

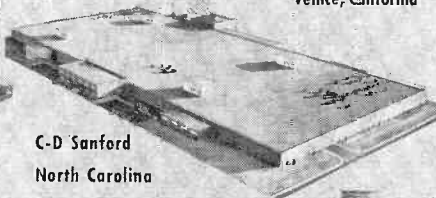
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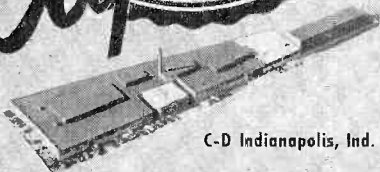
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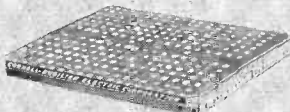


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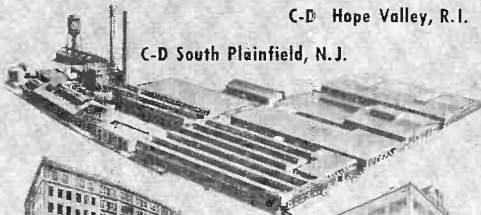


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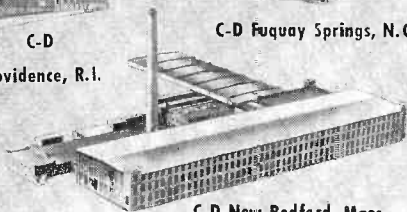
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No. 11

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COMPOSITE VOLTAGE AND ITS MEASUREMENT

A composite voltage, also called a fluctuating voltage, consists of an a-c voltage and d-c voltage in combination. The a-c is superimposed upon the d-c. Composite voltages and currents are encountered in a wide variety of electronic circuits. Thus: In electron-tube and transistor circuits, a-c signal voltages are superimposed upon d-c bias voltages; in power supply circuits, ripple voltage is superimposed upon the d-c output voltage; and in modulator and demodulator circuits, the a-c signal voltage often is superimposed upon a d-c "carrier," reference, or rectification voltage. In the output of an a-m detector, the d-c component is proportional to the average carrier amplitude, while the a-c component is the modulation envelope. Some control circuits utilize both the a-c and d-c components of a composite voltage for control purposes, either separately or in combination.

Figure 1 shows the relationships in a composite voltage when the d-c component is positive. In this example, the d-c component is voltage $+E_2$. The a-c component alternates between $+E_1$ and $+E_3$. Considering the a-c component alone, the peak amplitude of

the positive half-cycle equals $E_3 - E_2$. Similarly, the peak amplitude of the negative half-cycle equals $E_1 - E_2$. However, it should be noted that the a-c component is in intimate combination

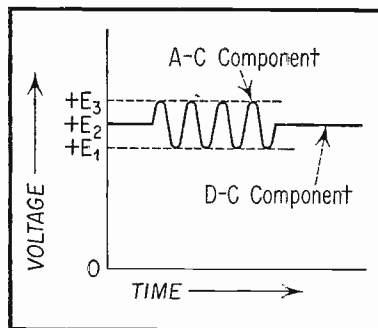


Fig. 1. Relationships in a Composite Voltage, D-C Positive.

with the d-c component, so that both the upper peak ($+E_3$) and the lower peak ($+E_1$) effectively are values of positive d-c voltage since both are above zero. Hence, the net result is a fluctuating voltage. When the a-c component is separated from the d-c, as through a transformer or coupling capacitor, the half-cycles of the separated product become truly positive and negative.

The composite-voltage pattern is similar but of opposite sign when the d-c component is negative. This is shown in Figure 2. Here, the a-c component alternates between $-E_1$ and $-E_3$, while the d-c component is voltage $-E_2$. Considering the a-c component alone in this example, the peak amplitude of the positive half-cycle equals $E_3 - E_2$ (the subtraction is per-

CORRECTION

In the circuit diagram Fig. 3, Page 7 of the September, 1957, issue of "The Capacitor," the lead from switch S_1 should be connected to the right-hand filament lead of the first 1U4 tube, instead of to ground.

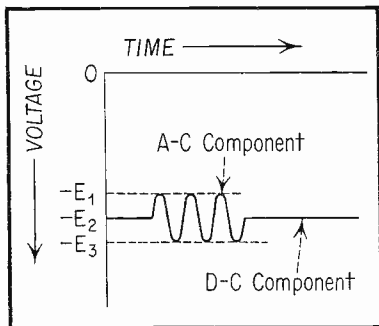


Fig. 2. Relationships in a Composite Voltage, D-C Negative.

formed arithmetically without respect to the algebraic sign in Figure 2). Similarly, the peak amplitude of the negative half-cycle equals $E_2 - E_1$. Here, also, it should be noted that the a-c component is in intimate combination with the d-c component, so that the net result is a fluctuating negative d-c voltage, since all values are below zero.

From the two preceding basic patterns, the mechanics of the fluctuating or composite voltage are readily discernible: During one half-cycle, the a-c component adds to the d-c; and during the opposite half-cycle, the a-c subtracts from the d-c. In the first in-

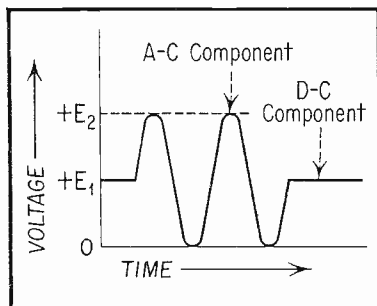


Fig. 3. A-C Component Equals D-C Component.

stance, the d-c is shifted to a higher value; in the second instance, it is shifted to a lower value.

In Figures 1 and 2, the a-c intentionally is shown smaller in magnitude than the d-c component. Figure 3 shows the relationships when the peak amplitude of the a-c equals the d-c component. Here, the d-c component is voltage $+E$. During one half-cycle, the peak a-c adds to the d-c and raises the instantaneous voltage to $+2E$, equal to twice the d-c level. During the opposite half-cycle, the peak a-c subtracts from the d-c, lowering the instantaneous voltage to zero.

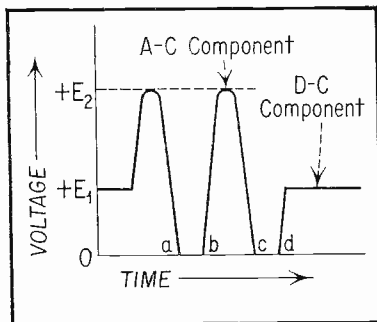


Fig. 4. A-C Component Higher than D-C Component.

Thus, the net voltage fluctuates between zero and twice the d-c level when the peak a-c amplitude equals the d-c voltage and the waveform of the a-c component is symmetrical. This is the condition obtaining in 100% amplitude modulation, where the peak a-f modulating voltage equals the d-c plate voltage of the modulated amplifier and the instantaneous plate voltage, E_p , accordingly swings between zero and $2E_p$.

Figure 4 shows the relationships when the peak amplitude of the a-c component is higher than the d-c com-

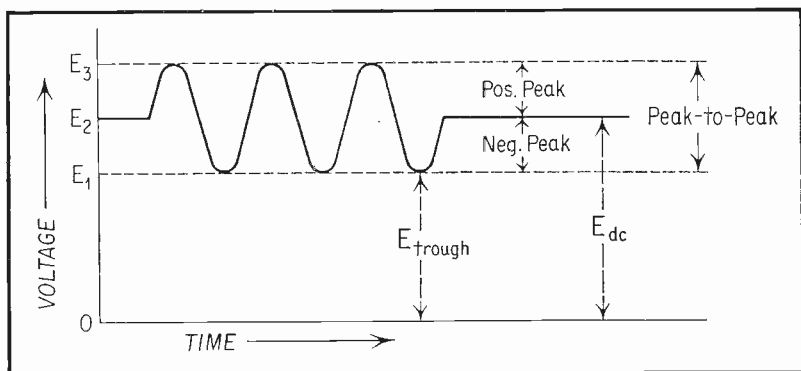


Fig. 5. Voltage Relationships in Composite Voltage.

ponent. Here, the d-c component is voltage $+E_1$. During one half-cycle, the peak a-c adds to the d-c and raises the instantaneous voltage to $+E_2$. During the opposite half-cycle, the peak a-c subtracts from the d-c; but since this peak is greater than E_1 , the instantaneous voltage remains at zero during the entire "lost" portion of this half-cycle. This results in the cutoff periods, a to b and c to d in Figure 4. This condition is comparable to one of the results of overmodulation in an a-m transmitter, where the peak a-f modulating voltage exceeds the d-c plate voltage of the modulated amplifier and accordingly reduces the instantaneous plate voltage to zero during a number of degrees of the modulation cycle.

Comparable cutoff periods also result when the grid signal of an electron-tube amplifier is much higher than the d-c bias voltage. This is an overdriven condition. During the positive half-cycle of signal voltage, the grid may be driven into saturation, giving rise to cutoff periods at a high value of positive excitation. And during the opposite half-cycle, the grid

may be driven to cutoff, giving rise to similar cutoff periods and distortion at a high value of negative excitation.

Voltage Relationships

Figure 5 illustrates the various voltage relationships in a composite pattern. The d-c component, $E_{dc} = E_2$. The average of all the instantaneous values of the fluctuating voltage between E_1 and E_3 equals E_2 and is the value which would be indicated by a d'Arsonval d-c voltmeter. The trough value is the lowest voltage to which the instantaneous value drops during the fluctuations, and is equal to E_1 . The positive peak amplitude of the a-c component equals the maximum swing minus the d-c component $= E_3 - E_2$. The negative peak amplitude of the a-c component equals the d-c component minus the minimum swing $= E_2 - E_1$. The peak-to-peak amplitude of the a-c component is the difference between the two peak amplitudes, and is equal to $E_3 - E_1$.

If the a-c component is a sine wave, its rms and average values may be calculated from its peak or peak-to-peak amplitudes: For the positive peak,

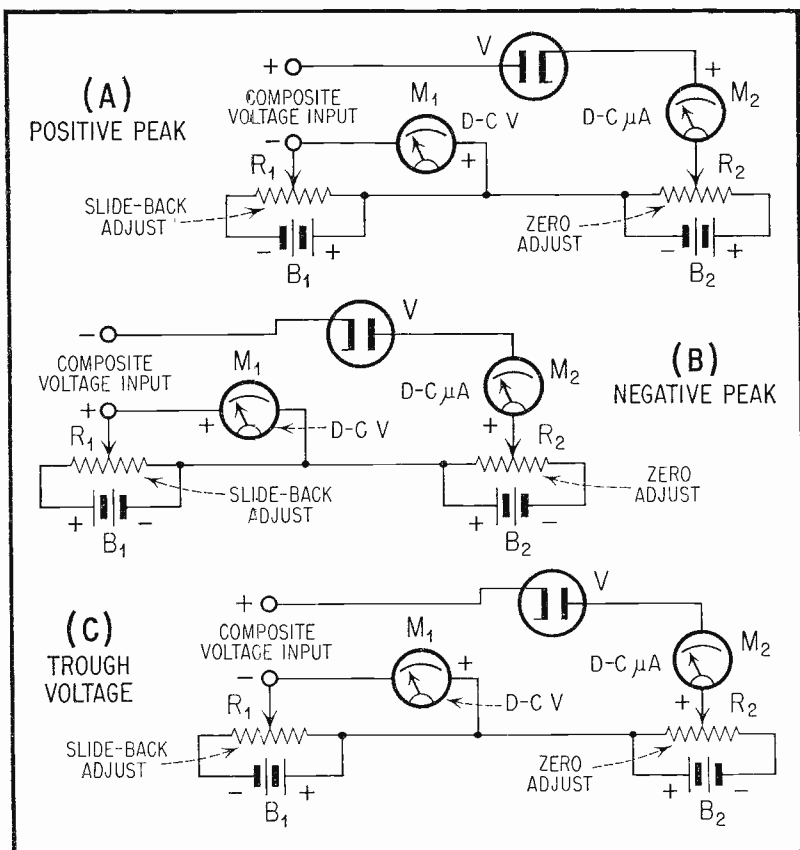


Fig. 6. Slide-Back VTVM's for Composite Voltages.

$E_{rms} = 0.707(E_3 - E_2)$, and $E_{avg} = 0.636(E_3 - E_2)$. For the negative peak, $E_{rms} = 0.707(E_2 - E_1)$, and $E_{avg} = 0.636(E_2 - E_1)$. If in addition to being sinusoidal the wave also is symmetrical, the rms and average values may be determined from the peak-to-peak value of the a-c component and will have the same value for both the positive and negative half:

$$E_{rms} = 0.3535(E_3 - E_1), \text{ and}$$

$$E_{avg} = 0.318(E_3 - E_1).$$

From these relationships, it is apparent that a composite voltage of the type illustrated by Figure 3 would have positive and negative peak amplitudes equal to E , a peak-to-peak amplitude equal to $2E$, and a trough voltage of zero. The rms value of the a-c component would be $0.707E$, and the average value would be $0.636E$. The average value of the composite voltage is E , since the average value is the mean (base line E) of the fluctuation.

Methods of Measurement

Tests and experimental analysis of circuits in which composite voltages are present involve the measurement of the separate components of this voltage or the over-all observation of the complete voltage. This Section describes briefly common methods of measurement.

D-C Voltage. The d-c component of voltage usually can be measured, without difficulty, with a d-c vacuum-tube voltmeter. An example is the measurement of the d-c voltage drop across a plate load resistor or transistor collector resistor, across which a signal voltage (a-c component) also is developed.

Use of Slide-Back VTVM. The slide-back type of vacuum-tube voltmeter may be used to measure the peak and trough values of composite voltage. Slide-back vtvm's have been designed both with triode and diode tubes. Figure 6 shows three diode-type slide-back vtvm circuits. In each of these circuits, M_1 is a high-resistance, multi-range d-c voltmeter, and M_2 is a d-c microammeter.

In each circuit, V is a diode tube. Battery B_1 must supply a voltage which can be adjusted, by means of Potentiometer R_1 , exactly to the peak value of the composite voltage. Battery B_2 supplies a much lower voltage the value of which is adjusted by means of Potentiometer R_2 to set the microammeter, M_2 , to "zero." Actually, this meter is not set exactly to zero but to a very low deflection (such as 5 or 10 microamperes), since better accuracy is obtained with a reference current such as this than when the meter is fully zeroed. When R_1 is adjusted to

supply a voltage exactly equal to the positive peak amplitude (Figure 6A), this voltage bucks the positive peak, and the microammeter deflection is reduced to the reference level. The positive peak value then is read from the d-c voltmeter, M_1 .

To use the circuit of Figure 6(A) to check positive peak voltage, first connect the input terminals of the circuit to a resistance equal to that of the composite-voltage source. For simplicity, the connection may be made to the source itself with the composite voltage temporarily switched off. Next, set M_1 to zero by adjustment of R_1 . Then, set M_2 to a low reference level (such as 5 or 10 microamperes) by adjustment of R_2 . Finally, switch-on the composite voltage, noting that M_2 is deflected to a high value. Adjust R_1 to return the deflection of M_2 to the reference value, and read the positive peak voltage directly from the deflection of Voltmeter M_1 .

In the circuit in Figure 6(B), the polarities of the batteries, tube, meters, and input terminals have been reversed. This circuit is employed in the following manner to measure the negative peak voltage: First, connect the input terminals of the circuit to the temporarily disabled composite-voltage source (or to an equivalent resistance), as explained in the preceding example. Then, set R_1 for zero reading of Voltmeter M_1 , and adjust R_2 for reference-current deflection of Microammeter M_2 . Next, adjust R_1 for full voltage from Battery B_1 which then will deflect Microammeter M_2 to a high value. Finally, apply the composite voltage, adjust R_1 to return the deflection of M_2 to the reference deflection, and read the negative peak

voltage directly from the deflection of Voltmeter M_1 .

In Figure 6(C), the polarities have been arranged for the slide-back measurement of the trough voltage of the composite voltage. Meter M_2 is set to the reference-current level in the same manner explained for the positive-peak circuit Figure 6(A). The composite voltage then is applied to the input terminals, and R_1 is adjusted to return the deflection of Microammeter M_2 to the reference level. The trough voltage value then is read directly

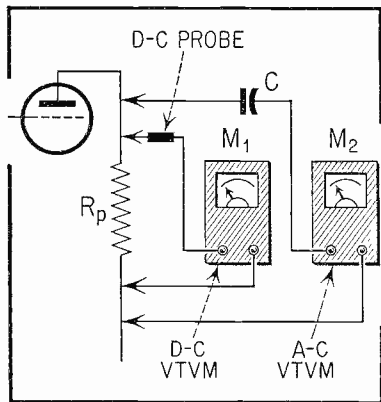


Fig. 7. Use of Conventional V-T Voltmeters.

from the deflection of Voltmeter M_1 . Use of Conventional VTVM Pair. Figure 7 shows how a pair of conventional v-t voltmeters may be used to check the a-c and d-c components of a composite voltage. M_1 is a d-c vtm, and M_2 an a-c vtm. In place of M_2 an a-c oscilloscope may be used. The oscilloscope can be provided with a voltage-calibrated screen or may be used in conjunction with a voltage calibrator.

The example selected for illustration in Figure 7 is the checking of the voltage components across the plate load resistor, R_p , in an RC-coupled

amplifier stage. The d-c vtm, M_1 , indicates only the d-c voltage drop ($I_p R_p$). The a-c vtm, M_2 , indicates only the plate-signal voltage. If the latter meter does not have a self-contained input capacitor, the external capacitor, C (0.1 to 1 ufd), must be provided as shown to block the d-c component from M_2 . Both meters operate simultaneously. Their test probes may be connected in parallel.

An advantage of using an oscilloscope in place of Meter M_2 is that most a-c vtm's are calibrated for sinusoidal signals. If the a-c component of the composite voltage is not sinusoidal, the error may be considerable. The oscilloscope, on the other hand, will reveal the peak and peak-to-peak amplitudes of any a-c component, whether sinusoidal or non-sinusoidal.

Use of D-C Oscilloscope. A voltage-calibrated, direct-coupled (d-c) oscilloscope is invaluable for checking composite voltages, since this instrument displays simultaneously the amplitudes of both a-c and d-c components and reveals the waveform of the a-c component. The vertical amplifier input terminals of the oscilloscope are connected to the source of composite voltage.

In using the d-c oscilloscope, follow this procedure: (1) Before connecting the oscilloscope to the voltage source, set the internal sweep frequency to a value which should give a display of several cycles at the frequency of the a-c component of the composite voltage. This is a trial setting which can be corrected after the voltage later is applied. (2) With the vertical beam-centering control, move the horizontal trace to the lower portion of the screen. This establishes the zero-voltage line, as shown in Figure 8(A). (3) The d-c component alone of the composite voltage will deflect the

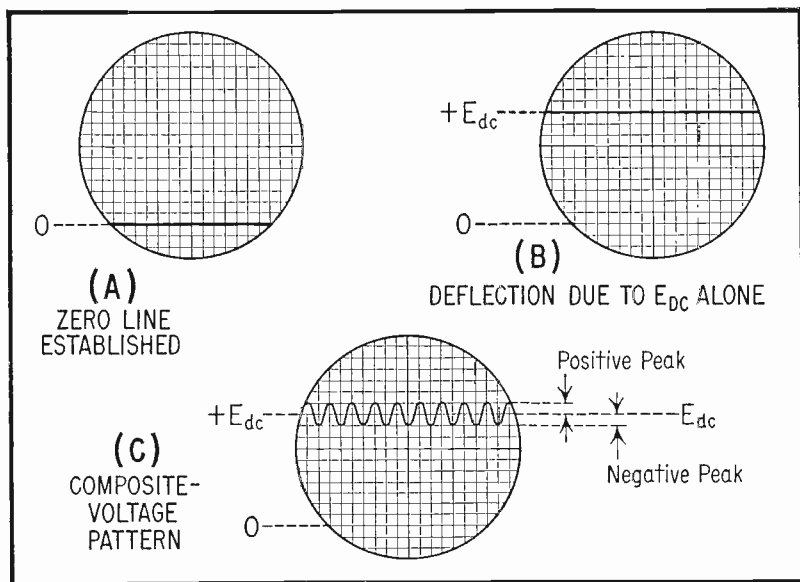


Fig. 8. D-C Oscilloscope Patterns.

trace to a higher position, E_{dc} , as shown in Figure 8(B). (4) The full composite voltage will produce fluctuations above and below the E_{dc} line, as shown in Figure 8(C).

To illustrate measurement by this method, let us assume that the voltage calibration of the screen is 20 volts per screen division. The d-c component has deflected the trace in Figure 8(B) 10 divisions upward from zero. The d-c voltage component, E_{dc} , therefore is $10 \times 20 = 200$ v. The a-c component, as shown in Figure 8(C), fluctuates from 1 division above to 1 division below the E_{dc} line. The positive peak amplitude thus is 20 v and so is the negative peak amplitude. The peak-to-peak amplitude of the a-c component is 2 divisions $= 2 \times 20 = 40$ v. The trough voltage, from Figure 8(C), is measured as 9 divisions above zero $= 9 \times 20 = 180$ v.

The patterns given in Figure 8 show

the up-scale deflection occurring when E_{ac} is positive. If E_{ac} is negative, the zero line must be set initially to the top of the screen (instead of at the bottom as in Figure 8A). The deflection then will be down-scale, and the voltage measurements will be made vertically from top to bottom, similar to the condition in Figure 2.

A shortcoming of the d-c oscilloscope method is that a very small a-c component in the presence of a large d-c component is difficult to measure on the screen, due to the difference in vertical amplification required by the two components. An example would be a 10-millivolt a-c signal superimposed upon a 300-volt d-c component. The 10-millivolt fluctuations would hardly be visible on the trace deflected to a 300-volt position on a 5-inch screen. This condition often is encountered in the low-level stages of an amplifier.



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FOR SALE — 4" square microammeter, bakelite case. 30-0-30 micro-amperes, \$5 fob. Gerald Baldauf, 3137 Philmont Ave., Huntingdon Valley, Pa.

TRADE — Table model radio; Motorola 505 car radio, for all-band receiver 540 KC to 32 or 34 MC. Prefer Hallicrafters. W. H. Cole, Jr., 6 North Cannon Ave., Sylacauga, Ala.

FOR SALE — UTC, S12 audio transformers, \$1; 3 enclosed relay racks, Par Metal Co., \$25 each; ARC filter-amplifier, F10A, 14 v., \$10 or best offer; Heath W3M amplifier, \$35. Watson, 96-01 133 Ave., Ozone Park, N. Y.

FOR SALE — 50 Sams with 2 binders, \$50; BC-221-M, selenium rectifier, no case, best offer plus shipping; 10" Tele-tone TV249, as is, \$7.50. J. Bernstein, 67-36 214th St., Bayside 4, N. Y.

FOR SALE — Tape recorder, amplifier, AM-FM tuner, speakers, oscilloscope kit, VTVM, battery eliminator, Send for list. R. Spera, 37-10 33 St., Long Island City, N. Y.

SELL OR TRADE — 4 A.N. DC series motors 27 v. with dropping resistors for use on 110 AC or DC; 80 E.D.I. rectifiers for precision instruments, many bridge types. Send for list. Leonard Knigin, 8678 Bay Pkwy, Brooklyn 14, N.Y.

WANTED — National HFS; Hallicrafters S36 or S37 and R42 or R44 speakers. C. F. Alberton, 2629 Paxton Ave., Akron 12, Ohio.

WANTED — Bug electric key, not too old. All offers considered. Tex Birnholz, 634 High St., Newark 2, N. J.

FOR SALE — Lysco 600, 40 w. CW-xmitter, VFO and xtal controlled, TVI suppressed; Heath AT-1; Eldico 40 w. modulator with power supply; code oscillator. Bob Hartman, Dakota, Ill.

SELL OR TRADE — Navy antenna mast; 13' tripod with ball-bearing swivel of special RF insulation. Will support 150 lbs., swivel support 200 lbs. Sacrifice for \$45 or for tape recorder. John O. Hehn, 18 So. Jardin, Shenandoah, Pa.

SELL OR TRADE — 3" scope in operating cond., constructed as part of Professional NR 2 TV course. W. W. Wallace, Clarkton, N. C.

SELL OR TRADE — Hy-Gain, all-band vertical antenna 10-80 meters, \$22.50 or trade or DB-23, Matchbox, etc. R. Fannon, 134 Highland St., Marlboro, Mass.

WANTED — Late model tube tester. Trade or sell 6 v. A eliminator; Radio City 705A sig. gen.; Hickok tube tester 530, and Heathkit 6 v. VTVM. Joseph Rennert, 238 Vivien Court, Paramus, N. J.

WANTED — PE 109, BC 728; 2K25's or 723 AB's. Louis F. Kralick, 522 Paine Ave., Toledo 5, Ohio.

WANTED — Service data and schematics of Silvertone 100196. Claude Stenets, 121 South Orena Ave., Redondo Beach, Calif.

SELL OR TRADE — Norelco projection TV in cabinet and special screen; RCA wire recorder; Heathkit SG-6 sig. gen. Need ham equip., fixed and Mobile. Selwyn Wynstock, 5002 S. Lawler, Chicago 38, Ill.

FOR SALE — 36 Sams Photofact binders, for \$36 or \$1.25 separately. Dixie TV and Radio Service, Moultrie, Ga.

SELL OR TRADE — RCP 322A tube tester; Brownie movie camera; Want VOM, Battery eliminator. Bruno DeCola, 379 S. Broadway, Salem, Ohio.

FOR SALE — Brown portable potentiometer model 1117, range 0-71 MV; Leeds and Northrup strip chart temperature recorders. H. A. Holmes, 1360 Jefferson Ave., Rahway, N. J.

SELL — Jensen A12PM spkr, \$12.50; GE 200-mc meter, \$4; Knight YZ750 20-w amplifier, wired, \$35; remote LC assembly for VFO (75 m), \$4.50. T. H. Mackintosh, Elon College, N. C.

FOR SALE — Riders 34, 65; Sams 100, 170, 158, 127, 253, 123, \$4.75. G. P. Oberto, 6731 Patterson Ave., Richmond 26, Va.

SELL — Heath 0-8 scope, \$25; push-pull 812 amplifier, \$12.50; 1000 v 200 ma power supply, \$12.50; 2 KVA variac, \$10. Marc Molyneux, Jr., 2101 Oakmont Ave., Anniston, Ala.

SELL — National SW-54 rcvr., \$35; Heath AR-3 rcvr., \$25, both cover 550Kc-30 Mc; Heath AC VTVM, model AV-1, \$15. R. S. Krebs, 1739 E. Susquehanna St., Allentown, Pa.

SELL OR TRADE — Electro Vcice 3300 UHF conv.; 6 assorted channel 36 strips; Philco UHF tuner; double bow-be indoor UHF ant., 10 Photofacts, 4 crt brightners, crt tester, all for DX-35, S-95, S106, S53, DB-23, or \$45 postpaid. W. Buffington, 4857 Appleton St., Jacksonville 10, Fla.

FOR SALE — Simpson 383A Capacohmeter Local only, \$65. George Siragusa, 3015 Roberts Ave., Bronx, N. Y.

FOR SALE — RCA 8T2X1 TV converted to 21" with like new 21FP4. Sell chassis or tube separately. Need manuals for Elec. Development Lab. 44 VTVM; Hickok 3" oscillograph. Antonio LoBianco 2861 Exterior St., Bronx 63, N. Y.

FOR SALE — Rear deck auto speaker kit 6 x 9 speaker grill, switch and wire \$4.85. George's Radio Repair, 3317 East St., Pittsburgh 14, Pa.

SWAP — Merit: HVG 10 horizontal output transformer, and TV III ratio detector; Stancor C-2326 filter choke; Miller No. 69 oscillator coil, all like new. William A. Borras, 438 Laroussini St., Westwego, La.

FOR SALE — Hickok 650 videc and white dot generator for B/W and color, chan 2-13; Model 292X microvolt sig. gen., 125 Kc-110 Mc 150 to 220 Mc on fundamentals. W. Watson, 96-01 133 Ave., Ozone Park 17, N. Y.

FOR SALE — C.R.E.I. Practical Radio Engineering Course, 56 lessons, \$20 plus postage. Shipping weight about 30 lbs. Norman Niemiller, 230 Parade St., St. Marys, Pa.

SELL OR TRADE — Bogen BB-1 and Alliance cascematic BB-2 TV boosters, both in good cond. Want AM sig. gen. and resistance-capacitance tester. W. L. George, Jr., 221 Palmyra Dr., Orlando, Fla.

SELL OR SWAP — Complete 6 m station, includes Tecraft xmitter, RME 2-6-10 rcvr., JT30 astatic mike, antenna relay, and 3 element beam, \$135 cash or photo equip. T. A. Lazot, 1558 Fifth St., Rensselaer, N. Y.

FOR SALE — Altec-Lansing A433A power amplifier and Pilot AM-FM tuner, \$50 each plus shipping charges. Both in new cond. Robert Slattery, 1403 Leaman, Rockford, Ill.

FOR SALE — Eico 360 TV-FM sweep sig. gen. with manual, test leads, 5MC crystal. Built, never used, needs calibration, \$20; De Vry TV-Radio correspondence course without kits, \$20. John Nay, Jr., 595 1/2 Franklin St., Shinnston, W. Va.

FOR SALE — "High Fidelity" mag. complete thru Aug. 1957 and "Audio Engineering" March '48 to date, make offer; Sams Photofacts, 22 sets, 250 thru 271, unused, \$23 for lot FOB. N. E. Nelson, 5166 N. Berkeley Blvd., Milwaukee 17, Wis.

FOR SALE — Horiz-output transformers. Philco: part 32-8572, \$4.50, part 32-8500, \$8; Philco speaker for model 46-420 radio, \$3.50; speaker: Electro-Dynamic 6", 4.0-ohm, \$4. Anders Radio and TV, 33 Adams St., Nelsonville, Ohio.

FOR SALE — 300 VDC regulated power supply, \$30; Bell tape player, \$25; Timex magnetic recorder, \$25; GE CRO-5A 5" scope, \$75. Mrs. Carolyn Burgen, 3007 Rice Ave., Rockford, Ill.

SELL OR TRADE — 750 v./250 ma. supply, 25 w. plate modulator, 40 w. novice transmitter; 400 v. vibrapack; Heath AT-1 modulator. Need S-38C and VOM. Stan., 2748 Meade St., Detroit 12, Mich.

WANTED — Used TV course, car radio for 1955 Chev. Will pay \$50 each for Samas Photofact folders and Supreme manuals, send list. Ray Herin, 1130 Wren Ave., Miami Springs, Fla.

FOR SALE — Eico 320 sig. gen., \$13; 12" dynamic speaker with large field coil, good bass response, \$4. John P. McCullen, 3050 Bainbridge Ave., Bronx 67, N. Y.

WANTED — E-200C sig. gen. for cash or swap electric $\frac{1}{4}$ " drill set. Local preferred. T. Ferguson, 171 E. 91 St., New York City, N. Y.

SELL OR TRADE — Unused RCA WR-35 color dot generator for mobile ham equip or 2 M fixed station. Lamar T. Hutchinson, Denham Springs, La.

SELL OR SWAP — Riders TV manuals, vol 1 thru 8, individually or lot. Make offer. I. Horowitz, 1775 East 17 St., Brooklyn 29, N. Y.

SELL OR TRADE — BC645 rcvr-xmtr; PE103A; Dumont 241 scope. Need power supply RA74, 84, or 94. S. Consalvo, 4905 Roanne Dr., Washington 21, D. C.

FOR SALE — 3-speed portable record player, \$20; Wagner-Nichols 331/3 rpm microgroove disc recorder, \$65; Mallory 6RSD power supply, 6 v. DC, \$15. Marilyn Phillips, 311 Penfield, Rockford, Ill.

WANTED — "Inductance Authority" by E. M. Shiepe also info. on coil-wire and condenser size to cover 3-12 Mc, 11-40Mc, 37-159Mc. L. Olson, 5734 Waring, Los Angeles 38, Calif.

WANTED — Bliley SMC-100 100-1000 kc crystal or other dual mode xtal of same frequency. State price and/or trade. Don Thomas, 2301 West 13, Lubbock, Tex.

FOR SALE — Factory checked DX-35 and VF-1, \$50 FOB Bordentown. William Emmons, 16 Laurel Ave., Bordentown, N. J.

SWAP — Hickok 530 tube tester; Radio City 705A sig. gen.; A eliminator and battery charger; VTVM, Heathkit. Need tube checker; S38 table radio, FM radio. Sam Berenblum, Greenwich, Conn.

WANTED — Power supply for BC-312n. Will pay cash or trade for radio parts. Rick Schrier, West 2203 Jackson, Spokane 12, Wash.

FOR SALE — GE 0-1 amp. RF meter, 2 1/2" round bakelite case, \$4.50 postpaid. L. Wienreb, 151-09 34th Ave., Flushing 54, N. Y.

SWAP — Precise VTVM; Solar cap. analyzer; TV boosters; Tenna Rotor. Need pre selector; comm. rec. metal locator. Thomas Rohland, R3, Martinsville, Ind.

SELL OR SWAP — Amateur coils, coil forms, radio and TV parts, etc. What have you? Vincent Malack, 10530 Edbrooke Ave., Chicago 28, Ill.

FOR SALE — Type J05 spectrum analyzer, complete, 115 v 60 cycle, by Sylvania. F. Brechlin, Radio-TV Dept., Eau Claire Voc. School, 1300 First Ave., Eau Claire, Wis.

MAN WANTED — For TV-radio repair. Prefer experienced TV man and who can repair radios, combinations and changers. State qualifications and salary expected. Tomalino's Radio and TV, Glendive, Mont.

WANTED — 5" to 10" table model TV in working cond. Will trade for radio equip. (tubes, etc.) of equal value. Joseph Smith, 600 Baver St., Clarksburg, W. Va.

WANTED — Manual on Hallicrafter S 27 VHF rcvr., also Sylvania type 400 CRO. Advise price and cond. Charles B. Shaw, Jr., Airborne Communications, Inc., Lunken Airport, Cincinnati 26, Ohio.

SELL OR SWAP — Electro-Voice model 1000 speech clipper, \$10. Want mobile equip., high power transmitter. Al Haberman, 129 Morgan St., Holyoke, Mass.

SALE OR TRADE — C-D capacitor analyzer, model BF; Hickok M505 scope and M156 Traceometer; Eico sig. gen., M324. Trade for good VOM, B and K Pix tester and rejuvenator, or Wintronix sweep analyzer. Ray's Service Shop, 1 Canal St., Ware, Mass.

FOR SALE — Transvision transistorized VTVM-VOM, factory wired, unused, \$45; Acme transistor metal locator, \$40; Apex transistor-diode tester, \$12; Garrard RC-80 changer, \$20. J. Chang, 127 Great East Neck Rd., Babylon, N. Y.

SELL — Radio manuals, books, diagrams, magazines and courses on different subjects. Battery eliminators, and radio servicing equipment. Write for list. Frederick R. Shutt, 612 Frantz Ave., Mullens, W. Va.

FOR SALE — Millen exciter/transmitter and Variam VFO, 80-40-20-10 meters with coils and instruction manual, \$40 Meissner 9-1090 signal shifter, \$30. Accept rcvr in trade. Bob Roske, 45 Hastings Ave., Pawtucket, R. I.

FOR SALE — Rcvs., transmitters. Bob Townsley, 5919 Almaden, Oakland 11, Calif.

FOR SALE — Vedio Products 630 TV rcvr. chassis with 17BP4B; Mallory TV 101 UHF tuner; back issues Radio Craft to 1946. Ernest Koda, Jr., Dawson, Ill.

FOR SALE — All Eico: deluxe sig. gen., \$50, tube tester, \$30, condenser tester, \$20. All factory wired, will trade. Edmund Zeranski, R 2, Elkton, Md.

WANTED — Signal tracer and condenser checker. State cond. and price. Sommers. 865 W. 180 St., New York 33, N. Y.

FOR SALE — Astatic UHF 3-tube TV booster, \$20; Webster wire recorder 228-1 with case and wire. Best offer. S. Strangle, Trout Creek, Mich.

FOR SALE — tower, used one year: TeleVue 30 with eye bracket and hinge over base. Cost \$58.75, \$35 takes it. Fred L. Kost, 431 Flamingo St., Philadelphia, Pa.

FOR SALE — 12 v., 30 amp, four-cycle gas gen., \$20. A. L. Humphrey, 5610 Todd Ave., Baltimore 6, Md.

FOR SALE — Sams Photofacts vols. 10 to 20 inclusive plus folders 201 to 207 all in binders. \$100 FOB. Want dual speed tape recorder. William Doran, 126 So. 11 St., Lincoln 8, Neb.

WANT — SW-3 coils, 60 series. Cash, or swap meters, parts. G. H. Goldstone, 25416 Pkwd., Huntington Woods, Mich.

SWAP — Unused drill press tapping head 1 with quill attachment, cost \$100, for good tape recorder or press camera. Steve's Radio, 842 N. Wolcott Avenue, Chicago 22, Ill.

FOR SALE — Old issues of Radio mag., books, etc. P. Calderaro, 594 Main St., Wakefield, Mass.

SELL OR TRADE — Motorola auto radio, 6-12 v., \$10; Weston meter 765; Heath AM-1. Want 10 or 15 meter beam, antenna rotor or coupler, intercom outfit. Myron L. Braun, 202 Howard St., Bellevue, Ohio.

SELL OR TRADE — 500 w. home built rig with 100THs final phone or CW with mod. and pwr. supplies in 6' commercial inclosed rack or pwr. supplies, mod. or exciter and RF final separately. Want commercial all band rig, and rcvr. John A. Berry, 5802 Master St., Philadelphia 31, Pa.

FOR SALE — Complete mobile unit, FTR commercial rig used by fire companies, etc. 30 watt xmtr., crystal controlled 150-160 mc. easy to convert to 2-meter, \$40 FOB. C. N. Vallette, 1026 Claire Ave., Huntingdon Valley, Pa.

WANTED — FM tuner or rcvr 39.1 mc. mobile or stationary. Need 39.1 mc xtal controlled mobile transceiver 6 v. DC; 35 w. Marine transceiver 6 or 12 v. DC. H. O. Lovic, 112 Country Club Dr., Plymouth, N. C.

FOR SALE — Best offer: Heath DX-100 xmtr., TS-4A alignment gen., LG-1 lab. gen., factory calibrated; HX 129X with speaker, central electronics signal slicer, co-axial relay, D-104 mike. Jean Blanton, Dahlgren, Va.

FOR SALE — 1957 V-M 710 hi-fi tape recorder. List \$189.95, want \$95. Want pre-war associated vertical transcriptions. D. G. Pace, 12 Joyce Rd., Plainview, L. I., N. Y.

WANTED — Radio for 1950 Chevrolet. Have NRI Radio and TV Servicing course for sale, no kits, \$15. Harold F. Dry, 5938 Goodwin Ave., Dallas 6, Tex.

SELL OR TRADE — Heathkit TS-2 transvision CRT tester-reactivator; NRI 67 tube tester; VHF TV booster; perma-power pack. Will trade for VTVM and 6-12 v. power supply. Virgil Franceschini, 708 Bigler Ave., Barnesboro, Pa.

FOR SALE — HI-FI 10 watt Bogen DB 10A amplifier, used very little, \$18, shipping extra. Armand Russo, 160 Sherman Ave., New York 34, N. Y.

TRADE — Electric 3-speed record player, automatic, with speaker, for photo enlarger to handle 35 mm film. Pennington's Garage, Wauneta, Neb.

SWAP — Good 7JP4 for good 8BP4. Tom's Radio and TV, Sidney, Iowa.

SWAP — Heath GD-1B grid dip meter wired and calibrated for Heath SG-8 sig. gen. in kit or wired. Even swap. C. Bernard Smith, 5209 Scottwood Rd., Paradise, Calif.

FOR SALE — HRO 60 rcvr. Will swap for smaller rcvr. and cash. Want transformer for 600-750 VDC. W. K. Duns-worth, 439 Rebecca Ave., Pittsburgh 21, Pa.

SELL OR SWAP — Knight-in-circuit capaci-tester. Want 7" TV. A. Delmarty, 142 Fir Ave., South San Francisco, Calif.

FOR SALE — Motorola TK-33M and TK-19M; Philco TV80-43-6688; 2 TV80-43-6474; TV90-UT-20A, 43-6591, and 2 GE UHF-103s. Clendenen Sites, R 3, Sturgis, Mich.

FOR SALE — Radio City combination Do-All tube and set tester model 808A VTVM-CRT reactivator plus HV probe, A-1 cond. Cash \$50. Make offer. Will ship anywhere. Raymond McKay, 32052 Brush, Royal Oak, Mich.

FOR SALE — Fully equipped radio and TV Shop. Sales and service established about 40 years in the same location. In the heart of business district. A. Squitieri, 549 Orange St., Newark, N. J.

FOR SALE — University 600 cy. cross-over network, 6 to 16 ohms, with H-F level control, 1. n., \$13; Knight printed circuit VTVM assembled, \$22. Both postpaid. Leonard Herron, 6340 Mag-nolia Ave., Chicago 40, Ill.

WANTED — Measurements Corp. 78B sig. gen., "Mobile Radio Handbook" by Milton B. Sleeper, State price and cond. Cherry Radio Co., 1438 Belfield Ave., Philadelphia 40, Pa.

TRADE — SX-43 rcvr., Hallicrafter bass reflex speaker inclosure, Lyco grid dip meter, multimeter with test oscillator, 4' cabinet rack for Johnson 11 trans-mitter. M. E. West, Rt. 2, Lenoir, N. C.

SELL OR TRADE — Precision 400E sweep gen., two 25 w. speakers in carrying case, dynamic mike with hand and floor stand. Want Zenith transoceanic radio. F. V. Hartmann, 63-04 B'way, Woodside 77, N. Y.

SELL OR SWAP — Bell and Howell 16 mm movie camera, model A, 1" lens, case and Weston light meter. Want Bozak speakers: B207A or B199A and B200X. Henry Peelor, 8 Hillcrest Ave., Oaklyn 6, N. J.

FOR SALE — Gorset super-six 6-12 v. converter; 40-80M Command rcvr. and spare parts; Morse sounder in resonator; UTC S9 and BC 375-E audio tfrs; 900 v. pwr supply. H. Leigh, Sr., 828 Nevada, San Jose 25, Calif.

FOR SALE — Professional 3 speed Crown tape recorder with built-in amplifier and speaker, mikes, 5-way speaker system, co-ax Durotone speaker in base reflex, used domestic recorders. L. M. Stone, R 1, Arab, Alabama.

WANTED — GE Ham News Vol. 1 bound. Will pay cash. John Savonis, 11 Dwight Court, New Britain, Conn.

FOR SALE — Collins rcvr. 75A4, \$595; 32V1 transmitter, \$255; 300 watt modula-tor, \$35; Triplett 4" square meter 200 microamperes, \$4.50. Ronald White, 403 Alden Rd., Hayward, Calif.

SELL OR SWAP — Precise 300 K factory calibrated 7" scope with C.A. probe. Perfect cond. for photographic equip. Precise TV, 176 Jackson Ave., Jersey City 5, N. J.

WANTED — Test equipment in any cond. Give make, model, age, cond., and price and state if manual and schematic are included. R. B. Johnson, 3922 W. 108 St., Inglewood, Calif.

FOR SALE — Hickok tube tester 532 P; RCA Voltchmist type 195A; Speco sig. tracer. Herbert Dregalla, 7193 Greenleaf Ave., Parma 30, Ohio.

WANTED — Tuning coils and cores for Silvertone 6408 radio, chassis 101 567A. R. V. Nelson, 938 South Vine, Denver 9, Colo.

FOR SALE — Hickok 288X sig. gen.; GE TC3-A portable tube tester; Quik-Chex tube filament tester; Tube-Toter all metal tube caddy. Best offer. John T. Wis-niewski, 15801 Loomis Ave., Harvey, Ill.

SELL OR TRADE — Radios: '49 Pontiac \$15, '49 Chrysler (less spkr) \$15; Univ. Truetone \$10; Univ Firestone \$10. Wayne Schmidt TV, Buckley, Ill.

SELL OR SWAP — Radio and TV tubes. Will sell Riders manuals vols 1-14; 2 outdoor aluminum amplifiers; horns \$12 each. John Andrews, 740 Maple St., Bethlehem, Pa.

SELL OR TRADE — BC-221, with original calibration manual. Interested in trans-mitter, i.e. DX-100, Ranger, Lyco 600S or similar. Walter Tilleman, R 1, Box H 10A, Worth, Ill.

TRADE — TV Schematics and Service Notes for trading stamps. 50 for each schematic. Selcraft, Box 394, Spring Valley, N. Y.

FOR SALE — Eicor 6 volts dynameter, delivers 425 v. at 375 ma; Baker 62 ft. self-supporting tower. Peter J. Donneau, 11 Blanche Ave., Cumberland Hill, R. I.

FOR SALE — Supreme 600 portable tube and set tester with instructions, \$60 and express. Albert Hart, 207 N. Raymond St., Griffith, Ind.

WANTED — Gonset 6 meter communicator and 2 meter FM converter. Both for six volt mobile use. Trade Gonset 3-30 converter. Martin Goffe, 1011-14th St., Brooklyn 19, N. Y.

FOR SALE — Sylvania 7" oscilloscope 132, \$60; TV-FM 500 sweep sig. gen., \$50; Triplett 625N VOM, \$20. Frank Mordini, 242 Everts Pl., Highwood, Ill.

SELL OR TRADE — Part for tape recorder — Wilcox-Gay disc recorder; Eico 950B cap-res. bridge; Eico 360 TV sweep gen.; Heathkit LG-1 lab. sig. gen. and TC-2; Approved Electronics instrument held strength meter, 7" Teletone TV. Charles A. Affleck, 1190 Iris Lane, Salem, Oregon.

WANTED — Schematic diagrams for power supplies for Lear aircraft LF transmitter model AMT-1, also Harvey Welis AR-3A aircraft revr. State price. Ralph W. Yauman, Box 46, Petersburg, Ohio.

FOR SALE — Heathkit TS-4 TV alignment gen., 1. n. Best offer. Eino A. Hokkanen, 188 Crescent St., Athol, Mass.

SELL OR SWAP — BC604 DM xmitr., new cond. 80 xtls, 20-30 mc. 8 tubes and spare set, all or part, fob. J. R. Seery, 146 McAllister St., San Francisco 2, Calif.

FOR SALE — P-8501 Motorola test set, good cond., \$50 fob. Cashiers check only. Duncan Caldwell, 169 So. Shepherd St., Sonora, Calif.

WANTED — Circuit and operating instructions for Vomag 900 electronic volt-meter made by McMurdock-Silver Co. E. Randall, 13, Charles Ave., Woodbrook, East London.

WANTED — Schematic diagram and operating instructions on Telvar transmitter, model T60-2. Will pay cash. John Maver, 144 W. Austin Ave., Libertyville, Ill.

WANTED — Used 630 Triplett VOM or Simpson 260. Must be in perfect cond. H. Kroll, Box 117, Seymour, Wis.

SELL OR TRADE — Two SE 712-A-1917 model revrs. William Barrett, 2828 South 9th St., Sheboygan, Wis.

SELL OR TRADE — RCP 403A multi-tester and RCA 150-B voltohmmeter. Both in working cond. \$5.95 each post-paid or trade for used AC-DC radio or sig. gen. Ewell Churchill, Jord, Ark.

SWAP — Auto radio, 51-Kaiser push button model 100170 perfect, for VTVM or sensitive VOM tube tester. Local only. Henrietta Feldman, 255 Cabrini Blvd., New York 40, N. Y.

WANTED — Schematic diagram and alignment instructions for Lafayette JS129 superhet radio revr. Wayne Wilson, Box 387, Haywood, W. Va.

FOR SALE — AF-67 transister and Gonset super-six converter. Both in A-1 cond. \$175 fob C. R. Brewer, S. H. Lynch and Co., Box 3069, Dallas 21, Tex.

WANTED — RCA dynamic demonstrator III stock 182 Give price and cond. Dixie Radio Supply Company, Inc., A. Carroll, 1320 "K" Ave., Cayce, S. C.

WANTED — one TV field strength meter battery or combination type in good working cond. Urgent. Lewis E. Sherrill, Bryson City, N. Car.

FOR SALE — Crosley F110GN portable radio less case plus two "A" batteries. Excellent cond, \$4.50. E. D. Schnurr, 528 N. Poplar, Wichita 6, Kan.

FOR SALE — Heathkit VFO \$15; Bud RLS coils and swinging link assembly; Simpson and Triplett milliammeter. J. Pyryt, 192 Norman Way, Paramus, N. J.

FOR SALE — Majestic radio, phono, wire recorder, \$35; Meissner radio, phono, record recorder, \$40. Both in good cond. Local only. J. W. Hittle, 2302 E. 20th St., Granite City, Ill.

FOR SALE — 500 watt Pi-net 80-10 final, 375 watt output modulator with speech amplifier, 1750 volt power supply. All in "36" par-metal cabinet. All or part. Chuck Garriqus, 964 Leslie Rd., Meadville, Pa.

WANTED — 10-15-20 multi-band beam antenna commercial type, State model, cond., and price. Ed Zelubowski, 2515 Gosnold Ave., Norfolk 8, Va.

SELL OR SWAP — BC 458, BC 459, \$10 each; vibrator 6 v in, 350 @ 200 mil out, \$20 cash or swap high power phone and CW. xmitter. A. Haberman, 3 Loomis Ave., Holyoke, Mass.

SELL OR TRADE — Transmitter, 100 watt AM-FM (home-built), 80-40-20-10 meters, in desk cabinet, separate heavy duty power supply, E-V mike, metered, de-TVI'd, built-in VFO. Cash or good FM tuner. C. Gabler, 1307 Merriam Ave., Bronx 52, N. Y.

SELL OR SWAP — UHF converters for cash or swap for good 3" or larger scope. Strader's Radio, 1217 Myrtle Ave., Danville, Va.

FOR SALE — Electro-Voice TV booster model 3000, \$10; Lear P10 3-band 200 kc to 6000 kc AC/DC battery portable receiver, \$10. K Miller, 14979 La Cumbre Dr., Pacific Palisades, Calif.

FOR SALE — Superior 247 tube tester, \$15; Superior UT-50 utility tester, \$5; transistor circuit kit, \$12; Wilcox-Gay tape recorder, \$50. Benson T. Hodgen, R. 5, Frankfort, Ind.

WANTED — Manuals for CRV-59 AAE (AT) or ATK TV camera and F-61 (AXT-2) TV transmitter. John Christy, 14553 Dickens St., Sherman Oaks, Calif.

FOR SALE — 9 tube Webster amplifier, worth \$100, sell for \$25; 600 v DC @ 200 ma power supply, \$10; GE mobile receiver transmitter with schematics, \$10. Stricker, 1204 El Prado, West Palm Beach, Fla.

FOR SALE — SCR 522 transmitter and receiver, \$25. Local. Steven Beder, 213 Nagle Ave., New York 34, N. Y.

WANTED — Tech manuals, Sig supply catalogs, instruction book on Silver 906 sig. gen. for cash or swap ham gear. George Pasquale, 9421 Thornhill Rd., Silver Spring, Md.

SELL OR SWAP — Metal locator, Popular Electronic magazines; hearing aid. Want Fate magazines. John Haynes, Doe Run, Mo.

WANTED — RCA 810T or similar radio, working or not. Sell or trade RCA UHF TV converter. J. H. Gordon, 520 So. 2nd St., McAlester, Okla.

WANTED — Test equipment, 3-speed changer. Will swap Kodak 35, carrying case, Heiland flash unit, filters, portrait lens. J. L. Pullen, 1423 Irby Dr., Greenville, Miss.

WANTED — Standard brand communications receiver. Send full details. Vlad Hamata, Schuyler, Neb.

SELL OR TRADE — Weston 150 and 250 milliamp. AC meters model 476, with stands. H. A. Johnson, 8218 10 Ave., Brooklyn 28, N. Y.

FOR SALE — Tel-ohmike TO-3, good cond., with instruction book. Make offer. Paul H. Case, Box 217, Ansley, Neb.

WANTED — Eico 1050 K or Heath BE-4 6-12 v battery eliminator. State price and condition. Larry Andrews, 2 Doyle St., Lawrence, Mass.

WANTED — RCA Pictoguide vol. III. State cond. and price. Joseph Karr, 1913 W. Armitage Ave., Chicago 22, Ill.

FOR SALE — Philco complete 7008 Precision align. generator, \$250. Friendly Electronic Serv., Wever, Iowa.

FOR SALE — GE synchro receiver and synchro transmitter, \$10 for both. Joe Barsomian, 21 Porter St., Watertown 72, Mass.

WANTED — Late Heath VTVM and 5" scope; radio for 1955 Chev.; Supreme manuals and Wallace Telades; Sams 200 and up. Ray Herin, 1130 Wren Ave., Miami Springs, Fla.

FOR SALE — Mobile transmitter Multi-Elmac AF-67, never used, for 6 or 12 volt operation, \$130 plus shipping. Jos. Rice, 17 Brittany Dr., Beth Page, N. Y.

FOR SALE — Projection TV: Snaider auditorium P-520 console, 20" x 23" picture, 37-tube circuit. Orig. \$1,495, sacrifice for \$39 F.O.B. Will send spec. N. P. Forcier, Haynes Ave., Middleton, Mass.

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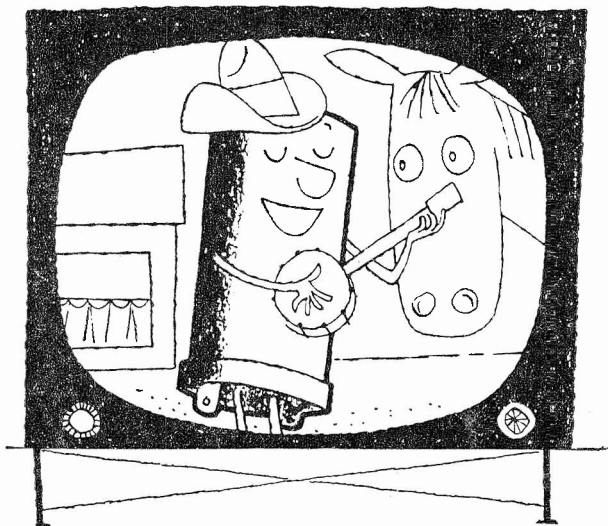
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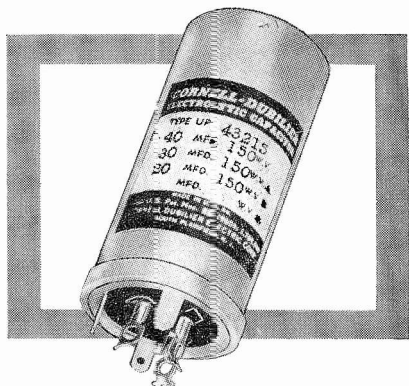
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