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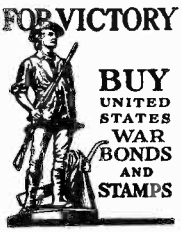

Mr. L. J. Morrice
3547 North 21 St.
Milwaukee, Wis.

RADIO SERVICE HINTS

Practical Suggestions on Solution of Radio Servicing Problems Encountered in Actual Experience by Servicemen Everywhere

This section, conducted by our servicemen readers, will be a regular feature of the C-D Capacitor, and is intended to provide other servicemen with helpful notes on testing, locating troubles in specific models of sets, repairing them, or any other suggestions to simplify service work.

Cornell-Dubilier will pay $2.00 for each hint published in this section. Notes must be limited to 75 words, or less. Any number of hints may be submitted at one time. Unpublished items will not be returned. Be sure to give your name and mailing address. Send hints to: Editor, C-D Capacitor, Cornell-Dubilier Electric Corp., So. Plainfield, N. J.

Modulation Hum in A.C.-D.C. Midgets

A bad modulation hum is apt to develop in various models of a.c.-d.c. sets such as the Philco midget PT26. This hum is only evident when a station is tuned in and is a condition quite often difficult to trace.

The blank terminal No. 3 on the 35Z3 tube is used as an AVC connection point in many sets. The hum is caused by leakage to that terminal from another 35Z3 socket connection. Removing the leads from the No. 3 terminal will eliminate the hum in most cases. In rare cases it is caused by leakage from the pilot light socket to chassis and also by leakage from voltage divider to chassis. Insulating them from the chassis will cure the trouble. — *Ralph Hunter, Catskill, N. Y.*

Knocking Noises in Emerson FG Models

In several of the Emerson FG chassis models an intermittent knocking noise developed which could be heard over the entire dial. The writer located the trouble as being a defective filter capacitor, 20 mfd. 150 volts. Even though these capacitors tested O.K. when replaced with new units of the same capacity and voltage rating the trouble was corrected immediately.

Apparently the capacity of the original units dropped in long use without disclosing any appreciable lowering of leakage current when tested with an ohmmeter.

Anyway it is advisable to try replacing these capacitors if trouble of this sort is encountered in this model. — *Charles Meyerson, New York, N. Y.*

Eliminating Whistle in A.C.-D.C. Receivers

Many of the lower priced midget sets develop a squeal or whistling noise due to poor contact through the rotor shaft of the tuning condenser to the frame.

This trouble in numerous cases can be eliminated by cleaning the wiping contact and part of the shaft on which the contact bears with a toothbrush on which a small quantity of carbon tetrachloride is applied.

The wiping contacts of the tuning condenser are then tightened and a very small quantity of graphite-oil applied to the roller bearings.—*Oliver F. Klem, Milwaukee, Wis.*

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S-R Silvertone 1.5 Volt Battery Models

Trouble in this model set may develop in the battery service life. At first the battery gives good service, then successive replacements seem to give shorter and shorter service.

This complaint may be traced to a shorted 10 mfd. 100 v. capacitor connected between the ground on the chassis and the B plus on the plates of the screens of the 1N5-1A7-1A5 tubes.

Replace this capacitor with a new one of the same capacity but of higher voltage rating and the trouble will be eliminated. In some instances the condenser can be omitted entirely with little or no notice in effective operation. — *John W. Burger, Westphalia, Kan.*

Substituting Resistance Coupling for Audio Transformers

Much has been told about substituting resistance coupling to replace burned out audio transformers, but a repair of this kind often proves unsatisfactory since much of the stage gain was originally accomplished across the transformer in the audio circuit.

If, however, the tube is changed to one of similar heater rating but giving greater gain, i.e., a 57 for a 27, no noticeable loss of volume will result. In any event it is best that the tube manufacturer's amplifier chart be referred to in all cases for the proper values of parts. — *Vincent J. Lewis, Jr., Yonkers, N. Y.*

Rewinding Ant., R.F., and I.F. Coils

Now that various types of coils are difficult to obtain during the war, servicemen should make every effort to utilize the old coil by repairing it wherever possible. Primary windings on i.f. transformers can be rewound by counting turns as the wire is being removed. Then rewind with new wire on the coil form in the same direction as the original windings. The same procedure may be applied to antenna coils and r.f. coils.

After windings are completed apply a coat of coil dope or speaker cement in order to keep them in place. Be sure to make a sketch of connections on paper before removing the old windings. — *Robt. J. Oja, Laurium, Mich.*

Zenith Model 9S369 Chassis 5907

Having had a few of these sets brought into our shop for repair, it was found that failure of reception was due to a defective paper type capacitor .05 mfd. 400 v. Part No. C-12 on the set diagram. In any case it is recommended that this unit be replaced with a new capacitor of the same capacity but of a higher voltage rating for safety against future trouble.

The 1,000 ohm ¼ watt resistor, No. R-6 on the diagram, was also replaced with one of ½ watt rating and same resistance value for completely satisfactory operation.—*E. C. Moyer, Reading, Pa.*

More Tube Substitutions

Due to the shortage of 50L6 and 35L6 tubes, the writer finds that a 70L7 can be substituted for either tube by simply changing the cathode connection, number 8 prong of the tube socket to the number 6 prong or cathode for the 70L7. In some sets the 6 prong is used as a lug and all that is necessary is to remove the connection letting it float, taping the connection for insulation. Although the 70L7 cost is higher, customers usually would rather pay more to have radios in working condition than not at all.—*Robert H. Knapp, Covington, Ky.*

U. S. SIGNAL CORPS NEEDS ENGINEERS

THE War Department, Aircraft Radio Laboratory at Wright Field, Dayton, Ohio, has a shortage of qualified civilian engineering and inspection personnel. Wright Field is the home of the Materiel Division of the Army Air Corps and there are concentrated all the experimental laboratories which are making such tremendous advances in the development of aircraft and aircraft accessories. The Aircraft Radio Laboratory is responsible for research, development, engineering, and inspection required in the radio field, incident to design, supply, and installation of radio equipment on aircraft.

The basic duties of a radio engineer are to perform or supervise the performance of professional engineering work in design, construction, research, and investigation. Responsibilities and duties are commensurate with the grade.

The Civil Service standards for Junior Radio Engineer, which pays $2.000 per year, are a degree in electrical engineering from an accredited college. The next higher rating, Assistant Radio Engineer, $2,600, has requirements of two years of progressive professional experience, plus substituted experiences year for year for college education that is lacking. A college degree, while very desirable, is not essential. A well qualified engineer without a degree is eligible for consideration.

Inspectors of Signal Corps Equipment are required to make inspections and tests of aircraft radio equipment to determine compliance with specifications, etc. This duty is usually performed at the plants of the contracting manufacturers. The salary range is from $1,620 to $2.000 per year.

The above salary rates are of course initial rates and promotions for higher rates of pay are made commensurate with responsibility and experience.

Engineers and service men who are interested in these positions are invited to submit a letter outlining their education and experience directly to:

DIRECTOR, AIRCRAFT RADIO LABORATORY
Wright Field Dayton, Ohio

A Free Market-Place for Buyers, Sellers, and Swappers.

These advertisements are listed FREE of charge to C-D readers so if there is anything you would like to buy or sell; if you wish to obtain a position or if you have a position to offer to C-D readers, just send in your ad.

These columns are open only to those who have a legitimate, WANTED, SELL or SWAP proposition to offer. The Cornell-Dubilier Electric Corp. reserves the right to edit advertisements submitted, and to refuse to run any which may be considered unsuitable. We shall endeavor to restrict the ads to legitimate offers but cannot assume any responsibility for the transactions involved.

Please limit your ad to a maximum of 40 words, including name and address. Advertisements will be run as promptly as space limitations permit.

WANTED—Capitol Radio Engineering Institute course. Must be 1940 or later. Will trade camera using 616 film, f 4.5, almost new condition which cost $41 for such a course or will pay cash. C. A. Brethen, 150 Saranac St., Rochester, N. Y.

SELL OR SWAP—Bausch Lomb microscope new, cost $85, also small one in wood case, .22 Colt revolver; new Argus Cintar candid camera f. 3 5, 35 mm film. Numerous other articles. Want water pump record changer, typewriter, or what have you? A. R. Kreuzer, Leroy, Mich.

WILL SWAP—A brand new Revere 88 movie camera, 3.5 lens, never used. Want Rider's Manuals 7 to 12. Will pay some difference List radio equipment in trade on this camera. Clyde W Wimer, Ellwood City, Pa., R. No. 2.

WANTED—Public address systems, large amplifier, 16mm projector with sound; will buy or swap for model 460 Jackson mf signal generator, recorder, etc. Write Tom Trinka, 610 Douglas St, Middletown, Ohio.

WANTED—Test equipment, meters, copper-oxide rectifiers, precision resistors, short wave receivers, plug in coils, all kinds switches, tools, firearms, Describe fully. Quote lowest prices. Roby's Swapmart, 3569 Cottage Grove, Chicago, Ill.

CRYSTAL-RADIO experimenters, we have a complete stock of hard-to-get, supplies. Molybdenite, oscillating zincite crystals, rubyite, carborundum, silicon, galena goldite. Couplers, potentiometers, coils, condensers. Loudspeaker crystal set. All diagrams. Free particulars write, Hewlett's Radio, 29 East 39th St, New York City.

WANTED — Tube checker, oscilloscope, vacuum tube voltmeter, multitester, signal chaser, audio oscillator, condenser tester, also Rider's Manuals, vols. 8 to 13, and good camera. Will pay cash or trade radio equipment. Norman Jacobson, 1117 Gerard Ave., Bronx, New York.

WANTED—Will pay cash for Solar model BQC, quick check and bridge. Have Weston model 425, RFO 125 ma, Jewell 74 0-15 v.a.c, several a.f. transformers, and large Amrad power trans. Ray Parker, 112 Ave C West, Kingman, Kans.

FOR SALE—Jackson model 640 test oscillator; Weston model 773 tube checker; West model 665 Analyzer type 1; W. E. 200 ohm oil damp 4A pick-up; Triplett ac amp. meter. John J. Spankowitch, 239 N. 9th Street, Allentown, Pa.

SALE OR TRADE—Radio parts, tubes, test equip.; meters, refrigerator tools and tanks, books and guns. Want slide rule, portable typewriter, navigation course, books, barometer OR? Wm. Hansen, R. 3, Niles, Mich.

BUY OR SWAP — Want tube tester for newest type tubes. Also oscillator and books on radio. Have radio motors, parts, tubes and safety electric razors. Sam Berenblum, Greenwich, Conn.

WANTED — 1942 Hickok dynamic mutual conductance tube tester, model 530 portable or model 510X combination. Must be in A-1 condition. Give full particulars, lowest cash price in first letter. L. M. Burtis, 2333 S. E. 53rd Ave., Portland, Oregon.

WANTED — Rider's Manuals volumes 11 through 13, good condition, cash. Advise what you have. Karl Wagner, C. C. Bk. Bldg., Des Moines, Iowa.

WANTED—Any standard make condenser tester. Will pay cash. State lowest price. Will also pay cash for brand new radio tubes in original cartons; state your best discount from list prices. C. A. Goditus, 313 East Market St., Wilkes-Barre, Pa.

WANTED—Emergency -- Multi-range volt-ohm-m.a. meter. Scale 3000 to 5000 v., resistance not less than one million ohms, complete with batteries and leads. If not available 2000 v. range, with corresponding ohm and m.a. range. Wanted by soldier in the islands, unable to get station equipment. Needs this equipment badly. Will pay cash for same. Paul Bauman, 242 Cambridge Ave., Jersey City, N. J.

FOR SALE OR TRADE for test equipment, or a Model WM Briggs and Stratton wash machine engine, many new and used radio parts and tubes. Write for list. Frank H. Carlson, New London, Iowa.

HAVE CASH—Want late radio tube, set testers, Channel analyzers, scopes, radio books, P.A. amplifier using 866s, 6 ft. trumpets, oscillators, vibrator testers, radio tubes in sealed cartons, neon radio sign. Glen Smith, 323 Factory St., Watertown, N. Y.

FOR SALE—Volumes 1, 2, 3, 4, 5, 6 and 13 Riders Manuals in absolutely perfect shape, complete with index. Reasonable. Moch Radio and Sound Service, 5925 S. Albany Ave., Chicago, Ill.

WANTED 2 RCA wireless players. Must be in good condition. Have Riders Manual No. 10 to swap or will pay cash. State price. Spada Enterprises, 227 Front St., Hartford, Conn.

FOR SALE—Microscope with following optical equipment: oculars—Huyghenian 5x and 7x. Objectives—5x, 15x, 45x, and 2 mm. 1.30 N.A. oil immersion lens. Abbe condenser in substage and double faced mirror. Complete with carrying case, dark field stop, cedar immersion oil, and slides. $65. D. Kurs, 4525 — 45th St., Long Island City, N. Y.

WANTED—Battery Charger, in good condition, bulb rectifier preferred, 110 volt 60 cycle. Have radio, chemical, and sporting equipment. Swap or cash. Raymond H. Ives, RT 1c; U.S.C.G., 822 Windsor Ave., Norfolk, Va.

FOR SALE—100 new tubes, worth $54.00, sell for $27.00. One Radio City tube tester, Model 307 in A-1 shape, price $6.00. Clarence W. Hull, Mineral Springs, Pa.

WANTED—Precision, or Supreme set tester and analyzer. Must have ac and dc meters. Portable tube tester, any that will check Loctal base tubes. State Song Shop, 2932 Hasting, Detroit, Mich.

WANTED—Riders Manuals, 7, 8, 9, 10, 11, 12. State condition and price. G. H. Croney, Widener, Ark.

WANTED—3" and larger meters, power trans. for 902 C.R. tube, No. 884 tube, socket hole punches, crystal for Hickok No. 188X, also Biley 100-1000 k.c. crystal. Have parts, sets, etc., cash. Huntress Radio, 418½ W. Spring, Freeport, Ill.

FOR SALE—Tire Reliners, 6.00-6.25 x 16, 5.50-600 x 17 new material 2 ply and composition, self vulcanizing $2.95 or will trade for radio tubes. Auto-Appliance Supply, Granby, Mo.

WANTED—A 3" oscilloscope in good condition. Will pay cash. Give full particulars Must be late model. Fred Hartman, 32-26—54 St., Woodside, L. I., N. Y.

WANTED—Will pay cash for r.f. meter 0 to 1 amp., also 0 to .5 amp., any make; also want capacitor analyzer and oscilloscope, any make. A. Y. Cottrell, Supt. Radio City of Lenoir, Lenoir, N. C.

FOR SALE OR TRADE—A Majestic Super-B current supply, rating 60 mils. at 180 v. Needs line cord and Majestic super power tube. Also have a Meissner coil and tuning kit containing: (a) 4 band ant., r.f. and osc. coil assembly with band switch completely wired and prealigned on sub-chassis. (b) 8" two speed oval airplane dial with second hand. (c) Ferrocast 456 k.c. input i.f. transformer. (d) Ferrocast 456 k.c. output i.f. transformer. (e) Beat frequency osc. transformer. (f) 3 gang .000410 mfd. variable condenser. Want: .25 caliber automatic, automatic tape machine or what have you. George Gould, 1540 E. 24th St., Brooklyn, N. Y.

WANTED—Supreme tube and set analyzer 585, Rider's Manuals from 1-6 volumes; D.C. milliammeters 0-50 or 0 to 75. Must be in good condition and state lowest price. Have all makes of old radio sets in playing condition, what am I offered. Goldstone Radio, 1279 Sheridan Ave., Bronx, New York.

SWAP — 10-20 d.c. milliamp, 10-100 d.c. milliamp, 10-300 d.c. ampmeter, 1 Ranger tube tester, model 440, all for amplifier using 6 volt tubes. Also have parts for old makes of radio, will swap. Charlie's Radio Service, 8123 Stow Rd., Delair, N. J.

FOR TRADE—Several of each: 954, 955, 956 Acorn tubes, RCA, for cameras, photographing equipment, transmitting equipment, such as power transformers and filter condensers, radio tubes, test equipment, and Weston meters. Household Repair Service, 6 Market St., Pittston, Pa.

(Continued on page 12)

THE CATHODE-RAY OSCILLOSCOPE*

PART 6 - Lissajous' Figures and Receiver Alignment

In last month's issue we showed how audio wave-forms were plotted against bases representing "time." But if we wish to illustrate the response of a tuned circuit we must plot its response against a "frequency" base, as in Fig. 1.

To draw such a curve "by hand" we would set up our instruments as in Fig. 2. With each change in frequency the vacuum-tube voltmeter

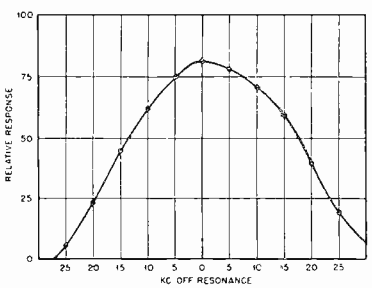

Fig. 1. A resonance curve plotted "by hand," with separate readings taken at a number of points.

reading would be noted by a point on the ruled paper. With a sufficient number of points established, a curve running through these points is then drawn.

This method is fairly simple for plotting the curve of a single tuned circuit, but much too slow when a number of cascade circuits are to be aligned, such as the intermediate frequency channel of a modern receiver. Since each i.f. trimmer adjustment alters the selectivity response curve, many graphs would have to be drawn before a job would be completed.

But substitute a cathode-ray oscilloscope for the v.t.v.m. (or usual output meter) and "wobble" the frequency of the signal generator. Synchronize this wobble with the oscilloscope's sweep oscillator and the desired frequency resonance curves will appear on the c.r. screen.

There are several ways of accomplishing this. But let's get a clear understanding of the principles involved first and examine the various methods later.

A simple set-up meant only for explanation, is shown in Fig. 3. A handle has been mounted on the signal generator to permit manual wobbling of its frequency. A potentiometer across a "B" battery places either a positive or negative potential on the free horizontal plate, swinging the beam across the screen in synchronization with the frequency changes of the signal generator.

As the beam is swept across the screen, the signal generator frequency will pass through the resonant frequency of the intermediate channel, producing a rectified a.c. voltage across the second detector divider load (when that type detection is used). This voltage is applied to the free vertical plate, usually through the oscilloscope's vertical amplifier, raising the beam in proportion to the i.f. amplifier response.

Note that a single movement of the handle makes one complete trace upon the screen. Returning the handle to its starting position, completing the cycle, makes another trace. But each trace lies over the preceding one, whether the response curve is symmetrical or not.

Such a simple mechanical arrangement is never used, although it would work if we could wobble the handle rapidly and used a long-persistence c.r. screen.

** By Jay Boyd in "Radio."*

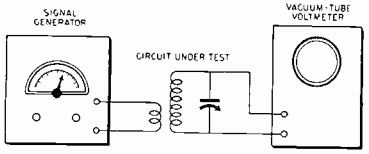

Fig. 2. The resonance curve of Fig. 1 could be plotted by means of the set-up shown above.

Motor-Driven Frequency Wobblers

In practice we find two methods for wobbling the signal-generator frequency. The first type uses a small motor for rotating a midget condenser, in parallel to the main condenser. Mounted on the same shaft will be found either a commutator or a tiny electrical impulse generator. Either of these will be found tied in to the sweep circuit, thereby locking the sweep frequency with the wobble frequency.*

The other method, or rather group of methods produces this desired wobble by electronic means, thereby eliminating all moving mechanical apparatus. While the electronic sweep systems seem to be gaining in popularity

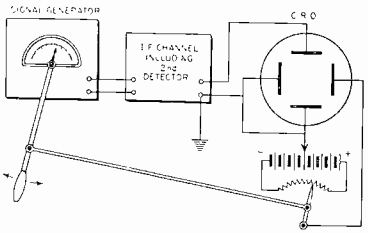

Fig. 3. A set-up by means of which the frequency of the signal generator can be wobbled. Potential on horizontal plate is synchronized with the frequency by means of a connecting arm.

it should be noted that the final result; that is, the resonance curve traces, will be essentially the same for either method. Also, it is quite practical to attach a motor-driven wobbler to any existing signal generator by the simple addition of a phone jack.

The motor-driven type is easier to understand. Two specific makes will be described; first, because of their popularity and secondly, because they are representative of all other manufacturer's types.

The RCA Frequency Modulator

This is a small motor-driven unit designed to wobble the frequency of any signal generator. The diagram is shown in Fig. 4. On the shaft of the small motor is a two-section rotating condenser of 35 $\mu\mu$fd. per section. A 14-inch low-capacity cable connects this rotating condenser in parallel to the main tuning condenser of the test oscillator. The motor turns at 1550 r.p.m., rotating the condenser about 25 times per second. The condenser goes from open to closed and back from closed to open once each revolution, thereby producing 25 double frequency wobbles per second.

With this system, the saw-tooth oscillator in the oscilloscope is used for horizontal deflection, forming the "base" of the graph being traced. The s.t.o. may be operated at either 25 or 50 c.p.s. but must be synchronized with the rotation of the revolving condenser.

Note the miniature a.c. generator on the right end of the motor shaft. Its output of a couple of volts connects to the "external sync." binding post of the oscilloscope. With the s.t.o. frequency controls set for approximately 25 or 50 c.p.s., the small impulses from this little generator positively lock the sweep frequency to that of the wobbulator.

If a single a.c. voltage is placed on both sets of plates simultaneously the pattern will be a single straight line as shown in Fig. 5-A.

Two separate a.c. voltages placed on the respective sets of plates will cause a similar pattern, provided these voltages are similar in character and in phase. They may differ in amplitude, however, this being indicated by a different angle than shown.

*The term "wobble frequency" denotes the number of times per second which the signal generator is wobbled. It should not be confused with the mean or extreme i.f. frequencies produced by the signal generator.

If the two voltages are similar in character but differ by 90° in phase the pattern will be nearly a perfect circle, as in Fig. 5-B. It would be an exact circle if both sets of plates were equally sensitive.

Other phase differences will cause an ellipse which broadens as the phase difference increases, up to 90°. If the breadth is one-half its length, as sketched in Fig. 5-C, a phase angle of 45° is indicated.

Lissajous' Figures

In the 1800's a French physicist, in his experiments, connected two pendulums so their motions would act upon a single stylus. Setting these pendulums in motion at different frequencies produced patterns which now bear his name.

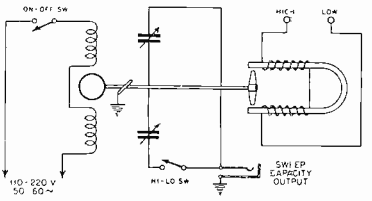

Fig. 4. The RCA Frequency Modulator, consisting of a rotary condenser and tiny synchronizing voltage generator.

Similar patterns may be traced on the c.r.o. screen by application of a.c. voltages of different frequencies to the two sets of plates. If the ratio of these frequencies is equal to the ratio of two integers, and if their ratios are not too complex, an interesting series of Lissajous' figures will be produced. These are valuable for frequency comparison.

It should be noted that the three preceding patterns, Figs. 5-A, 5-B, and 5-C, were all produced with similar frequencies on both plates.

But now make the vertical frequency twice the horizontal and you'll find a "figure 8," a distorted "figure 8" or a parabola, depending on the phase relationship of the two frequencies. These are sketched in Figs. 6-A, 6-B, and 6-C respectively.

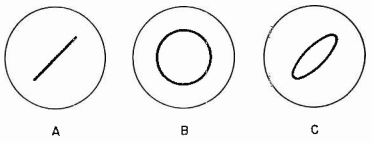

Fig. 5. Three traces produced with similar frequencies on both c.r. tube plates. Trace A is obtained from a single a.c. voltage.

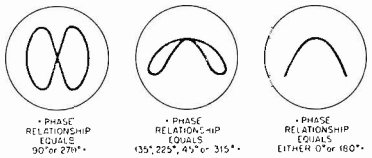

Fig. 6. Traces obtained when the vertical frequency is twice the horizontal frequency, the shape of the traces depending upon phase relationships.

If the two frequencies differ by a ratio of 3-to-1 the patterns will look like those of Figs. 7-A, 7-B, or 7-C. The three loops due to the vertical frequency, and the single loop caused by the horizontal frequency are indicated in Fig. 7-A. Combinations of frequencies in multiples of 4-to-1 or more produce Lissajous' figures of similar construction, differing only in that four loops will be produced when the vertical frequency is four times that of the horizontal frequency. Higher multiples will produce proportionately more loops. When the horizontal frequency is known, it is possible in this manner to determine the frequency of any multiple thereof which is applied to the vertical plates.

Receiver Alignment

The method of connecting a signal generator and cathode-ray oscilloscope to a receiver to be aligned is shown in Fig. 8. Note that the oscilloscope vertical amplifier input leads connect from the diode load to ground; across which the rectified "wobbled" frequency is developed. As this frequency is usually of the order of 60 cycles or less, it is preferable to connect directly across the diode load rather than to the point marked "AF" because at the latter point a phase shift may be introduced by the coup-

ling condenser which would alter the appearance of the image on the c.r. screen. Connection to the point shown will not short out the diode load, as might be assumed, because a blocking condenser is built into the input circuit of the vertical amplifier of the c.r.o.

Note that the synchronizing pulse is fed to the external synchronizing circuit. In most instruments a switch is provided for internal and external synchronization and should be adjusted so as to utilize the external pulse for aligning operations. If internal synchronization is employed, the image will drift and alignment will be difficult.

The first step in all receiver alignment operations is to align the last i-f stage, and the method of connecting the signal generator to do this is shown in Fig. 8. The signal generator is first tuned to the intermediate signal frequency and the signal is fed through a blocking condenser to the last i-f tube grid. The blocking condenser is necessary in order to avoid grounding out the a.v.c., which might cause the i-f amplifier to oscillate (this is more likely to happen when going through subsequent aligning operations than in adjusting the last stage, but is good practice anyhow). The test signal is thus amplified by the last i-f tube and adjustments of the last i-f transformer trimmers are made.

necessary to hold the image stationary on the screen. Any excess voltage

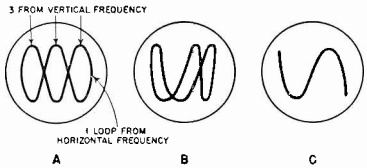

Fig. 7. If the two frequencies differ by a ratio of three to one, the patterns will look like those above.

tends to produce distortion which interferes with proper alignment.

When the adjustment of the secondary trimmer to produce a curve of maximum height is completed, the primary trimmer is then adjusted to produce a symmetrical curve. It may be necessary to go over the secondary adjustment and touch it up when the primary trimmer has been set at approximately the correct point. In making these adjustments, with 'scopes using the double-image system—which is by far the most widely used—make certain that the bases, not the peaks, of the resonance curves coincide. If the synchronizing voltage is not excessive, there will usually be no trouble in also making the sides of the curves coincide, but if adjustment is made only to make the peaks coincide, the stage will not be properly aligned.

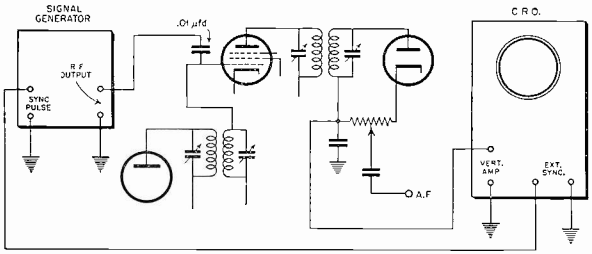

Fig. 8. The method of connecting a signal generator and cathode-ray oscilloscope to a receiver to be aligned. Note that the oscilloscope vertical amplifier input leads connect from the diode load to ground, across which the rectified "wobbled" frequency is developed.

The secondary trimmer is first adjusted until a resonance curve appears on the screen, and the synchronizing voltage gain adjustment on the 'scope is adjusted until only sufficient synchronizing voltage is applied as is

Typical Screen Curves

Various stages in the aligning process are illustrated in Fig. 9. In Fig. 9-A, the alignment is correct but the traces fail to coincide due to incorrect synchronization. In Fig. 9-B, the align-

ment is incorrect: the bases of the two traces do not coincide, though the peaks do. In Fig. 9-C, the alignment is incorrect, though the bases coincide, because adjustments of the primary and secondary circuits have not been made so as to produce maximum gain. In Fig. 9-D, proper alignment is indicated, both traces coinciding throughout and the height of the peak indicates adequate gain.

After the last i-f stage is aligned, the next preceding stage is adjusted, connecting the signal generator to the preceding i-f grid but leaving the c.r.o. connections undisturbed. Adjustment of the preceding stage trimmers is made in the same manner as previously described, until a symmetrical curve is again obtained. Due to the increased amplification of the test signal, it is important to reduce the test signal level when feeding to any stage other than the last i-f grid, to avoid overload. Only sufficient signal strength should be used as is necessary to produce a clean signal trace on the c.r.o. screen. If the signal is too weak, it will be necessary to advance the gain control on the vertical amplifier of the 'scope to a point where hum and extraneous pickup make the trace fuzzy.

The last step in completing the adjustment of the i-f amplifier is to feed the i-f signal to the converter grid. Final adjustments are then made of the first i-f transformer trimmers and the i-f amplifier should require no further attention.

Oscillator Adjustment

Adjustment of the oscillator section of the converter may now be made by leaving the signal generator and c.r.o. connected as is, but readjusting the signal-generator frequency to the high-frequency aligning point specified for the band being aligned. For the broadcast band, this will ordinarily be of the order of 1600 kc. With this test signal frequency fed to the converter grid, the oscillator trimmer is adjusted to produce maximum signal output, as indicated by maximum height on the c.r.o. screen trace.

At this point we'd like to remark that the accuracy of frequency calibration for the frequency-modulated type of signal is not as great as that for the amplitude-modulated signal, because the beat-frequency principle is employed to provide the output signal in the former case, whereas only a single r-f oscillator is required for the latter. Thus, to produce a 1600-kc. signal, the average beat-frequency type of oscillator will supply the difference frequency resulting from the beating together of a frequency-modulated 700-kc (usually) signal and a 2300-kc unmodulated signal. Provision is made in all beat-frequency type signal generators to supply an amplitude-modulated signal for this purpose in which the beat-frequency principle is not utilized. Further, in aligning higher frequency bands, up to 20 mc, harmonics of the 700-kc oscillator used in the b-f oscillator cause difficulties. That is why only an amplitude-modulated signal is customarily used when aligning r-f and oscillator circuits on such bands.

These points are in no way derogatory to the beat-frequency type of frequency-modulated test oscillator, which

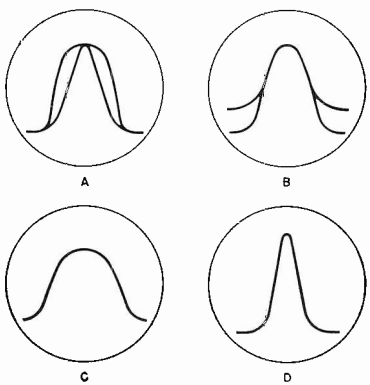

Fig. 9.- Various traces obtained under specific conditions when aligning a receiver. Proper alignment is indicated in 9-D.

is far superior in every way to simpler types when used in conjunction with the c.r.o. for aligning purposes; it is simply necessary to remember that each

type of oscillator has its limitations, and each must be used for the purposes for which it is best fitted.

When using the amplitude-modulated signal, it will of course be necessary to use the internal sweep of the c.r.o., which is adjusted to the modulation frequency, usually about 400 cycles. Synchronization is ordinarily obtained with the internal synchronizing adjustment, and involves no particular care in adjustment, since we are primarily interested only in noting the height of the image and not its wave-shape.

The oscillator adjustments just described are made, of course, with the receiver dial adjusted to the test frequency. This applies likewise to padding adjustments, which are made by tuning both the receiver and the signal generator to a specified frequency near the low-frequency end of the dial. For this adjustment, only a frequency-modulated signal should be used, because the interaction which normally results between circuits during this adjustment is thereby avoided. When a simple amplitude-modulated signal is employed, it is necessary to rock the gang condenser in order to avoid trouble from this source. This is automatically taken care of in the frequency "wobbling" resulting from frequency modulation.

After completion of the adjustments of the converter-oscillator circuits, the signal generator is connected to a preceding r-f grid—or to the antenna input, if no r-f stage exists, and the r-f coil trimmers are adjusted for maximum signal output at the specified aligning frequencies. The alignment is then complete.

Single-Image Method

Our discussion and traces have been based on the double-image system, which is employed in most of the c.r. oscilloscopes now in use. However, some use the single-image method, in which the return trace is suppressed by simply shorting out the sweep during the period of the return trace. The result is an image which varies in symmetry during the aligning process but upon which no reverse trace is superimposed. The final result obtained by either the single- or double-trace methods is identical, so there is no difficulty in applying either method. Some find the double-image method simpler, since the position of the return trace indicates at each instant, the effect of any adjustment. But the change in symmetry in the trace produced by the single-image method, as a result of similar adjustment, is equally informative to those who use the latter method, and in conjunction with a ruled screen, the frequency range covered is readily ascertained.

THE RADIO TRADING POST

(*Continued from page 6*)

WANTED—Condenser tester, signal generator, also Rider's Manuals. Quote lowest cash price. L. J. Arends, Radio Service, Box 202, Alma, Wis.

WANTED—H. T. 7 or equivalent. Give full particulars and price asked for same. H. Wagner, 4411 Indianapolis Boul., East Chicago, Ind.

SELL OR SWAP—1 $50.00 Truetone car radio; 1 $50.00 Chevrolet car radio both have cables and control head 1938 and 1937 respectively. Trade either one for good standard keyboard typewriter. Must be in good condition, or sell either one on receipt of money order for $25.00. North Side Radio Service, 652 East 19th St., Indianapolis, Ind.

WANTED—National model NC-45 or Hallicrafter, model S-20 R in good condition, will pay cash. Describe in full in first letter. Joseph A. Texera, Jr., 28 Prospect St., Somerville, Mass.

FOR SALE—Hickok model 530 counter type dynamic mutal cond. tube tester in A-1 condition. F.O.B. New York City $50.00. Tony's Radio Shop, 1729 Lexington Ave., New York City.

WANTED—I will pay cash for a Model "G" Porta-Power pack, or its equal to handle six .050 amp. tubes. Also cash for a Model 562 Supreme audolyzer. Cripps' Radio Service, 1110 Florence Ave., Dunsmuir, Calif.

WANTED—Milliammeter 0-1 scale. Will pay cash. Prefer 4 in. meter, will take 3" or larger. Write description. Valley Appliance Sales, Spring Valley, Ill.

WANTED—Supreme Model 561 oscillator, also RCA audio oscillator and Supreme model No. 547 multimeter, must be in A-1 shape, will pay cash, no other type wanted. Write or phone: Camden 0089-J or Hall's Radio Service, Cor. Eighth and Pine Sts., Camden, N. J.

FOR SALE—Model 1175A All-Wave Triplett portable laboratory consisung of model 1151A all wave signal generator and model 1125B AC-DC volt-ohm-milliammeter in leather case. Perfect condition, $25. Book of instructions included. Chester T. Martawicz, 116 E. 7th St., New York City.

FOR SALE—Federal model 120 photo enlarger with f6-3 lens $9. Herman Yellin, 351 New Lots Ave., Brooklyn, N. Y.

FOR SALE—Meters, $10.50 buys the following meters prepaid: Jewel 0-15 m.a. d.c., model 135; Jewel 0-300 m.a. d.c. model 54; Weston 0-10 v. d. c., model 301; Jewel 0-15 v.a.c., model 74; Sterling 0-15 and 0-100 m.a. d.c. Harry Kay, Rt. 2, Box 255, Imlay City, Mich.

WANTED—Will pay cash for a Morrison signal tracer. Must be in good condition with original instructions. Edgar D. Cameron, R. F. D. No. 3, Ash Grove, Missouri.

WANTED—Test sets, analyzer tube tester, etc. Advise price and description, R. Robleski, Hastings, Mich.

FOR SALE—Peerless Signagraph with key and 5 tapes, used very little or will trade for or on good high resistance V.O.M. August Wherley, 4813 Oneota St., Duluth, Minn.

WANTED—A Precision model 912P portable tube tester 4½ in. meter 1941-42 model, also Rider's Manuals Vol. 1 and 2, auto radio power supplies. Paul Capito, 637 W. 21 St., Erie, Pa.

WANTED—A 1 or 2 inch oscillograph tube, will pay cash or swap meters. P.F.C. Harry Spear, 1200th Service Unit, Fort Jay, Governors Island, New York, N. Y.

WANTED — Audels Electric Library, red books, pay cash. Westinghouse Signal Corps, 110 volt a.c. 200 watt ball bearing generator for sale, practically new, $9.00. Horace Ursillo, 85 State St., E. Providence, R. I.

WILL SWAP — Four 3½ ft. trumpets, 2 Racon giant units, 2 Western Electric 555-W units (all 6 volt) in good working order for, RCA Chanalyst, or Rider volt ohmyst or state best cash price for above test equipment. Ed. Norris, 1152 Haddon Ave., Camden, N. J.

WANTED for cash, signal generator, all wave A.C. operated. Also 2 or 3 inch scope. W. A. Conklin, 70 Community Drive, Cranston, R. I.

WANTED—One commercial 6 foot standard radio relay rack, state make, condition and price. George W. Bartlett, 261 Whitman St., New Bedford, Mass.

FOR SALE—Radio City tester, model 446, a.c., d.c., and d.b. and ohms. Like new, $10 takes it. C. R. Poole, Royalton, Wis.

SWAP—Stamps for Rider's Manuals. Army and Navy issue Virginia Dare in sheets of 50. Fine condition, well centered. Frank Creswell, 48 College Ave., Tarrytown, N. Y.

WANTED—Tube tester volt ohm milliammeter, small a.c.-d c. receivers, communications receivers, photo equipment, etc What have you? Will pay cash. E. C. Ashburn, 5 Greene Ave., W. Barrington, Rhode Island.

WANTED—A good 0-50 microammeter and a good standard make all-wave generator. Wm. E. Horlbeck, Commercial Radio Operators Police Radio Maintenance Service, 4793 Yew St., Pittsburgh, Pa.

WANTED — Complete radio shop test equipment and supplies. Send list and offer to W. H. Miller, 1017 Westgate Rd., Troy, Ohio.

WANTED — Hickok RFO-5 oscillograph, model 210-S volt, ohm, milliammeter, model 530-P tube tester. Also RCA model 161 Signalyst. Other makes acceptable. Please state condition and price. Box 144, Noble, Ohio.

WANTED—One Cooke radio slide rule, price must be reasonable. Mrs. Ernest J. Nosseau, 44 Sargent St., Cohoes, N. Y.

WANTED—Rider's circuit books from vol. 7 to 12 inclusive, in good condition, state lowest cash price, single or all. Chester J. Capps, 1958, 18th Ave., San Francisco, Calif.

FOR SALE—One RCA cathode ray oscillograph, type TMV 122B, 50 watt, 3 inch, for $55. S/Sgt. William W. McLaughlin, Radar Detachment Co. Y, 15 Sig. Tng. Reg., Fort Monmouth, N. J.

WANTED—Will pay cash for Radio City models 661 or 414p multitester; Precision, models 920 or series EV-10. Aerovox, Sprague, Solar, C-D Capacitor analyzer; Triplett, model 1600E or 1200F. Must be in A1 condition. H. L. Mills, 8006 Truxton Ave., Los Angeles, Calif.

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