rundquist Radio 374 Bellflower Blvd. Bellflower, California	125	50	75
Ward Brothers Radio 2916 East Anaheim, L. B.	50	15	35
Signal Radio 3395 Orange Avenue, L. B.	20	20	..
O. K. Radio Laboratory 1504 East Broadway, L. B.	15	15	..
Turner Radio & Music 523 East Broadway, L. B.	10	..	10
Spencer Radio 315 East Compton Blvd. Compton, California	25	15	10
	519	193	326

What Other Dealers Say—

On Feb. 11th R. F. Adair of Adair's Radio & Appliance Store, Long Beach, had this to say, "The tube shortage is our greatest problem at present. We have more than a dozen sets tied up in our shop now for lack of tubes. We are refusing from twenty to thirty people daily who ask to buy tubes of the types that we cannot obtain from the distributors, also, we are having to turn down many repair jobs for the same reason. This condition is getting worse as weeks go by and so far no relief is in sight."

E. R. Paul of Pacific Ave. Radio Service wrote, "At the present time we have in our shop several radios for which we have been unable to get parts for repairs. Most of these sets belong to customers who have but the one radio in their home. Most of them are without a radio for weeks."

"It has been our understanding that the government intends that there should be enough parts manufactured to keep all radios playing, but it is becoming increasingly difficult to procure these parts.

"The parts needed most are the following tubes:

12 Series and 12S Series Tubes; 75s; 50L6s; 1 Series and 1L Series and 5U4s.

Other tubes are becoming scarcer all the time."

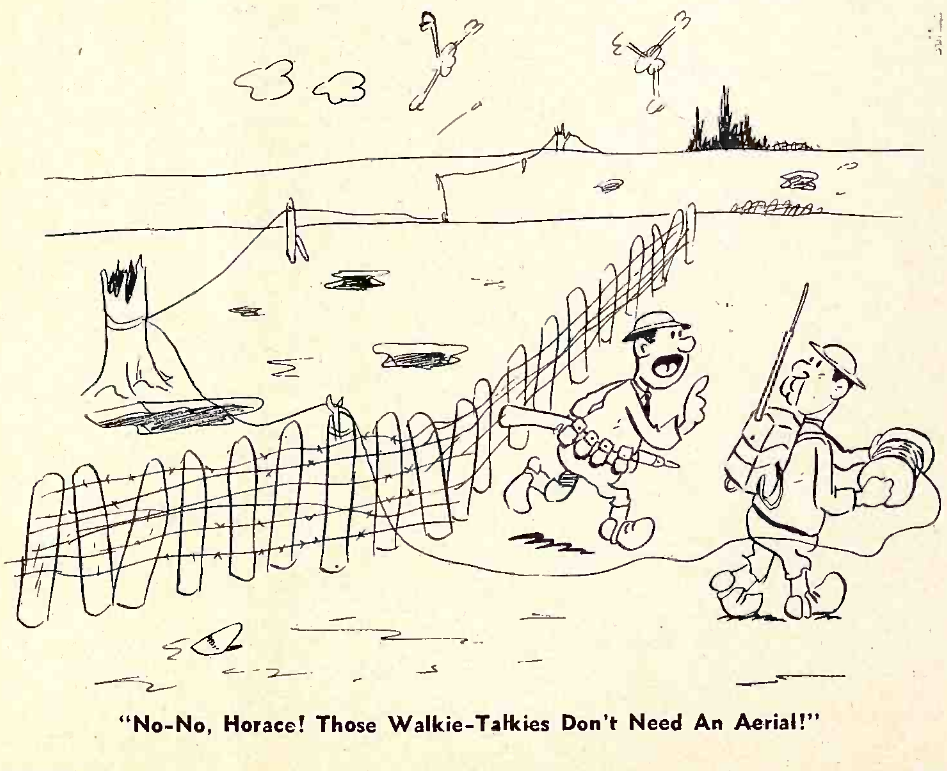
We could close this discourse with a tabulated list of over 700 tubes that Lawrence Bros. Appliance Co. needs badly, along with 28 transformers, 270 condensers and 55 volume controls. It would serve no purpose for practically every reader finds himself in the same position, with disgruntled radio set owners piling up a huge back-log of sets that simply cannot be made operative due to present shortages. One further bit of information comes to light, on the subject of deferment from the draft, and it is worth recording for the benefit of readers who might labor under the impression that they are positively deferable merely because they are radio repairmen. Also, we might mention the short-sightedness of certain jobbers who are adding their share to the general confusion. We'll take them in order.

Draft Status Becomes Questionable

In Bellflower, California there is a radio service laboratory which serves a community of nearly 60 thousand people, 85% of whom are defense plant workers. This shop is refusing from 10 to 45 repair jobs a day, has a steady backlog of over 100 sets in the shop, (ofttimes the backlog goes as high as 250 receivers). It refuses to service any type of mobile or auto radio. In addition the owner is a member of the Civil Air Patrol Squadron, teaches a class in radio for C.A.P., also handles radio maintenance for the Long Beach Airport and in spare time keeps in repair the civic air-raid warning communications systems.

On the surface one could understand why such a man would be considered "essential" to the war effort but, his local draft board has decided otherwise and has reclassified the man into 1-A, ordering him to report for induction on April 1st. The facts speak for themselves! Our manpower is not being used to best advantage through an induction of this type. When many thousands of home receivers are forced into disrepair, when civilian defense and air terminal communications are made sub-

(Continued on page 21)



"No-No, Horace! Those Walkie-Talkies Don't Need An Aerial!"

Cathode Ray Tube Theory, etc.

(Continued from page 11)

Now that we have briefly discussed the various components of an oscilloscope and learned something of the functioning of the components thereof we will pass to a brief study of Lissajou Figures. When varying voltages are applied to the deflecting plates of a cathode ray tube, a pattern is obtained on the screen. The shape of this pattern depends upon the wave forms of the applied voltages, their frequencies and phase relationships. *Fig. 9* represents a sine wave voltage applied to the vertical pair of deflecting plates of a cathode ray tube and an identical

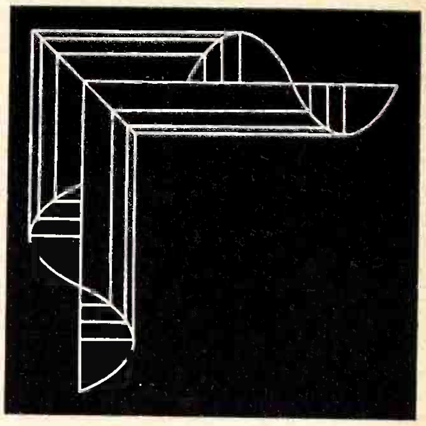


Fig. 9. Frequency ratio 1:1—Applied Voltages in Phase.

voltage applied to the horizontal deflecting plates. The resulting pattern is a straight pattern, or line, having a 45° slope. *Fig. 10* shows the summation for two identical voltages having the same amplitude but 90 degrees or 270 degrees out of phase. The resulting figure is a circle.

Many other combinations are possible and for those readers who are

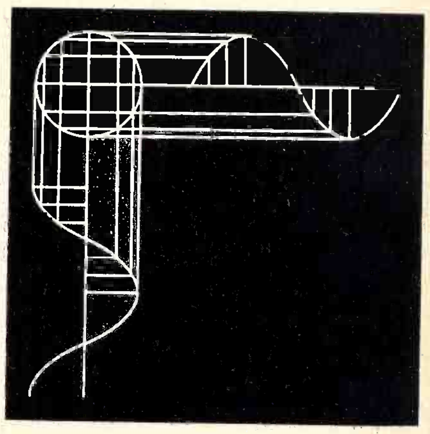


Fig. 10. Frequency ratio 1:1—Applied voltages 90° out of phase.

interested in the further study of Lissajou Figures, the bibliography following this article should be consulted.

The use and applications of the Cathode Ray Oscilloscope is of such scope to entail considerable explanation and is therefore left to another article which will appear in RADIO SERVICE-DEALER.

Bibliography:

Books:

Electronics—Millman and Seely
Engineering Electronics—Fink
Electron Optics in Television—Maloff and Epstein
The Cathode Ray Tube at Work—Rider
Ultra High Frequency Techniques—Brainerd
A Guide To Cathode Ray Patterns—Bly

Chaos Fast Approaching!

(Continued from page 19)

ject to inefficient operation because of a man like this being considered expendable to civilians and not to actual military service, it is time for a review of values. There must be (according to the War Department's official report to Congress) 14 men on the home front to serve each fighting man, and Southern California can ill spare a loss of morale amongst war plant workers due to instances such as this.

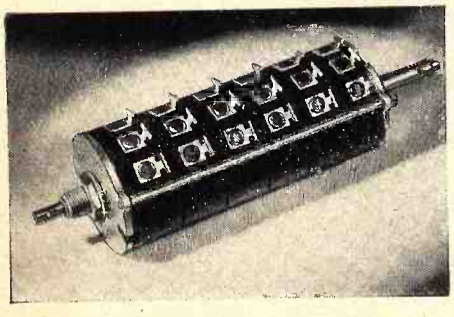
The Jobber's Short-sightedness

Many parts jobbers are still selling over-the-counter to any Tom, Dick and Harry who walks in with ready cash. The distributor must not hoard, but he should differentiate between the experimenter and professional repairman, favoring the latter with trade discounts and restricting sales to essential users. Wasteful distribution is rampant in Southern California and particularly now such tactics impair efforts to obtain concessions from the War Production Board. One source suggested that jobbers be restricted to sell only to "licensed" technicians. Nationwide licensing of radio maintenance men has not yet been attempted, but should it come about, the cessation of hostilities would find barriers set up against the radiomen who wish to return to their pre-war occupation. The alternative is this—let all men in all phases of radio sales and service use common sense. Only in that way can we do our prime duty, that of keeping one set in every home in operation.

★

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.



Clarostat Tandem Control.

The metal and discs and tie rods hold the cases together and provide rigidity. The single shaft passes through and locks with each rotor in the stack. The finished assembly is to all mechanical intents and purposes a single control with a plurality of independent sections for as many independent circuits. 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.

"42" Series 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.

★

WAR PRODUCTION DOES NOT STOP

»» The Snyder Mfg. Co., makers of Radio Antennae and associated products has purchased a new factory at 22nd and Ontario streets, in Philadelphia, Pa.

This new factory will provide ample space for government contracts and sufficient room for the enlargement of Snyder's post-war lines.

A Sensitive Output Meter

by Willard Moody

IN alignment of a radio receiver, a signal generator having a fixed tone is used. The frequency is usually near 400 cycles. A series resonant circuit as shown in Fig. 1 will pass a maximum amount of current at 400 cycles, and since the choke has a high inductive reactance, resonant voltage step-up will occur across it. The result is that the meter is made very sensitive, which is desirable for alignment.

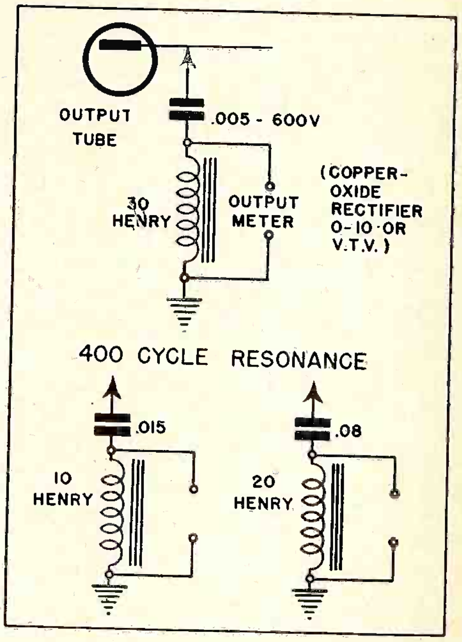


Fig. 1. A Series Resonant Circuit.

For generators which have other values of modulation frequency, a similar circuit can be used, and different values of capacity selected experimentally until the one giving the greatest meter deflection is found.

The loading effect on the circuit of the receiver is negligible at frequencies away from resonance and is practically zero at resonance.

SOLAR AWARDED ARMY-NAVY "E"

»» The Solar Manufacturing Corporation, Bayonne, N. J., has been awarded the Army-Navy "E" for excellence in the production of war equipment.

This company has been manufacturing capacitors (mica, paper and electrolytic) "Elim-O-Stats" (radio noise suppressors) and capacitor analyzers since 1932, for industrial, radio, television and service applications.

The presentation of the award was made on Apr. 10th, at which time prominent Army, Navy, State and Civic officials joined with the management and several thousand employees in appropriate ceremonies.

BELDEN WAR CATALOG EDITION

»» The 1943 issue of the Belden Radio Wiring Line Catalog has just been released by Belden Mfg. Co., Chicago.

Catalog 843, as the War Edition is called, completely streamlines the entire Belden line of wires and cables for radio and communications. Only certain numbers are shown which have been selected in an attempt to use a minimum amount of critical materials, reduce idle inventory, and yet make possible the servicing of a maximum range of equipment.

Catalog 843 will service all essential needs with 171 numbers as compared with 467 numbers listed in the previous Belden Catalog 841.

AEROVOX OPENS SECOND PLANT

»» Again stepping up its production capacity to meet the enormous war requirements for mica capacitors, Aerovox Corporation of New Bedford, Mass., announces the opening of a plant in Taunton. This second plant, with some 60,000 square feet of production space will be devoted exclusively to mica capacitors and will virtually double the Aerovox mica output.

Shop Notes

Data presented as "Shop Notes", contributed by service-dealers as a result of practical experience, is carefully considered before acceptance. We believ it correct but we assume no responsibility as to results.

Card 1

BASS BOOSTER

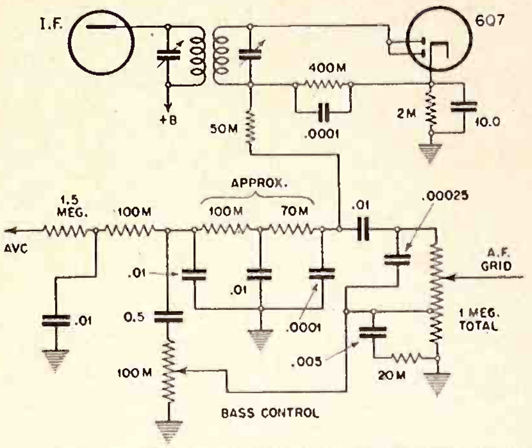
The Bass content of a receiver may be very effectively and easily controlled or boosted, particularly at low volume, by means of the slight circuit revisions shown in the schematic diagram to the right, "Card 2".

Resistors and condensers of various values must be tried to obtain optimum results in some types of receiver, but the values given here are not far away from the most generally suitable.

Submitted by H. F. Gulliver

BASS BOOSTER

Card 2



Card 3

MOTOROLA MODEL 40BW

(Gain Data)

Signal analyzer, generator and receiver grounded to external ground and tuned to 600 KC.

ANT.		1.	through .0002 conds.	600 KC
1A7 GT	grid	2.25		600 KC
1A7 GT	plate	220.	osc. freq.	1055 KC*
1A7 GT	plate	32.	i-f	455 KC
1N5 GT	grid	9.	i-f	455 KC
1N5 GT	plate	1400.	i-f	455 KC
1H5 GT	plate diode	440.	i-f	455 KC
AVC	dc volts measured at Vol. Control 2.3			
1st A.F.	plate	4.3	volts 400 cps	
1Q5 GT	grid	3.7	volts 400 cps	
1Q5 GT	plate	54.	volts 400 cps	

* Do not rock conds. for that one reading. For other tests the gang conds. must be rocked, going to peak.

Submitted by Robert Boudreaux

PHILCO MODEL 41-90

Card 4

(Gain Data)

Sig. anal., generator and receiver grounded. Turn attenuator to high, tune receiver for dip on analyzer gain indicator. Adjust attenuator to give 1.0 at the receiver.

ANT.		1.	through .002 conds.	600 KC
1A7 G	grid	22.		600 KC
1A7 G	plate	100.	osc. freq.	1055 KC*
1A7 G	plate	130.	i-f	455 KC
1n5 G	grid	53.	i-f	455 KC
1n5 G	plate	3000.	i-f	455 KC
Diode	plate	2000.	i-f	455 KC
AVC	dc volts measured at Vol. Control 8.			
1st A.F.	plate	6.	volts 400 cps	
1A5 G	grid	5.	volts 400 cps	
1A5 G	plate	50.	volts 400 cps	

* Do not rock tuning condenser on this one test.

Submitted by Robert Boudreaux

Card 5

SPEAKERS THAT "DRAG"

(Correction Method)

Small speakers that are dragging and have no adjustment can be corrected. Press on each side of the speaker to ascertain which side is rubbing or too close and needs freeing. Then take a pair of pliers and bend, either in or out, the brace that connects the cone frame with the field or magnet.

Submitted by C. A. Tucker

Card 6

3Q5 GT and 1A7 GT

(Salvaging burned out or non-oscillating tubes)

3Q5 GT tubes that have been used in portable battery sets frequently burn out the tap section and usually will test "good" in all other respects when only the tap is "out." Such partially bad tubes can be used satisfactorily for a period of time in a straight battery set that uses such types not requiring a tap.

1A7 GT tubes, used in portable battery sets, that stop oscillating or become weak, usually give excellent results and extended service when used in straight battery operated model receivers.

Submitted by C. A. Tucker

Card 7

HARD-TO-TUNE, "FROZEN" VARIABLE CONDS.

(Loosening to eliminate dial cord slippage or breakage)

Complaint: breakage or slippage of the dial pointer cord caused by excess friction or "freezing" at the gang condenser rotor bearing points. Solution: to ease the tension in condensers not having adjustable bearings, remove the entire gang assembly. Place it face down in your hand and sharply tap the center of the back frame with a light hammer. This tends to spread the metal that binds and releases all excess pressure.

Submitted by C. A. Tucker

Card 8

EXCHANGE PROCEDURE FOR PARTS

(Crosley)

Before certain parts can be sold the old defective unit must be returned. This is due to present materials shortages.

The following parts must be turned in to secure replacements:

Part #	Type of Part
134116	P. B. Tuning Unit
134087	P. B. Tuning Unit
132429	P. B. Tuning Unit
MG3-49912	P. B. Tuning Unit
MG8-49709	P. B. Tuning Unit
MG12-130111	P. B. Tuning Unit
MG10-130409	P. B. Tuning and Function Unit
MG13-130756	P. B. Tuning and Function Unit
MG36-131440	P. B. Tuning and Function Unit
134088	P. B. Tone Unit
132411	P. B. Tone Unit

STANCOR'S NEW TRANSFORMER CATALOG

»» The Transformer Encyclopedia of the Radio and Electronic Industry. Contains detailed specifications covering Stancor's complete line of transformers and chokes for replacement and general purpose use. A handy classified and

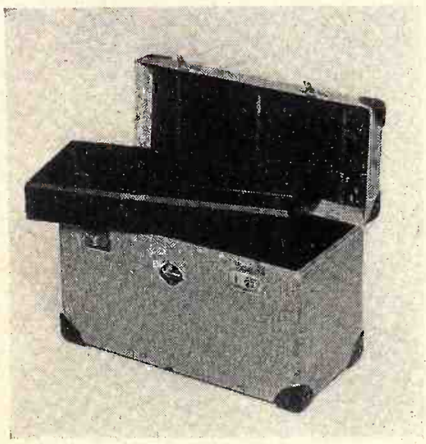
numerical index and price list permit instant location and cost estimate of the item you want. Many pages are devoted to transformers designed for special shop, laboratory, and industrial applications. Catalog is illustrated throughout with mounting types available. Send for your copy of Catalog No. 140 today. Standard Transformer Corp., 1500 N. Halsted St., Chicago, Ill.

★

SYLVANIA SERVICE KIT

»» Sylvania offers a radio service kit. It is attractive, gray tweed-mixture aeroplane cloth—washable and smooth-finished of sturdy construction. It features removable tool tray, metal lock and fittings, leather corners and handle, and plenty of room for tubes, parts and small tools. Inside dimensions are 17 x 10 x 7 inches.

Many servicemen find the service kit an indispensable part of their equipment, because of its convenience and neat professional appearance. They are



Sylvania's Service Kit

available at $3.00 each from Sylvania jobbers or by writing directly by Sylvania Technical Helps, Sylvania Electric Products Inc., Emporium, Pa., specify Kit 1A. Also still available, black leatherette covered Sylvania Kits in two sizes. Kit No. 1 is identical with 1A, except for the covering. Price $3.00. Kit No. 2 has almost twice the carrying capacity. Inside dimensions are 14 x 22 x 8 inches. Deep cover has a leather flap to hold contents in place. Price $5.

NAVY DISCLOSES RCA PRODUCTION FEAT

»» A production feat at the RCA Victor plant which made it possible for fifty-four ships to sail on time from seventeen different American ports, came to light when naval officials authorized the RCA Victor Division of the Radio Corporation of America to make public certain facts relating to a rush order for vital radio equipment.

Where the ships were going, what they carried and whether they were warships or merchantmen are military secrets. All that may be said is that they were awaiting radio equipment (not to be described) and that they were scheduled to leave around the first of the year. To make that possible a new record in high speed production was established.

Shortages of essential materials developed after the initial order had been placed. Suppliers of parts made from these materials delivered some of the units. Then the materials bottleneck cropped up, and precious time flew by while government officials and company executives sought to crack it.

Unexpectedly the break came on December 29. On that date RCA Victor was notified that a first shipment of the badly wanted parts would arrive sometime on the afternoon of the following day. The company was also asked to break all previous production time records in getting out the shipment.

Union shop stewards and foremen got together with aides of the plant's joint labor-management War Production Drive Committee. They worked out co-operative measures. The urgency of the order was made clear to everyone. Men and women workers caught fire with the spirit of the contest against time. They all felt the personal part which they were playing in getting out the equipment.

Geared to rapid change and quick action by more than a year of war work and two years of preparation before Pearl Harbor, RCA Victor's Special Apparatus Division promptly began to maneuver its battalions into new positions. Girls from a second shift were taken from other work and given intensive training in the assembly of naval equipment. They and another already skilled second shift were then formed into a special "graveyard shift" —to operate the eight hours after midnight.

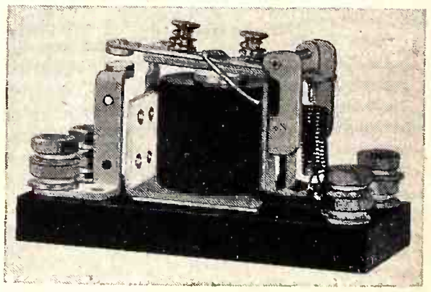
As a consequence all was in readiness in the shops at two o'clock the next afternoon — December 30 — when the parts began to arrive. By three o'clock the job was rolling. The equipment is highly complicated, requiring skilful and delicate handling. But soon the RCA Victor final inspectors were making their checks and passing the finished products to Navy Inspectors for final check.

Deliveries—for the ships—began on December 31, when 45 units were rushed to the docks under Marine escort. On January 1 the delivery was stepped up to 51 units. The final five to complete the order left the plant on January 4.

★

NEW AIRCRAFT RELAY

»» The B-2-A relay described is one of a series in Guardian Electric's new line of units which have been designed for remote control of aircraft electrical circuits. Built to U. S. Army Air Force specifications, unit has a contact rating



of 25 amperes continuous and 100 amperes surge at 24 volts D.C. It has single pole, single throw, normally open contacts. Weighs 6 ounces.

Manufacturer claims unit has acceleration and vibration resistance over 10 times gravity. Metal parts are heavily plated to withstand 200-hour salt spray test. Designed primarily for aircraft, unit is said to have numerous applications in other industries. Descriptive bulletin and full details are available from Guardian Electric, Dept. B-2-A, 1637 West Walnut Street, Chicago, Illinois.

"THIS MAY BE YOUR LAST ONE"

»» "Men's lives are depending on countless types of dry battery operated equipment, and the Burgess Battery Company is working at top-speed to supply thousands of the many types of batteries the United States Army Signal Corps requires. Hence, the shortage of dry batteries on the home-front."

Thus, the Burgess Battery Company warns consumers of the impending shortage of both radio and flashlight

batteries and outlines several simple easy-to-follow rules on dry battery conservation in the attractive leaflet illustrated above.

The ready interest displayed by the number of requests for this enclosure is evidence of the desire on the part of America-at-home to conserve critical war materials.

This enclosure is available to those dealers desiring to aid their customers in a patriotic and necessary war time measure by writing to the Burgess Battery Co., Dept. 304, Freeport, Ill.

★

MUSIC-MANPOWER GAINS

»» Mr. Fred D. Wilson, recently appointed sales manager of the Commercial Sound Division at Operadio Manu-

Fred D. Wilson

facturing Company is devoting his efforts intensively to the application of music and voice-paging to manpower conservation in war industry.

Under Mr. Wilson's direction authoritative research on industrial music is being incorporated into literature for wide distribution to essential industry, and streamlined engineering and production methods have brought the cost of plant-broadcasting within easy reach of the average factory.

VIC MUCHER W.P.B. RESISTOR CONSULTANT

»» Clarostat's Vic Mucher has been appointed a consultant to the Radio and Radar Division of W.P.B. on the dollar-a-year basis. He is subject to call at

Victor Mucher

any time and spends several days in Washington each month. Vic knows resistors, for he's been brought up in a family that has specialized in this field for the past 22 years. Vic also brings to W.P.B. a keen knowledge of the radio parts industry and its present problems.

★

LAIRD NAMED OHMITE VICE-PRESIDENT

»» Roy S. Laird, Sales Manager of the Ohmite Manufacturing Company, Chicago, has been named Vice-President of the company. Mr. Laird will continue in charge of sales.

Ohmite is engaged in producing Rheostats, Resistors, Chokes, Tap Switches,

Roy S. Laird

and Attenuators for war equipment and for industry. Every effort is being made to meet the tremendously increased demands for these products.

Shop Notes

Data presented as "Shop Notes", contributed by service-dealers as a result of practical experience, is carefully considered before acceptance. We believe it correct but we assume no responsibility as to results.

Card 1

SUBSTITUTING AC-DC LINE CORDS FOR BALLAST TUBES

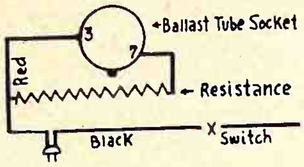
(In Crosley Receivers)

In some cases, when the required ballast tube is no longer available, it is possible to restore operation by substituting an AC-DC line cord, values of which are listed on Card No. 2.

Operating results of receiver will be normal except that the pilot light will not be in the circuit.

To make this change, proceed as follows:

1. Remove burned out ballast tube and old line cord.
2. Select recommended AC-DC line cord and install, connecting black wire to On-Off switch, red wire to pin #3 and resistance wire to pin #7 on ballast tube socket.



Card 2

CROSLEY AC-D-C LINE CORDS

Part #	Resistance	Tubes	Model of Set
34702	325 ohm	1—6.3 1—25.	201
30951	300 ohm	3—6.3 1—12.	166
30487	220 ohm	4—6.3 1—12.5	176
35350 46114	165 ohm	2—6.3 2—25.	425, 428
44917	160 ohm	3—6.3 2—25.	597
45491	140 ohm	3—6.3 (6-8 Pilot) 2—25.	5597
46652 36957 34772	120 ohm	3—6.3 2—25.	588, 503

Card 3

ZENITH CHASSIS 5808

(Weak Reception)

Usually "eye" action is poor or R-F alignment will not track. Might seem like AVC trouble or gassy tubes.

REMEDY: replace R-F screen by-pass condenser. Leakages higher than 15 megohms cause the trouble. Consult schematic. Use VTVM and Ohmmeter.

Submitted by George Batchelder

F. M. ALIGNMENT PROCEDURE FOR CROSLEY MODEL 59 A.M.-F.M. CHASSIS

A.M.-F.M. CHASSIS

Card 4

EQUIPMENT NECESSARY: 1 modulated signal generator accurately calibrated and an output meter.

1. Connect output meter from plate to plate 6V6's.
2. Remove F. M. oscillator tube—6SA7 to right of gang.
3. Connect generator input to #4 pin of 6SJ7 F. M. limiter tube and generator ground to chassis.
4. Set generator to exactly 13.6 megacycles (AM signal with 400 cycle modulation).
5. Turn function switch to FM2.
6. Adjust the discriminator primary and secondary (broad) for peak.
7. Set generator to exactly 13.7 megacycles.

Continued on Card 5

Card 5

8. Adjust discriminator secondary (broad) for null (minimum reading on output meter). This null is very sharp and one peak will be considerably higher than the other.
9. Adjust discriminator primary until uniform peaks are obtained by shifting generator alternately from 13.6 to 13.8 MC, and carefully noting output meter readings.
10. Set generator to exactly 13.7 MC and note null point reading on output meter. Then turn function switch to FM1 (sharp) and adjust discriminator secondary (sharp) to null point. This adjustment is necessary to assure that FM1 and FM2 positions have same cross-over point.

NOTE: The relative height of peaks on FM1 is somewhat less than the FM2 position as can be noted by comparing with readings obtained in operation 9.

Continued on Card 6

Card 6

IF ALIGNMENT

1. Connect generator output to #4 pin of second I-F 6SK7 amplifier.
2. While shifting generator from 13.6 to 13.8 MC, adjust 3rd FM I-F primary and secondary for maximum gain and EQUAL PEAKS.
3. Connect generator output to #4 pin of 1st I-F 6SK7.
4. Follow same procedure outlined in step #2, using just enough output to give a reasonable indication on meter.
5. Clip generator output to 3rd terminal on antenna board and adjust 1st FM I-F primary and secondary, following same procedure as in step #2, using just enough input to give a reasonable indication on meter.

F. M. R-F ALIGNMENT

(a) Check Dial Calibration

Continued on Card 7

Card 7

1. Leave generator output connected to antenna—replace FM oscillator 6SA7.
2. Set generator to exactly 12.5 MC (fourth harmonic is 50 MC). Tune in 50 MC signal on dial null between peaks.
3. Set generator to 10.5 MC (fourth harmonic—42 MC). Tune in 42 MC signal on dial, null between peaks. Correct dial calibration by bending osc. plate on gang.

(b) Set Generator to 11.5 MC (fourth harmonic—46 MC).

4. Remove dipole shorting clip (not on all models) and ground #2 dipole lug. Place a 100 ohm carbon resistor between terminals #2 and #3.
5. Connect signal generator output to #3 terminal.
6. Tune dial to either of signal peaks (not null).

Concluded on Card 8

Card 8

7. Turn FM antenna primary trimmer, item 20, all the way in.
8. Adjust FM antenna secondary trimmer, item 21, for peak.
9. Repeak FM antenna primary.
10. Check at 42 MC (Gen. 12.5 MC), 50 MC (Gen. 12.5 MC), output meter readings should be approximately the same over band, with slight humps on ends.

NOTE: If there is an appreciable variation between readings on the output meter on the frequencies in step #10, carefully repeat complete R-F alignment.

NOTE: If some receivers oscillate at one end of dial and not at the other end, it is possible that the red lead (top) on the FM oscillator coil is too close to the secondary side. This lead should be dressed down toward the chassis and closest to the grounded end of oscillator coil, using top as reference point.

Intermittents With Noise

(Continued from page 6)

which are lightly coupled to the circuits under test. In the absence of a commercial TRFVTVM (tuned RF vacuum tube voltmeter), another receiver may be used, with a small condenser to couple it to the set under test. Tie the chassis together with a .1 mfd condenser, to provide a common ground return for the signal.

A high gain public address amplifier works very well in place of the audio voltmeter, and is even more sensitive. About .0001 mfd will be found large enough to couple the amplifier to the set under test. The audio amplifier of another radio will give enough gain, particularly if headphones are used in place of the speaker.

As in all intermittent testing, we must have the noise present while testing for it, and it may be necessary to wait for the noise to appear. Since most noises are due to some form of poor contact, it is reasonable to expect that the contraction and expansion accompanying heating and cooling of the chassis, will alter the amount of noise. If it develops that the noise is less frequent as the set warms up, it will probably be well to cool the chassis off well before starting to work on it. On the other hand, the noise may be greater after the set gets thoroughly warm. A cloth thrown over it will hasten the warm up.

Fortunately, most arc type noises are not easily or temporarily cured accidentally, especially if electronic test equipment is used. We may usually touch the test prods wherever we wish, while the set is operating, without too much danger of stopping the noise accidentally.

★

This is "RSD's" Fourth Anniversary issue. We'll do our celebrating when the Allied Nations Win The War.—Ed.

$1.00 PAID FOR SHOP NOTES

Write up any "kinks" or "tricks-of-the-trade" in radio servicing that you have discovered. We will pay $1 in Defense Stamps for such previously unpublished "SHOP NOTES" found acceptable. Send your data to "Shop Notes Editor," RADIO SERVICE-DEALER, 132 W. 43rd St., New York City. Unused manuscripts cannot be returned unless accompanied by stamped and addressed return envelope.

SAYS GOLENPAUL—ON PD-1X

»» Many jobbers are easing themselves out of business, warns Charley Golenpaul who heads the jobber sales for Aerovox Corporation. Says Charley: "I have definite proof that many jobbers are not taking the time to check their inventory and fill out the PD-1X form in order to replenish their stock of civilian-radio repair parts. Some of these jobbers are large operators, and they are now loaded with real war business. The excuse they give is that they are too busy filling high-priority orders.

"Well, maybe. But maybe too they are making their great mistake. By their failure to stock repair parts, they are driving trade away from their door. Comes the day when Government war business is no longer being passed around and those jobbers will find themselves more or less out of business. Some may think they will make enough wartime profit to carry them over or even enable them to retire. That theory is cockeyed.

"Many of us at the manufacturing end have done everything possible to keep the jobber in business in spite of the tremendous production strain placed on us by war requirements. Likewise the Jobbers' Association and the Sales Managers' Club have moved heaven and earth to get replacement parts for the trade. The jobber should be appreciative of such cooperation and take advantage of the medium by which he can secure replacement parts for his servicemen customers. Come on, fill out that PD-1X and put it to work!"

Charles Golenpaul

★

NEW LIGHT ANNOUNCED

»» A light signal that operates by fluorescent reflection of "black light," dependably showing signals even in total darkness, is the "Signalette" just announced by Littelfuse, Inc., Chicago.

The new indicator banishes the blur and glare of the light-transmitted signals—does not dim out in bright sunlight, and makes for better vision in night-flying. While the Signalette is primarily designed for aircraft, it is believed that many other uses will be found.

Testing Coils and Condensers

(Continued from page 16)

sulated wires, the capacity coupling through the insulation giving adequate coupling.

We have mentioned that a v-t voltmeter may be used as an indicator in many of these tests. A very simple v-t voltmeter design which is not only suitable for these applications but also for almost any others where r-f or a-f measurements are needed, is shown in *Fig. 8.* As shown, this is a conventional detection circuit for plate detection, such as was used in many receivers some years back. The meter, which may be an 0-1 ma type, is connected in the cathode circuit and a value of *R2* is selected which gives a current reading of 0.2 ma. When an a-c signal is applied to the grid, through the .0001 coupling condenser, the current reading will increase. This v-t voltmeter will give full scale deflection on a 1 ma meter for an input signal of less than 2 volts, r.m.s. It may be calibrated against an ordinary a-c meter of any type, using a 60-cycle line, if the .0001 condenser is shunted by a larger value, say 0.1 mf, and the calibration will then hold for radio frequencies.

The circuit of *Fig. 9* is similar to that of *Fig. 6* and is useful for checking large values of inductance or capacitance. A 60-cycle supply may be used for capacitors of the order of 0.1 mf or larger. *R1* is a potentiometer which may be of any range depending upon the value of capacitance and frequencies at which tests are to be made. When *R1* is so adjusted that the output signal with *S1* on *point a* is equal to that which is received with *S1* at *point b* the reactance of *Cx* at the frequency being used is equal to the resistance of *R1*, from moving arm to ground.

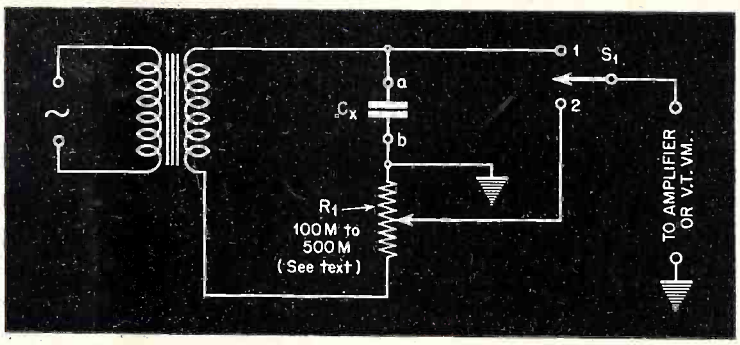


Fig. 9. . . . This circuit may be used for checking large condensers and iron cored chokes. When the signal across R1 is equal to that across Cx, the resistance of R1 is equal to the reactance of Cx at the test frequency.

While chokes are best measured with d-c flowing, in the case of iron-cored types, the circuit of *Fig. 9* is useful to detect faults due to shorted turns, etc., which cause a tremendous loss of inductance. The method of making the tests is the same as for large condensers.

If electrolytics are to be checked, it is recommended that a polarizing voltage be applied. This is done by connecting a battery, with a high resistance in series, and shunting it across the condenser under test. The polarity of the battery should match that of the condenser. For rough tests, it is necessary only that the battery voltage be greater than the peak a-c test voltage being used. Of course, leakage is important in checking such condensers, too. A suitable circuit which takes care of all such required tests was published in the March, 1941, issue of RADIO SERVICE-DEALER.

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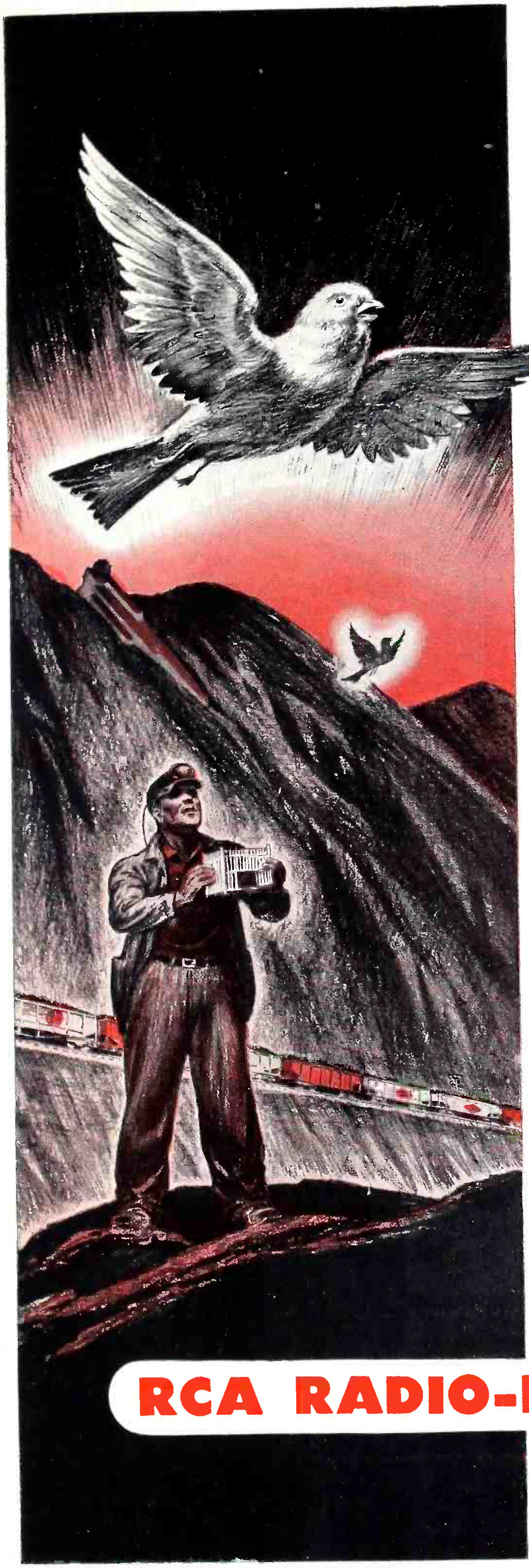

GOODBYE, CANARY BIRDS

. . . 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 RADIO-ELECTRONIC TUBES

RCA Victor Division

RADIO CORPORATION OF AMERICA, Camden, N. J.

BUY U. S. WAR BONDS AND STAMPS

New wartime uses for RAYTHEON tubes are almost a daily occurrence. In large cities for automatically cutting off the illumination from lighted billboards RAYTHEON tube-equipped receivers are being used to work in cooperation with local broadcast stations . . . when the broadcast station goes off the air the sign illumination is automatically cut off—thereby completing the blackout. Another RAYTHEON contribution to radionics.

Raytheon tubes were selected for this wartime job because of RAYTHEON'S long operating life and dependability under all operating conditions.

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DEVOTED TO RESEARCH AND MANUFACTURE OF TUBES FOR THE NEW ERA OF ELECTRONICS