

The
CORNELL-DUBILIER
Capacitor



Vol. 10

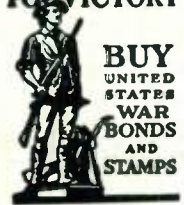
MARCH, 1945

No. 3

CORNELL-DUBILIER ELECTRIC CORP.
 HAMILTON BOULEVARD
 SOUTH PLAINFIELD, N. J.

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FOR VICTORY



BUY
 UNITED STATES
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 AND STAMPS

Mr. George M. Beale
 130 25th Ave.
 San Francisco, Calif.

WANTED!

Case Histories of **Cornell-Dubilier Capacitors**



HUNDREDS of Dubilier mica and paper capacitors made over a decade ago and more, are still giving efficient and reliable service in radio and electronic equipment. These capacitors are as good today as the day they were made. We are collecting case histories of such units.

If you know of a Dubilier capacitor ten years old or more, in use today, please tell us all about it and in what type of equipment it is used. A post card will do. Thank you.



Address:

EDITOR, THE C-D CAPACITOR
Cornell-Dubilier Electric Corporation,
South Plainfield, N. J.



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 transaction 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.

FOR SALE—SX-24, less speaker. Good as new in every respect. Make cash offer. Jerry A. Hardison, W4HQM, Rt. 3, Humboldt, Tenn.

WANTED—Complete set of Rider Manuals, 1 Triplett 7" panel VOM complete, Weston model 301, 0-1 ma meter. For Sale Univex camera 8mm with telescopic view finder. Louis F. Lete, 318 South Third, Effingham, Illinois.

FOR SALE — Model BN C-D capacitor bridge complete with tubes. Practically new, with instructions and leads. Price \$20.00. Will send prepaid, Cash with order. Also Alliance motor and turntable. Brand new. 110 v.a.c. Best offer accepted. Louis Fialkoff, 143-48 41 Ave., Flushing, N. Y.

FOR SALE—Fine old 'cello, two bows, trade for 9x15 rug equal value, cash difference either way. 'Cello requires slight repairs. Consider rug smaller, larger, or for cash. Satisfactory local musician pass on value, quality of instrument. Fred Edmonds, 426 6th St. N., St. Petersburg, Fla.

WANTED—A 67½ volt Mini-Max or equal portable radio battery. Will buy or trade. Also want 12 series and over radio tubes. Jack Rudie, 4725 28th Ave. So., Minneapolis 6, Minn.

FOR SALE—Want best offer for Aerovox model 95 LC checker, Beede 0-150 ac voltmeter round case, Superior 1230 signal generator, used power transformers for 2½ volt tubes. Radio Man, 155 Cotton St., Philadelphia 27, Pa.

FOR SALE—1 FB7 I.F. xstal and holder, 1 gaseous P.E. cell (unknown make), many other parts. What have you and what do you want? Urgent need of instruction sheets (will buy or rent) concerning Superior VTVM Model 1260. Anthony Pusateri, 1101 Fleming St., Coraopolis, Pa.

FOR SALE — Victor Victrola in console table model in very good condition, solid walnut, with records. First good offer takes it. E. Forman, 1212 East 18 St., Brooklyn, N. Y.

FOR SALE—One 913 cathode ray tube. Used \$3.00. Meinen Electric Co., Chipewa Falls, Wisconsin.

WANTED—Rider's Manuals, 1 to 12, also late tube tester. For Sale 500 watt phone transmitter \$300.00. Write Fred W. Rudolph Service, 350 E. Beecher St., Adrian, Mich.

WANTED—Used communications receiver, Echophone EC-1 preferred. State price and condition. J. R. Sidelko, 30 Main St., Luzerne, Pa.

WANTED—Rider's Manuals, all or any volumes, must be in fair condition. Cash waiting. Howard Electric Shop, 224 South Riverview Dr., Kalamazoo 15, Mich. Phone 3-5439.

FOR SALE—Precision 2 meter analyzer, separate ac-dc meters, ac-dc ohms, condensers, output milliamps, \$25 or suitable U.S. stamp collections. Other material available. Fels Radio, 612 Rogers Ave., Brooklyn 25, New York, N. Y.

WANTED -- Condenser tester, any make; amplifier chassis and screen, 10" x 16 or 17"; output trans. to match 6L6s in pushpull of 30-35 watt into 6, 8, 15-580 ohm speaker or line. Have cameras, 15 in. dynamic speakers, radio parts, cash. John Arnold, Bluffs, Illinois.

FOR SALE—RCA ac chassis, pk., spkr., model 46, R 32 chassis, pk. and spkr., ac 60 chassis, pk.; dc chassis. Majestic 90B chassis and 90 spkrs, 370 chassis and spkr., table model. Colonial mod. 38, chassis and spkr. Louis A. Goldstone, 1279 Sheridan Ave., Bronx 56, New York.

WILL TRADE—Perfex "55" candid camera, F 2.8 Wollensak lens, with 2 rolls 36 exposure film, for 5" oscillograph, Dumont model 208 or RCA model 158D or 160B. Milton S. Roth, 3646 Antisdale, Cleveland Hts. 18, Ohio.

FOR SALE—Six new 6 v Vibrator trnsf. \$2.50 each. Wanted—Record player or recorder and player; hard to get tubes; converter to play 32 v. 60 w. radio from 110 ac line. Have 3 hp Milwaukee Hot-shot operated outboard motor for sale or trade. Send your list with prices. McKinley's Radio Service, Zebulon, Ga.

WANTED -- All kinds of test equipment, Also Rider's Manuals. Send description and cash prices. Samuel Berenblum, Greenwich, Conn.

HAVE Webster three stage power amplifier with push pull 250's in output. Complete outfit for making glass numbers and signs. Electric hair clippers, car radio and heater. Want all-wave Silver Scott or similar radio, condition or cabinet not important. Also all test equipment or manuals. Glenn Watt, Chanute, Kansas.

FOR SALE—One new and unused copy of Electrical Engineering, Vol. 2, Alternating Current by Chester L. Dawes, for \$3.50 postpaid. T. W. Hopkinson, 600 Bashford Lane, Alexandria, Va.

FOR SALE—Transmitter parts, crystal and tubes, complete 100 watt rig, and 600 power supply. Write for reasonable price and list. Bou Radio Service, 3131 N. Percy St., Philadelphia, Pa.

WANT TO BUY—Echophone EC-1 or good short wave set, similar. Also 30 radio tube. Wilson Chastian, 928 Broad St., Nashville 3, Tenn.

WANTED—Any one of the following output transformers, new or used. UTC LS-55, Thordarson CHT 15S90, Kenyon K-407, or K-408. Please state price and condition. C. L. Goebel, 221 W. 233 St., Bronx 63, New York.

WANTED—2 1/2 and 5 meter transceiver for use in a car complete. Will pay cash for home-made or commercial construction. Wallace Printz, 1259 East 13 St., Brooklyn 30, New York.

OLD TUBE COLLECTORS—I have the following to swap for what have you. A DeForest 401, and DL5, UX199, C301 and one of the first BH tubes. Have Vibra-pack from RCA 6BT6 farm radio. Never used. Need 45Z3 tube for test inst. Interested in your swap lists. Arthur A. Hale, 357 East Park Blvd., Akron 5, Ohio.

FOR SALE—Latest model RCP tube tester and ac signal generator. Write best offer. Milton Mautasch, 535 Grand St., Brooklyn 11, New York.

WANTED—For cash, Rider's Manuals 1 through to 14. Must be 100 per cent OK. R. J. Hagen, 77 Griffen Place, White Plains, N. Y.

WANTED—Rider's Manuals, Vols 8 to 13 in good condition. M. A. Acton, 1107 De Leon St., Tampa 6, Fla.

WANTED—2 1/4 x 3 1/4 Speed Grafic camera, new or used. Will pay cash. Write details to W. Printz, 1259 East 13 St., Brooklyn 30, N. Y.

WANTED—Any number of the following tubes: 50L6, 12SQ7, 12SA7, 25Z5, 25Z6, 75, 12K7, 41, 42, 12SN7 and 12A8. Quote price and number of tubes. Mervyn Stagg, 484 Valley Place, Englewood, New Jersey.

NEED TUBES—State type, quantity, all at OPA list and new. Send deposit with order. Balance C.O.D. Will try to fill your order as much as possible. H. Steiny, 456 Bedford Avenue, Mt. Vernon, N. Y.

HAVE EASTMAN 3-A folding camera, Ansco Memo 35MM with case, Perfection hot water car heater, Motorola Golden Voice car set, electric car clock, electric hair clippers. Want Weston 772 or similar combination, other equipment including manuals. Glenn Watt, Chanute, Kansas.

FOR SALE—RME DM-36 5 and 10 meter converter, used very little, complete with tubes; covers 28 to 30 m.c. and 56 to 60 m.c. ham bands; best offer over \$35.00. Joe V. Wright, Marine Hospital, Galveston, Texas.

WANTED—Atwater Kent radio, model 435 or just the antenna coil, (T1 on diag.). Also tubes 35Z5, 35L6, 50L6, 70L7, 24A, 12SA7. Have for sale, amplifiers, spkrs., books, misc. parts. Royce Saxton's Radio Shop, Rt. 1, Pontiac, Illinois.

(Continued on page 11)

HIGH FIDELITY RECORDED-MUSIC REPRODUCTION*

High fidelity amplifier design and installation is quite a complex project. Usually straight line gain over a wide frequency range is the customary popular demand. Actually, it may be undesirable for the amplifier to have a perfectly flat electrical characteristic. In designing an amplifier, every effort may be made to get the perfectly flat electrical response over the audio band, but it is also necessary to introduce modifications of that response to suit special conditions. In that way, it is possible to secure an over-all curve which provides harmonious and faithful reproduction attractive to the ear. But here again we bump into difficulties. What sounds good to one may sound bad to another. We have psychological as well as engineering factors to face. These psychological factors, as might be expected, have a physical basis and are related not only to the age of the listener but also to the condition of the person in a given case. Some people are nervous, sensitive, and the higher frequency sounds, if accentuated, may be tiring and irritating. Some, because of age, may have a decreased ear sensitivity at the low and high frequency ends of the audio bands, calling for over-emphasis of the lows and highs to provide desired faithfulness. Other individuals may be absolutely tone deaf and able to distinguish only gross distortion. The latter class of people, of course, will not be interested in high-fidelity reproduction because they don't know what it is and can't appreciate it. (See article "High Fidelity and Tone Control" in this issue.) Therefore, in amplifier work, it is quite es-

sential to make a careful survey of your prospects.

Selling and installing custom-built phonograph amplifier jobs can be very profitable. The service is specialized and of a professional nature as distinguished from routine servicing.

One of the most important requirements of an efficient amplifier is a husky loudspeaker. One having a 10" or 12" diameter cone that will not rattle on bass notes is recommended. The speaker may be mounted in a special cabinet, and the heavier the wood and the larger the cabinet, the better in general will be the reproduction. The quality of the wood seems to have a bearing on the tone, just as in the case of a fine violin or a piano. A good cabinet, therefore, is highly desirable. However, by equipping the amplifier with a tone control and experimenting with the parts used in the circuit the over-all frequency response and fidelity can be adjusted to the best possible values. An item that has a direct bearing on the fidelity, particularly in a quiet room, is hum level. This level should be kept down to a low value by using output tubes which are properly matched. In checking the output tubes in a tube tester, it is important to select a pair of tubes which have approximately the same emission. Then, hum currents flowing in each half of the output transformer primary will tend to balance out. Using high-quality filter condensers will also help to keep down the hum. Careful wiring of the amplifier itself with grid circuits isolated from the heater wires is also essential. The chassis used should preferably be one of low resis-

* By Willard Moody, courtesy of "Service."

HIGH FIDELITY AND TONE CONTROL*

Postwar receiver plans indicate that tone quality will be quite a major feature. F-m, of course, will contribute its share toward tone quality emphasis. The projected interest in this phase of receiver design will prompt many problems that only a substantial knowledge of sound will solve. A review of some of the basic principles of sound and application data that would be of assistance in solving these problems therefore ap-

pears to be a *must* on the Service Man's program.

To assist in this important program, a brief review of the essentials are offered in this article. In our approach we will review the physical aspects of sound from the time it originates in the broadcast studio, trace its path through the transmitter and receiver into the sound reproducer, the room in which the receiver is installed, and, finally, the ear

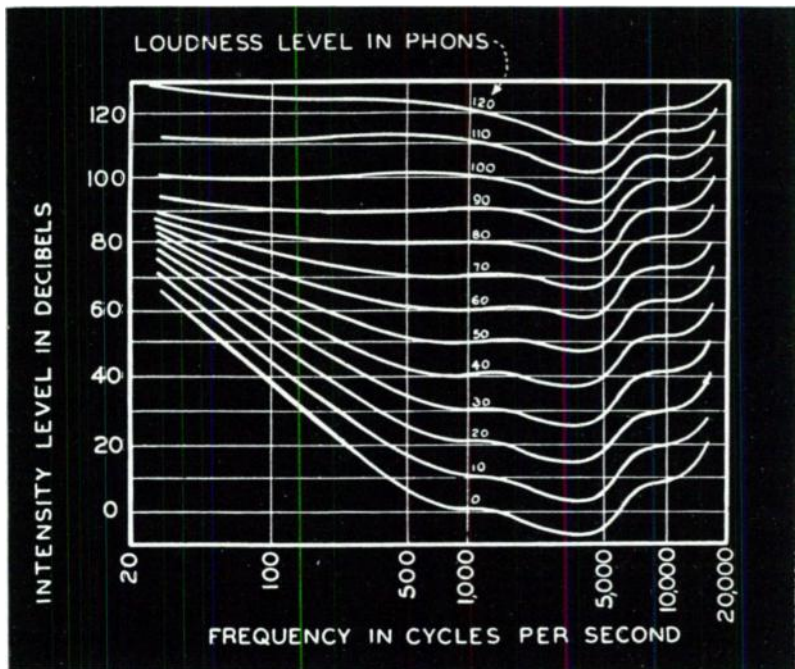


Fig. 1. Chart of relative frequency response of the ear for varying sound levels. Note poor response for both extremes of audio spectrum.

* By Edward Arthur in "Service."

of the listening public. In addition, design methods of tone control will be discussed, as well as an analysis of some commercial systems.

Any audio frequency has two important characteristics, its frequency and its amplitude, or volume level. For high fidelity, it is important that the final signal contain all the audible frequencies of the original signal transmitted at their relative amplitudes. Again, frequencies not present in the original, should not appear in the final signal. For *best* or *ideal* reproduction of both speech and music, a frequency range of 30-15,000 cps is essential.

The relative amplitude range at the point of transmission varies from 70 watts for a full orchestra, to .05 watt for a triangle. However, the limitations imposed by the components involved in both transmission and reception, limit both the frequency range and the amplitude range.

A high fidelity a-m broadcast station is limited in its audio frequency range of transmission to 30-90,000 cps, because of federal regulations limiting the side band transmission by ten kc. In addition, the amplitude range must be compressed, since background noises would override the low intensity audio signals, and the high amplitude levels would tend to overmodulate the transmitter, creating serious audio distortion, or causing possible station failure. Other factors influencing the fidelity of transmission are the particular microphone used by the studio, the studio from which the transmission takes place, and the attenuation factor and frequency characteristic of the lines over which the signal is piped from the studio to the transmitter.

F-m transmitters have a *possible* audio range of transmission of 30-15,000 cps. Because of the limited action of the f-m receiver, the signal-to-noise ratio is better than in a-m systems, and the signal distortion less than 2%.

A-m receivers limit the ultimate audio-frequency response. Detuning effects in the r-f and i-f sections of the receiver due to variations in signal am-

plitude, AVC action, and the voluntary limiting of side-band response to reduce monkey chatter, or cross talk, create signal distortion even before detection takes place. In f-m receivers, the r-f distortion is reduced so as to be a negligible factor.

Audio amplifiers may be designed to have a flat-response characteristic from 30-15,000 cps, so that distortion in this part of the circuit can be ignored. Modern diode-detector circuits can be controlled, so that the distortion in this part of the receiver is also a negligible factor.

The loud speaker and its associated equipment, such as the cabinet in which it is mounted, or the sound diffusers used with it, is the final unit associated with the electrical system of sound reproduction. The fidelity of this unit can be controlled within fairly narrow limits by design and construction. Multiple speakers, to give adequate response to the entire audio spectrum, or sound diffusers incorporated in the cabinet design to permit more uniform distribution of energy, are essential components of all high-fidelity systems.

The final factors involved, are the room in which the loud speaker has been installed, and the hearing ability of the person or persons listening.

The furniture, rugs, and draperies in a room, the size of the room, the position of the listener with reference to the sound source, all exert a great influence on the audibility of various portions of the audio spectrum. It should be noted that the relative amplitude of the various audio frequencies is here involved, and not the fidelity of the frequencies themselves. In general, it may be said that more uniform response is obtained when the sound source is installed in a corner facing the center of the room.

One factor not previously discussed, and possibly the most important, is the hearing ability of the listener. Individual abilities vary widely. There is a progressive deterioration of hearing ability with age. This is particularly true of the ear response to the upper

registers. A surprisingly large percentage of people are tone deaf in varying degrees.

Given a person of normal hearing, the response of the ear to frequencies between 30-15,000 cps varies, so that maximum response seems to lie between 3,000 and 4,000 cps. The second and more important factor in relation to receiver design, is that this variation in ear response is a function of volume level, Fig. 1. From this empirical chart, it can be seen that hearing response is poor at low frequencies at low levels, and improves as the amplitude is increased. High-frequency response likewise improves with amplitude, but not as rapidly.

A third factor is the influence of the duration of listening. Hearing acuteness decreases with time, due to fatigue.

The enumeration of these problems is not intended to discourage, but rather to point out the obvious need for some system of audio-amplitude control, which would control the relative response of the various portions of the spectrum, in order to overcome these problems.

It is quite difficult to determine just what high-fidelity reproduction means, since there are so many factors affecting a signal between the time it first is produced at the studio, and finally arrives to the listener. Two facts should be noted. Poor fidelity tends to tire the listener. Again, the listener, individually, is the final judge of whether the reproduction is good or bad. Here, the hearer may be influenced, since he will recognize better fidelity when it is compared to poor tone.

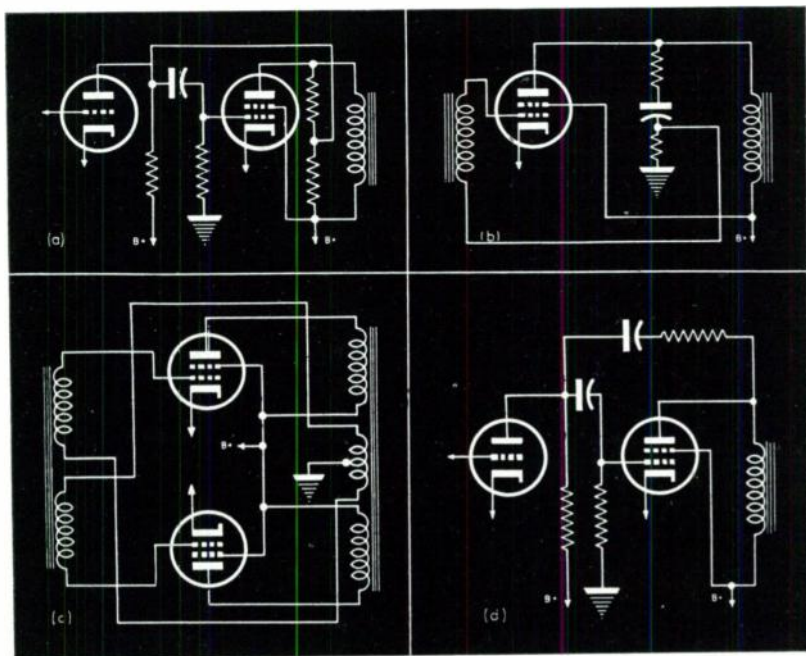


Fig. 2. Various systems of inverse feed-back. Most of these systems operate in the final stage of the a-f amplifier.

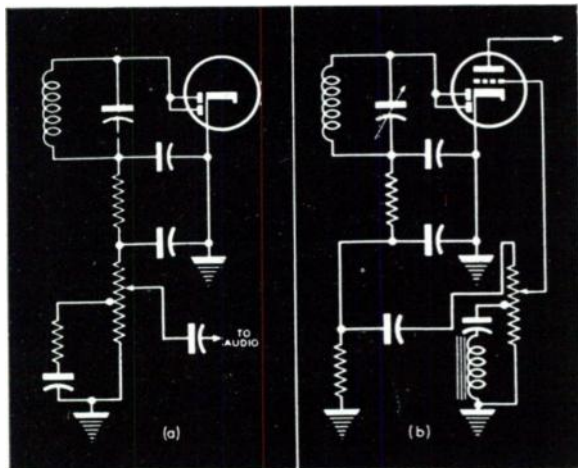


Fig. 3. Two methods of bass compensation are shown in a and b. Method shown in a is a popular method; b method offers both treble and bass compensation.

There are three factors that influence fidelity:

(1) The percentage of the frequency range of the original present in the final signal.

(2) The frequencies not present in the original, but found in the final signal (harmonic distortion).

(3) The relative amplitudes of the various frequencies in the original, and their relative amplitudes in the final signal.

As previously stated, *perfect* reproduction involves a frequency range of 30-15,000 cps. However, the extreme frequencies may be eliminated, and satisfactory reproduction will still be obtainable. To gain some idea of this, 95% quality may be obtained in orchestral music with a frequency range of 70-10,000 cps, 90% with a range of 90-8,000 cps. Authorities differ, but the limits for good reproduction would seem to lie between 90 and 100 cps for the lower end, and 9,000 and 10,000 cps for the upper end. A note should be made that satisfactory *speech* reproduction limits are 200-3,000 cps.

Harmonic distortion may also be tolerated within limits. These limits de-

pend, to some extent, on the frequency bandwidth being used. A narrow bandwidth permits more harmonic distortion, since not only are the higher frequencies removed, but the harmonics of the lower frequencies present in this upper range are also silenced. For high fidelity, the total harmonic distortion (that is, 2nd, 3rd, . . . 6th) should be less than 5%. This range may vary to 10 to 12% for fair fidelity.

Amplitude distortion is not necessarily an evil, since it is a function of tone control. As shown in Fig. 1, the ear responds unequally to both ends of the tone scale, depending on the amplitude. Since most music is produced at higher levels than it is reproduced, it becomes necessary to compensate for the frequency characteristic of the ear with a change in level. It is important that we do *not* overemphasize the non-linear ear reaction at a particular reproduction level, since the reaction of the ear to the original signal would have the same non-linear frequency characteristic. Therefore, it should be borne in mind that the difference in audibility for both extremes of the audio range accompanying a change in level, is the most important characteristic of the ear.

It is an anomaly that for high fidelity, it is necessary to have an amplifier with a flat response characteristic to the audio range, and then proceed to distort it with tone control. Tone control, in other words, is a method for compensating for:

- (1) The non-linear ear characteristic.
- (2) Amplitude distortion inherent in both the transmitter and receiver.
- (3) The room in which reproduction takes place.
- (4) The individual hearing ability and taste of the listener.

A flat-response characteristic is obtained by proper design of the audio components. To facilitate this design, and reduce harmonic distortion, negative or inverse feedback is often employed, Fig. 2. This is accomplished by feeding back a portion of the output of a tube to the input of that tube in such a manner as to cancel, or buck out, a portion of the input driving power. It is usually employed in the final stage. The benefits to be derived from this procedure are, more uniform frequency response, reduction of stage hum and harmonic distortion, and reduction of *hangover effect*. A secondary result is the reduction of stage gain, which is not necessarily detrimental, since most receivers have more than ample output. This latter effect is usually overcome by increasing the driving power to that stage. (The average radio is operated in the home at a volume level of less than 2 watts, and generally, less than 1 watt.)

Hangover effect is due to a speaker cone resonating at its natural period. It is most prevalent when the output tube has a high plate resistance. Since inverse feedback also reduces the apparent plate resistance, the shunting, or loading effect of the tube is increased, with a consequent reduction in hangover or speaker boom. Some receivers use transformer coupling for inverse feedback, Fig. 2c. The theory is still the same; feeding back a cancelling voltage out of phase with the input voltage. Bass compensation, to give a rising characteristic to the low frequencies, may be incorporated in the feedback circuit, by the proper proportioning of the resistive and capacitive elements, Fig. 2d.

Bass boost, as differentiated from bass compensation, is the accentuating of frequencies in the range of 60-250 cps. Most bass-boost systems involve the use of inductance to give a sharply rising characteristic to those frequencies below 250 cps. This is necessary, particularly at low volume settings, because of the ear response.

Bass or treble compensation for low level operation is usually incorporated in the volume control, Fig. 3a, b. The particular point on the volume control where it is installed is a function of the level of the incoming signal, and is determined from tests conducted by the design engineers. For this reason, it is important that an identical control be used where replacement is necessary. Fig. 3a shows a bass compensation system, and Fig. 3b a more ideal system for both bass and treble compensation.

(Continued in next issue)

THE RADIO TRADING POST

(Continued from page 4)

FOR SALE—Two 30 watt 110 ac or 6 volt dc Bogen amplifiers, one 70 w. 110 ac and 30 w. 110 ac Bogen amplifier, 30 w. 110 ac Stromberg Carlson amplifier, all new. Four PH-SAH Universal speakers. Sold at list price. Milani's Radio Shop, 215 Grant St., Decatur, Ala.

WILL TRADE—Gernsbach Manuals 1 to 7 and others. Want good camera. W. S. Crooks, Box 94, Kent, Ohio.

WANTED—Philco model 030 dynamic tester. State condition and price in first letter. Must be in good operating condition. Louis Fialkoff, 143-48 41st Ave., Flushing, L. I., N. Y.

FOR SALE—Universal Velocity Mic. 200 ohms, output db 63, freq. response 40-10,000, \$10.00 C.O.D., never been used. Charles Horne, 707 W. Park St., Sandusky, Ohio.

FOR SALE—1 model 156 RCA roll chart tube tester, with new roll chart, never been used. 1 502 Supreme tube tester and VOM. Just been modernized. Crystal pickup and arm and a few tubes. What have you. Mackey's Radio and Record Shop, 307 N. Spring St., Tupelo, Miss.

WANT—Any quantity, new, of following tubes: 1A7GT, 35L6, 50L6, 1LA6, 35Z3, 35Z5, 117L7, 117P7, 12SA7. State quantity and prices. Also can use phono motors, 78 rpm. Leading Radio Service, 114 East Third St., Mount Vernon, N. Y.

FOR SALE OR SWAP—New Crescent V-1 enlarger, \$16.00. New Precision enlarger 3½" F 4.5 lens, tilting head, 35 mm. to 4" x 7 neg., interchangeable lens board, \$35.00. Cash or swap for test equip. Model Laboratory, 8536 89th St., Woodhaven 21, N. Y.

WANTED—1 1LA6 or 1 1LC6, 2 35A5, 1 50Y6, 1 117P7GT. I have most any tubes but these to trade, except 12 v. Tubes are used but in good condition, some in sealed cartons. Joseph M. Palmer, P. O. Box 492, North Wilkesboro, N. C.

WANTED — A RCA Rider Senior model Voltomyst in new condition with instruction manual. Reasonable. Paul Capito, 637 W. 21 St., Erie, Pa.

WANTED—Will pay good price for a 25-B8 and a 117L7 tube, also want a 50Y6. Have lots of 6 v. P.A. parts. L. H. Francis, Parkville, Missouri.

FOR SALE — 2 new Precision enlargers, hairline focusing, tilting head, interchangeable lens board. No. 1 with 2" F 4.5 and 4" f 6.3 lens, 35 mm to 3¼" x 4½ neg., \$41.00; No. 2 with 5¾" F 6.3 lens, 5 x 7 neg., \$45.00. J. Dunnigan, 591 Coney Island Ave., Brooklyn, N. Y.

FOR SALE—A Praxidos enlarger, 2¼"x2¼", F 4.5 lens, drop cord, and enlarger bulb. 6 or 6.5 centimeter condenser, Haynes Gray scaler, glass type book carrier, handles strip film, or individual. In perfect condition. Lloyd R. Goyer, 2701 Chicago Ave., Des Moines 17, Ia.

WANTED — For cash, all kinds of test equipment, meters and Rider's Manuals. What do you need? Capitol Radio Service, 107 Virginia Ave., Cumberland, Maryland.

SWAP—Hard to get tubes for signal generator in good condition, prefer Superior 1230 or similar. Send complete dope on S.G. for list of tubes I will offer. Milton Kalashian, 2 Congress St., Newburyport, Mass.

FOR SALE OR TRADE—For 16 mm. movie projector, Philco Ford 35-36 radio. Gerald Miller, Radio Servicing, Washington Street Extension, St. Marys, Pa.

WILL TRADE—Radio tubes in original cartons, new and guaranteed. 12SF5, 12F5, 1C5, 89, 30, 31, 34, 33, 25Z6, 12F5, 12SG7, 6P5, 6N7, for Triplet model 1220C free point tester, complete with instruction, carrying handle, adapters, and four foot cable and plug. Smith Radio Service, 132 So. 7th St., Steubenville, Ohio.

WANT—Rider's Manuals 4, 10, 11, 12, 13 and 14. Any of Rider's books as follows, "The Meter at Work," "The Oscillator at Work," "Vacuum Tube Voltmeters," "Automatic Frequency Control Systems," any one or all of "An Hour-a-Day With Rider" series. Carl Becker, 849 W. 60th, Seattle 7, Washington.

WANTED—Precision 910 tube tester, portable type. Sig. generator, 702 R.C.P. Solar capacitor analyzer, type CA. Acc dc multimeter. Gregory Trego, 3648 Bailey Ave., Cleveland 13, Ohio.

FOR SALE—Cash no trades. Practically new Al model SY Signalyzer, complete with instructions and 11 tubes. All good. Uses 3 6SF5; 2 75, 1 6SC7, 1 6Z4, 4 6E5. Good unit to find cut off troubles. \$23.00. A Fiess, 3224 Midland Ave., Syracuse 7, N. Y.

WANTED—For cash, Hickok 155 Tracometer, Precision 920P tube-set tester, Hickok 510X tube-set tester, Superior Channel-Analyzer, complete set Riders. State condition, lowest price first letter. For sale: Meissner FM adapter with 8 6-volt tubes, \$35 prepaid. Soundways, 560 Walnut St., Fall River, Mass.

SELL—Four 852 tubes, dozen 4 mfd. 1000 v. condensers, 1 KVA 110/220 to 2200/4400/8800 v. C.T. transformer. Want back issues radio and electrical magazines, Weston type 301, 425, 476 meters. Grote Reber, 212 W. Seminary Ave., Wheaton, Illinois.

WANTED—Riders Manuals 1 to 9 or 10. State price and condition. Frank Cresswell, 48 College Ave., Tarrytown, N. Y.

TRADE—Remington Automatic .22 caliber rifle used 1 month, for any radio test instrument. Make offer. Paul R. French, 128 Utah St., Baytown, Texas.

TRADE—Set Rider's manuals, test equipment, Remington portable typewriter. Want new or good used communications receiver, 2½ meter equipment, or Hallicrafters model S-36 u.h.f. receiver. Describe fully. All inquiries answered. Frest Radio Service, 811 21st St., East Moline, Ill.

HAVE TUBES to swap for 35 mm. camera. Prefer Argus or Kodak 35. Many scarce numbers as 43s, 6SA7s, etc., new, as new, many in cartons. H. Gursh, 1481 Shakespeare Ave., Bronx 52, New York.

WANTED—Back issues of "Service" mag., also Radio Service Trade Kinks, Simon Radio Hand Book, Gernsbach Household Elec. Refrig., Wastrel & Prætz. Fred Wittich, 7202 Juniper Valley Rd., Middle Village, N. Y.

TRADE—One No. 10 Erector Set for a good sig. generator. Vertis O. Rogers, P. O. Box 1071, Beckey, W. Va.

FOR SALE OR TRADE—Miscellaneous meters and relays. Send for complete list. George F. Oelkers, 222 No. Lemon St., Anaheim, Calif.

WANTED — 3" oscilloscope tube. Type 3AP1-906P1. Have one 3AP1-906P1 oscilloscope tube to be repaired. Please quote price for repair. Lights very dim. P. O. Box 722, York, Penna.

SWAP—Pair Colmont Freres, Paris, 8-power stereo-prism binoculars in new condition. Want Solar model CE condenser analyzer, or equivalent. Radiodell Radionics Lab., P.O. Box 66, San Antonio 6, Texas.

WANTED—To secure circuit diagram and service data for Philips Aachen Super D58 all German radio. Will buy or rent to make photostat copy. Guarantee return to owner. Also have Clough-Bregle model OC signal generator for sale, price \$40.00. James Howard Jones, 1606 Asheboro St., Greensboro, N. C.

FOR SALE—Radio Parts condenser, meters, transmitter parts, tubes, transformers, etc. Send for list. Want Weston 301 0-1 m.a. 1 Weston 301 0-200 microamps. 1 Weston 476 0-10 or 20 amp. a.c. Leo F. Kersey, White Sulphur Springs, W. Va.

WANTED—Code instructograph, type using paper tape and Candler system of code instruction. Westcott Electric, Ontario, Oregon.

FOR SALE—6 v. 2-speed phono motor, 0-1 m.a. and 0-15 v. a.c. meters, Stancor 10-P transmitter, D.B. mike, 955 tube, etc. Send for list. Earl Huss, 414 Hildreth St., Charles City, Iowa.

WANTED—1½ v. and 90 v. supply power packs. State price and condition first letter. Also one 25 A7 tube. Henry House, 306 South Second St., Guthrie, Okla.

FOR SALE—Radio tubes at OPA ceilings. Send stamp for list. Crose Radio Service, 901 W. Touhy, Park Ridge, Illinois.

WANTED—Superior model 1240 tube tester, also Knight 7 or 14 watt amplifier system. Will pay cash. H. G. Radcliffe, 1013 High Street, Petersburg, Virginia.

WANTED—Complete set of Rider's Manuals. A. R. Ayers, Head Physics, George Peabody College, Nashville 4, Tenn.

FOR SALE—Supreme 89 De Luxe tube and set tester. Used very little. G. W. Splittgerber, 409 Congdon Ave., Elgin, Illinois.

WANTED—Kodak film, size 616. Black and white type; any speed, must be fresh. Also want small battery charger, 5 to 10 amp. charge rate; electric hair clippers, motor type, 110 v.a.c. in A1 condition. Clyde W. Wimer, 800 Wampum Ave., Ellwood City, Pa.

SWAP—\$75.00 list value of new tubes in cartons including 12SA7, 12SK7, 12SQ7, 7A8, 5U4, 5Z3, 80 other scarce tubes, for Precision model 954-P tube and a set tester. Will pay cash for Solar or C-D capacitor analyzer and af and rf signal generators. All above must be A-1. G. A. Zimmerman Radio Service, Box 77, Barton, Wisconsin.

FOR SALE—Model 560 Jewel oscillator, battery operated, used very little, best offer takes it. **WANTED**—New or used power transformers for GE J 125A or RCA same type. State price. Art Comstock, Winsted, Conn.

FOR SALE OR SWAP—New pair of 813 and 100TH. Best offer accepted. D. Camreta, 484 Clifton Avenue, Newark 4, N. J.

WANTED—Rider's Manuals, sig. gen., used or new radios and appliances. Give list prices. Ozark Electric Co., 212 W. Commercial, Lebanon, Missouri.

FOR TRADE—16 mm. Bell & Howell movie projector. Wanted Hallicrafter SX-28. A. H. Dreesen, Mansfield Centre, Conn.

WANTED—Dead or alive, used radios. What have you? Also interested in Radio City model 419 or 419P multimeter, if reasonable or equivalent in other makes. State prices. Estes Radio, P. O. Box 324, Fountain, Colorado.

WANTED—Astatic B-10 pickup. 12" recording motor, Thordarson T14C70 choke. Will sell vacuum tube and carbon hearing aids, can be rebuilt into novel miniature portable radios. John Owen, 1351 First Ave., New York 21, N. Y.

WANTED—Clough-Bregle testing equipment. Give details and price. All letters answered. Harrison Radio Service, Paul St., Dedham, Mass.

FOR SALE—2 PM 12B spkrs. and cases; 2 CR heavy duty booster spkrs.; 1 Bogen 100 w. booster amplifier, 1 Bogen E-14 amplifier. Hyle's Radio Service, Emaus, Pa.

WANTED—HRO receiver, set of coils, for cash. Griffith Sechler, A.C.R.M., L.C. N.T.S., U.S. N.A.S., Quonset Point, R. I.

WANTED—0-20 dc ammeter, also Rider's Manuals, Nos. 6 and 12, in A-1 condition. Will trade Weston 0-4 dc ammeter or new phono motors and tables, pick-up arms with crystals, or hard to get tubes, 35, 50L6, 12SK7, 12SA7, 12SQ7, Perry Radio Electronic Co., 3902 Jennings Rd., Pine Lawn 20, Missouri.

FOR SALE OR SWAP—1 Atlas 6" bench lathe, 30" bed, includes taper and milling machine attachments, complete cutting tools and holders, reversing switch, 4" Universal chuck, 4" 4-jaw independent chuck, complete set gears. Will swap for Riders Channelyst and No. 132 Stancor power pack. Sound Radio & Electronics, 210 Kings Highway, Brooklyn 23, New York.

WANTED—Supreme Vedolyzer 506-A. Will pay top dollar. Urgently needed. Allied Radio, 1234 Broad St., Providence, Rhode Island.

WANTED—Rider's Manuals, vols. 9 to 13, with index. Cash, good condition, reasonable. C. M. Zeman, 1918 1/2 Hill St., Davenport, Iowa.

WANTED—Oscilloscope and sig. generator. Must be in top condition. Give details. Charles H. Cote, 111 Woodlawn Circle, East Hartford 8, Conn.

WILL TRADE—New boxed tubes, 32, 34, 33, 1A6, 1C6, 30, 1A4, 1G5G, 1B4, 22, 49, 31, 57, 6L6. Used 6v vibrator units, used Remington No. 24 auto rifle, .22 calibre. Want good bass fly-rod, tubes 6A8, 1V, 2A7, 6X5, 6A7, 6K8, 7A8, 7B8, 6D8. Popma Radio Service, Orange City, Iowa.

SELL OR TRADE—For test equipment, complete Sprayberry Course. Just finished same. All lessons, business builders, binders, etc. Course includes master service course, electronics and television. Hilton Radio Elec., Waymart, Pa.

WANTED—Dual speed transcription motor with 16" turntable. Must be in good condition. State price. Vinton Radio, 1201 B Avenue, Vinton, Iowa.

WANTED—Channel analyzer, sig. gen., and tube tester. State condition, model and price. G. Brokaw, Rt. 4, Box 544, Stockton, Calif.

WANTED—Rider's Manuals 10 to 13 must be in good condition. Also following tubes: 1A7, 6A7, 6A8, 6Q7, 6F6, 6K7, 6SQ7, 6V6, 7A8, 7B7, 12A8, 12K7, 12Q7, 12SA7, 12SK7, 12SQ7, 25L6, 25Z6, 35Z5, 50L6, 70L7, 5Y3, 80, 42. Glass or metal. New stock. Quote cash price. Hudelson, Box 115, Vandalia, Missouri.

FOR SALE—New tubes individually sold at OPA list: 2 7A4; 3 7K7, 1 7E6; 2 6SK7; 2 6SF7; 3 77, 3 56; 2 41 or lot 30% off. All F.O.B. S. Milwaukee. Akre Electric Co., South Milwaukee, Wis.

FOR SALE—Approx 300 new tubes, original cartons, in types shown: 1A4, 1A6, 1B5, 1C6, 1C7G, 1D5G, 1D7G, 1E5G, 1E7G, 1F7G, 1H6G, 2B7, 6A4, 6B8, 30, 31, 32, 34, 48, 52, V99, X99. Any quantity 50% off list price plus postage. C. W. Norwood, 4 Lincoln Terrace, Caldwell, New Jersey.

FOR SALE—RCA factory sealed tubes in cartons: 6SK7, 6SQ7, 6J7, 6D6, 24, 6C5, 6SA7, 6F5, 5Z3, 5U4, 42, 2A5, and many more, some ceiling prices, some less. Superior Radio Service, 60 E. Mt. Eden Ave., Bronx, New York.

WANTED OR SWAP—Any quantity new tubes: 7A8, 12A8, 12K7, 12SA7, 12SQ7, 7C6, 12SR7, 12AH7, 25Z5, 25B8, 32L7, 35Z5, 35L6, 50L6, 35A5, 1N5, 11P77, 45Z5. Gus J. Scuto Radio Service, 25 Newbury St., Lawrence, Mass.

FOR SALE—1941 edition of NRI radio course. 50 lessons. Make offer. Wanted Ac voltmeter 1000 ohms per volt, two ranges, 0-20 and 0-150 volts approx. Denver Radio, 1427 Glenarm Pl., Denver, Colorado.

WILL SELL—Oscillators, testers, all kinds, transformers, speakers, switches, condensers, 244 tubes, mostly new hard to get. Get list. All or none, price \$420.00. W. E. Collins, Church Point, La.

FOR SALE—Auto radio for 1942 Ford or Mercury, original carton, never in car, six tubes, separate speaker, push button and foot control, all accessories. Make offer. Want FM converter or receiver, test equipment, or Rider's Manuals. George Swanson, Box 224, Englewood, N. J.

FOR SALE—12, 25, 35, 50 v. tubes repaired on your present tube tester. Send 50c for details. Want 1.4 v. tubes, and sound head for 35mm Powers movie projector. L. M. Wycoff, Marmaduke, Ark.

FOR SALE—1,000 6SL7 tubes, new in original carton. Wire or write F. A. B. Distributing Co., 704 Baronne St., New Orleans 13, Louisiana.

FOR SALE—New tubes (not boxed) 100 No. 41, 43c, 100 6B6 (same as 6Q7), 61c; 100 6V76 (same as 6Q7G) 72c; 50 48, 80c; 50 6V6G, 60c; 15 85, 49c; 15 6F5G, 61c. Also 200 in boxes, one of each on the list, including all hard to get numbers at OPA list. Salbrook Radio, 3835 White Plains Ave., Bronx 67, New York.

FOR SALE—Radio tubes, 1A4, 1C6, 4S, 6A4, 6B4, 6B8, 6C7, 6E7, 6V7, 6Z5, 6Z7, 6Y5, 6Y7, 30, 31, 32, 33, 34, 49, 70L7GT, 20, 40, 14 and Ballast 3, 4, 5, 9. Burcher's Elec. Store, 513 Main St., Honesdale, Pa.

FOR SALE—New tubes in cartons, whole lot only. 1C5, 3; 1Q5, 3; 2A1, 2; 42, 7. 6V6, 2; 6J5, 4; 7A7, 4; 7H7, 2; 6L6G, 4. 46, 3; 6D6, 4; 39/44, 4; 2A6, 2. \$48.00, or for test equip. and portable phonographs, portable battery sets. Horace Ursillo, 693 N. Broadway, E. Providence, Rhode Island.

WANTED—RCA Voltohmyst, Jr. New tubes factory sealed cartons. 5Y3, 6K7, 6SK7, 6SQ7, 6A8, 6A7, 6SA7, 12SK7, 12SQ7, 12SA7, 25L6, 25Z5, 25Z6, 35A5, 35L6, 35Z4, 35Z5, 35Z6, 50L6, 70L6. Paul W. White, Kingsport, Tennessee.

High Fidelity Recorded Music Reproduction

(Continued from page 6)

these condensers until the best results are obtained. A listening test, by ear, instead of arbitrary measurements by instruments, is of course used. Ordinarily, servicing in the home is out of the question, but this is custom work, specialized and painstaking. The customer also feels flattered that you are hand tailoring the amplifier to his exact requirements, and the difference is quite apparent. Every room has its own peculiar acoustic properties, and what might sound fine in your shop need not, necessarily, be anything better than *ordinary* in the place where the equipment is used permanently.

The preliminary work should be done in the shop, and the final touches added in the home. The equipment, in every case, need not be excessively elaborate.

Matching Output Tubes

An important point to remember is that output tubes must be properly matched to the load. Small differences can be compensated by adjustment of the value of the .003-mfd condenser in the 6K6G plate, as an example, but an effort should be made to check the turns ratio which for practical purposes is the same as the voltage ratio. Supplying an input signal to the a-f amplifier, the signal voltage across each half of the primary winding connected to the output tube plates should be checked. Then the secondary or voice

coil voltage should be measured. The ratio of the voltage across one half of the primary to the secondary voltage is a measurement of the turns ratio. As each output tube requires (see a tube manual) a load of 7600 ohms, if we assume a voice coil having a d-c resistance of 3 ohms, its impedance will be approximately 3×1.5 or 4.5 ohms at 400 cycles. In any event, the turns ratio required should be determined using either factor and then adjustments should be made for the best tonal quality, as required. It is essential that the output transformer be of good quality, with plenty of iron in its core.

The individual Service Man may have his own ideas on types of amplifiers to build, choice of tubes and other characteristics, and need not necessarily adhere to the circuit design shown here. The important thing is to recognize that there is a definite field for this type of work, and that it can be made extremely profitable. Incidentally the record player turntable should be rugged and the motor should be capable of revolving without excessive laboring. A good quality motor which will maintain its speed is essential. Motors which vary in speed cause serious distortion, and such distortion can be quickly detected by trained ears. A shimmeying, wavering sound indicates an unsteady motor speed. A governor type motor is considered best.

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