

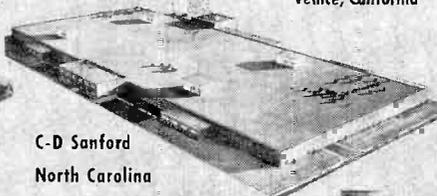
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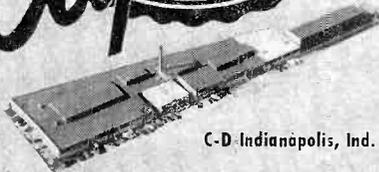


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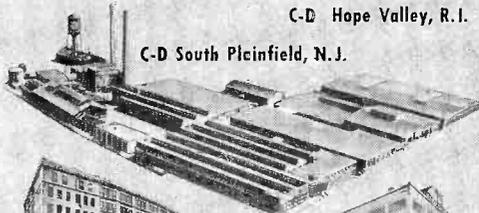


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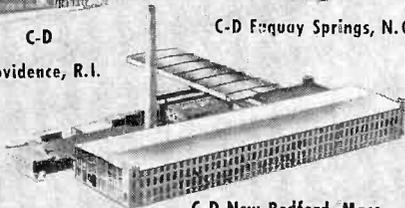
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## FREQUENCY DIVIDER METHODS

The task of producing a submultiple frequency from an available standard or operating frequency seems simple enough on the surface. This attitude probably arises from reciprocal reasoning: Frequency multiplication is a simple, practical fact, so why not also frequency division? The practical realization of frequency division, however, is neither as simple or common as multiplication. The technician confronted with the problem often has perplexity as a companion.

The needs for frequency division are varied. Thus, submultiple frequencies may be required for purposes of instrumentation, calibration, control, operation of lower-frequency circuits or equipment, synchronization, timing, counting, comparison, etc. Because of the relative unfamiliarity of the sub-

ject, it is well to review here the state of the art with respect to frequency division.

### Conventional Multivibrator

The conventional multivibrator is one of the better-known electronic frequency-dividing devices. Synchronized from the source of initial frequency, the multivibrator will divide that frequency by a factor depending upon the time constants of the multivibrator circuit components.

Figure 1 (A) illustrates the arrangement. The multivibrator is designed for operation at a natural frequency ( $f_2$ ) equal to the desired submultiple of the signal-source frequency ( $f_1$ ). Thus, in radio frequency standards,  $f_1$  usually is derived from a precise 100-kc oscillator, and the frequency ( $f_2$ ) of the

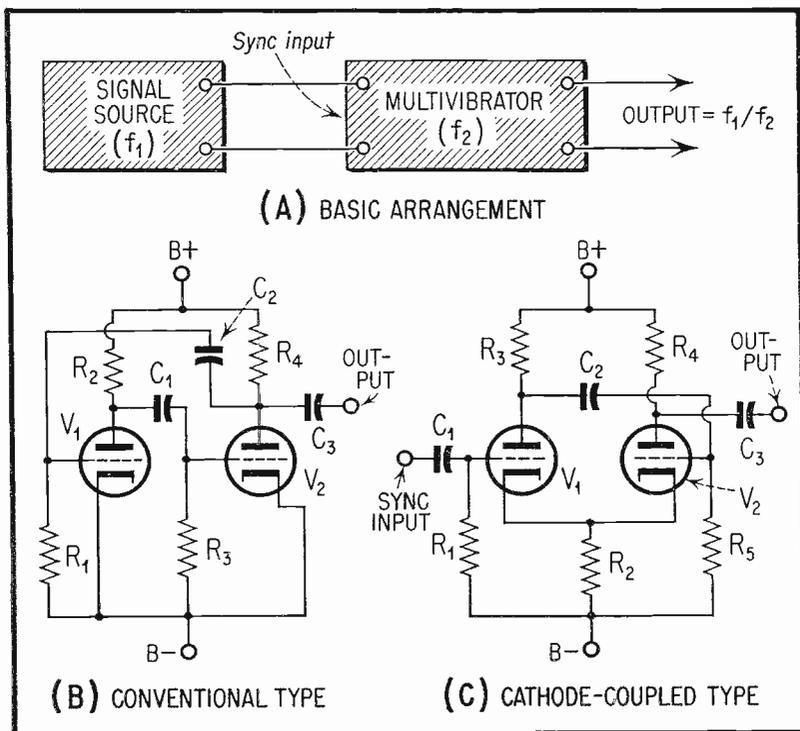


Fig. 1. Multivibrator Method.

the multivibrator may be 10 kc. Frequency division of 10 to 1 is common, although ratios as high as 100:1 have been achieved experimentally.

Also shown are two representative multivibrator circuits. The conventional multivibrator (Figure 1B) essentially is a 2-stage RC-coupled amplifier with output coupled back to input through capacitor  $C_2$ . This is a symmetrical circuit in which  $C_1 = C_2$ ,  $R_1 = R_3$ , and  $R_2 = R_4$ . The circuit is unstable and is self-oscillating at a frequency equal approximately to

$f/(500RC)$ ; where  $f$  is in kc,  $R$  (the resistance of either  $R_1$  or  $R_2$ ) is in ohms, and  $C$  (the capacitance of either  $C_1$  or  $C_2$ ) is in ufd.

A synchronizing voltage from the signal source, injected into the multivibrator circuit at either grid or plate, will lock the multivibrator into step and thereby stabilize its operation. The multivibrator then will not only divide  $f_1$  but will have the same frequency stability and accuracy as that of the signal source. Signal injection at the grid of either  $V_1$  or  $V_2$  tends to favor odd values of

frequency division, while injection at either plate favors even values.

Figure 1 (C) shows a cathode-coupled multivibrator. Here,  $V_1$  is coupled to  $V_2$  through capacitor  $C_2$ . But the feedback coupling occurs as a result of current flow through the common cathode resistor,  $R_2$ . In this circuit as in the preceding one, the natural frequency of oscillation is determined by the constants of the grid coupling capacitor ( $C_2$ ), grid resistors ( $R_1$  and  $R_6$ ), and to some extent cathode resistor  $R_2$ .

The multivibrator signal-output voltage does not necessarily have the same waveform as that of the controlling signal. The multivibrator output is essentially rectangular in shape. The controlling signal may be a sine wave or pulse. When sinusoidal multivibrator output is desired, it may be obtained by passing the output signal through a suitable bandpass filter.

It is important to remember that normally a multivibrator is capable of operation with or without synchron-

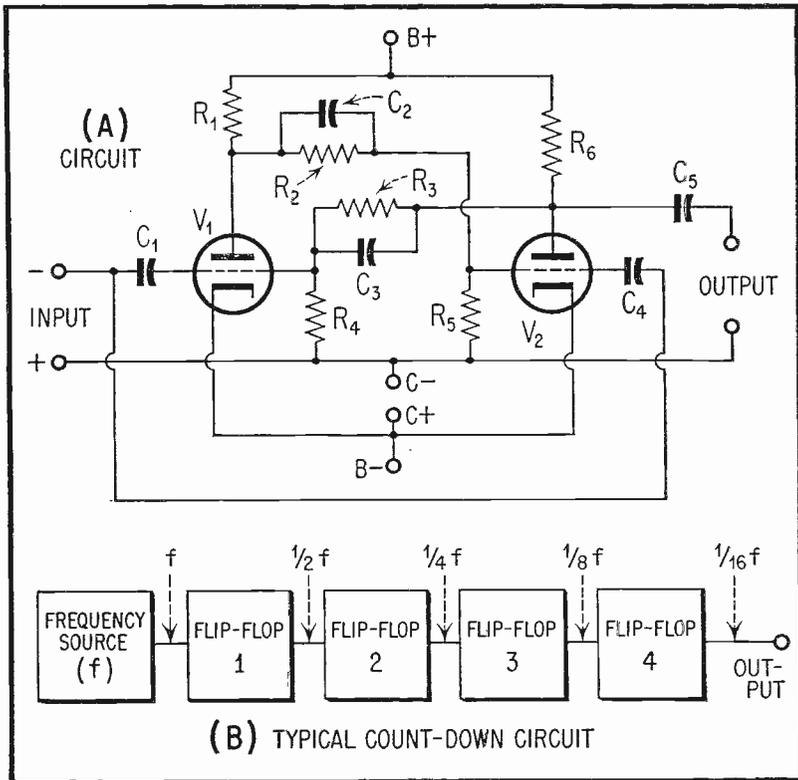


Fig. 2. Flip-flop Method.

ization but its output is unstable in the absence of synchronization. For this reason, signal-output voltage ordinarily will be present at the multivibrator output terminals whether the signal source is in operation or not. When the output is to be zero when the signal source is disabled, at least one tube in the multivibrator circuit must be biased to cutoff so that the circuit cannot operate in the absence of sync voltage.

### Flip-Flop Circuit

Somewhat similar in configuration to the multivibrator previously described is the Eccles-Jordan or flip-flop circuit. This is a symmetrical circuit which delivers an output pulse only in response to every second input-signal pulse. Thus, it is a frequency-halver or, as it often is termed, a "scale-of-2" counter.

Figure 2 (A) shows a typical flip-flop circuit. This is seen to be similar to the conventional multivibrator except that the plates and grids are cross-coupled through resistors  $R_2$  and  $R_3$ . In the flip-flop, as in other multivibrators, one tube conducts plate current during the interval that the other tube is cut off. When a suitable trigger pulse is applied to the cut-off tube, the latter is switched to the conducting state and the opposite tube is cut off.

A somewhat simplified explanation of flip-flop action takes the following sequence: When power is applied to the circuit, the plate current of one tube will, by chance, be somewhat higher than that of the other. This probably results from switching transients which drive one grid more positive than the other. Assuming that  $V_1$  has the higher conduction, the

plate-cathode voltage of  $V_1$  then is lower than the supply voltage by the amount of the drop across  $R_1$ . This lowered plate voltage causes a less-positive voltage to be applied to the grid of  $V_2$  through the voltage divider  $R_3$ - $R_4$ . This more-negative potential increases the plate-cathode voltage of  $V_2$ , and this in turn makes the grid voltage of  $V_1$  more positive through the voltage divider  $R_2$ - $R_5$ . This action causes the plate current of  $V_1$  to increase still further, and the grid voltage of  $V_2$  to become even less positive. This action continues until  $V_1$  is driven rapidly to high conduction, the final plate current of this tube being limited by the resistance of  $R_1$ . Concurrently,  $V_2$  is driven rapidly to cutoff. This is one of the two stable states of the flip-flop.

Now, if a negative pulse of sufficient amplitude and short duration is applied to the INPUT terminals, this negative voltage at the grid of  $V_1$  will reduce the plate current of that tube. This momentary reduction will reverse the sequence of events explained in the preceding paragraph; and, as a result,  $V_1$  is driven rapidly to cutoff and  $V_2$  to high conduction. This is the second stable state of the flip-flop. A subsequent negative pulse at the INPUT terminals can have no effect on  $V_1$ , since this tube already is cut off. But, being applied simultaneously to the grid of  $V_2$  (through capacitor  $C_4$ ), it will reduce the  $V_2$  plate current momentarily and cause conduction to be flipped again to  $V_1$ . Consequently, a pulse appears at the OUTPUT terminals only when  $V_2$  is cut off. Since this coincides with every other input pulse, the number of output pulses in any given time interval

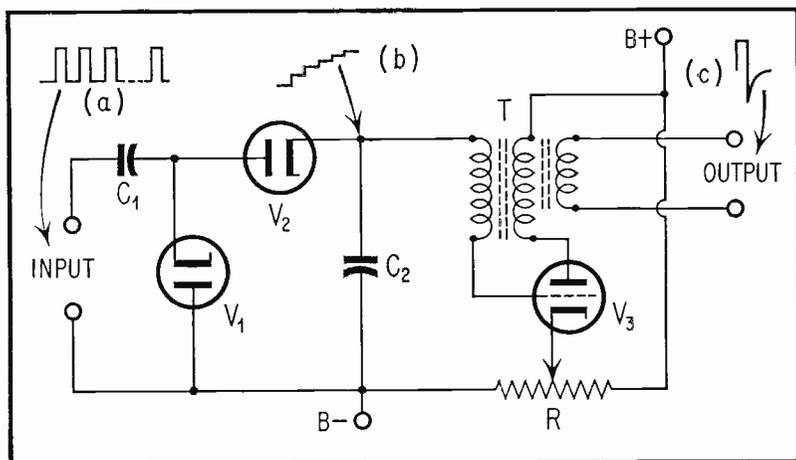


Fig. 3. Staircase Circuit.

is one-half the number of input pulses.

Flip-flops may be cascaded to obtain successive frequency halving. By proper selection of the number of stages, division of the input signal by 4, 8, 16, 32, 64, etc., may be accomplished. The final frequency division  $= 1/2^n$ , where  $n$  is the number of stages. Thus, in the cascade shown in Figure 2 (B), flip-flop 1 divides the source frequency ( $f$ ) by 2, flip-flop 2 divides the output of flip-flop 1 by 2, flip-flop 3 divides the output of flip-flop 2 by 2, etc. The output of flip-flop 1 accordingly is  $f/2$ ; flip-flop 2,  $f/4$ ; flip-flop 3,  $f/8$ ; and flip-flop 4,  $f/16$ .

Efficient flip-flop action is obtained when the input signal is a series of pulses of short duration. If the frequency which is to be divided is sinusoidal or of long duration, the input signal may be converted into satisfactory, sharp pulses of the same repetition rate by means of suitable

shaping circuitry before presentation to the flip-flops.

The waveform of the flip-flop output signal often bears no resemblance to that of the input signal. The reason for this is that the abrupt on-off switching operation of the flip-flop makes the output waveform essentially rectangular. However, when required, the input wave shape may be recovered by means of suitable filter circuitry.

Practical flip-flops have been designed around active components other than tubes. Such components include transistors, ferristors, magnistors, crytrons, and neon lamps. Low-speed flip-flop action also may be obtained with relays. (See C-D CAPACITOR, November 1955, p. 10).

#### Staircase Circuit

In Figure 3, a pulse-type signal (a) of constant amplitude is applied to the INPUT terminals. During the

positive rise of this signal, capacitor  $C_1$  is charged with its diode side negative. The plate of diode  $V_2$  now being positive, this tube conducts, charging capacitor  $C_2$  (which is large with respect to  $C_1$ ) by a small amount. During the negative half-cycle of signal voltage,  $V_2$  cannot conduct because its plate is negative. However,  $V_1$  is poled for conduction during this half-cycle and this tube passes current, discharging capacitor  $C_1$ . However, capacitor  $C_2$  has no discharge path and accordingly retains its charge. During the next positive half-cycle, the voltage on  $C_2$  is increased a small amount, in a step. This action continues, the voltage on  $C_2$  increasing during subsequent positive half-cycles according to a staircase pattern, as shown at b. Note that successive steps decrease in height exponentially as the charge voltage increases.

Capacitor  $C_2$  is connected, through the primary winding of transformer  $T_1$ , to the grid of triode  $V_3$  in a single-swing blocking oscillator circuit. The grid-signal voltage of  $V_3$  therefore is the staircase voltage developed across the capacitor,  $C_2$ . The operation of this circuit is set, by adjustment of potentiometer  $R$ , so that the oscillator

will be triggered, delivering one output pulse (c) when a desired number of input-signal steps has been reached across  $C_2$ . This action discharges  $C_2$ , and the sequence of stepping up the staircase is repeated. Potentiometer  $R$  thus serves as a counting-rate control which permits adjustment of the circuit to divide the input frequency by a desired factor.

This method is employed with thyatron tubes as well as with blocking oscillators. Sometimes, a 1-shot multivibrator is used instead of a blocking oscillator. When a thyatron is employed, the circuit is adjusted so that the voltage across  $C_2$  after a desired number of steps has been attained is equal to the firing potential of the tube.

In practical frequency dividers of the staircase type, the requirement that the input signal have constant amplitude is met by interposing an amplitude limiter between the INPUT terminals and diode circuit. While a rectangular input signal is shown at a in Figure 3, the circuit will operate with other wave shapes. However, the output signal will have the typical single-pulse shape (c) of the blocking oscillator and, in most instances, the

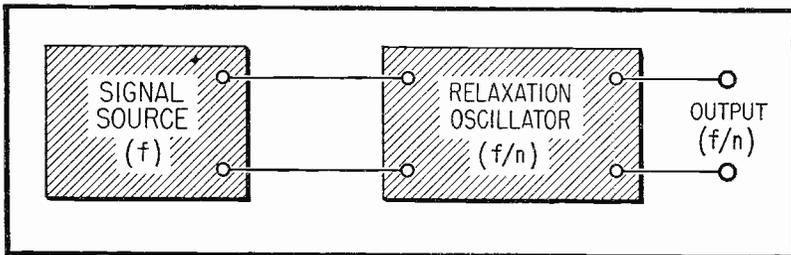


Fig. 4. Synchronized Relaxation Oscillator.

latter will bear no resemblance to the input-signal waveform. However, this output waveform may be modified, as desired, by means of suitable shaping circuitry.

#### Synchronized Relaxation Oscillator

Relaxation oscillators other than conventional multivibrators also may be synchronized from a signal source. Since the source frequency may be several times the natural frequency of the oscillator, the latter effectively divides the synchronizing frequency. Stable frequency divisions up to 1/10 are obtained in practice.

The basic arrangement is shown in Figure 4. Here, the relaxation oscillator may be any one of the well-known types: gaseous diode, gaseous triode, hard-tube, transistor, or fer-ristor. The oscillator circuit constants are chosen such that the natural frequency of the oscillator is near the desired submultiple of the signal-source frequency. The oscillator frequency must be an integral submultiple of the source frequency. Upon application of the signal, the oscillator frequency is pulled into step at an exact submultiple of the source frequency.

The output-signal waveform of a relaxation oscillator generally is sawtooth in shape. However, the oscillator may be synchronized with signal voltages having other waveforms. When the output signal must have the same waveform as that of the synchronizing signal, the sawtooth wave may be reshaped by means of wave filter action.

Normally, the relaxation oscillator

delivers an output signal even in the absence of the synchronizing voltage. When it is desired that the output be zero when there is no signal input, the oscillator circuit must be suitably biased to cutoff and arranged for immediate triggering into operation upon application of the control signal.

#### Beam Switching Tube

The magnetron-type beam switching tube (e. g., Burroughs Type 6700) is by nature a fully-electronic distributor. It contains ten sets of special electrodes spaced axially about a common cathode. A series of input-signal pulses will switch the electron stream from the cathode successively to the various sets. The target output plate in each set delivers an output signal only when the electron stream enters that set.

As a result of this action, the output signal moves around the circle of plates in step with the input signal as the latter alternates or pulses. Thus, any single plate delivers output for only 1/10 of the time and the beam switching tube so used is essentially a 10:1 divider. It is possible also to interconnect the electrodes externally so that fewer than the full ten positions are utilized and the division reduced correspondingly to a figure less than 10. Similarly, two or more tubes may be operated in cascade so as to obtain divisors higher than 10.

The beam switching tube may be used to divide the frequency of sine-wave or pulse signals and may be operated at input frequencies up to several megacycles.



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**FOR SALE** — Weston 769 analyzer, all probes complete, 1. n.; Sylvania portable tube checker, 1. n.; pocket metal multimeter TS-297/U; radio and auto mags; GE console 3-band radio, AC, good shape. Peter Loden, 8749 Crispden St., Philadelphia 36, Pa.

**FOR SALE** — National NC 101X, very good cond., has added noise limiter, no drift, 10" speaker and cabinet, excellent rcvr., \$60. Lawrence Benjamin, Box 49, Hutchinson, Minn.

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**FOR SALE** — Craig 16 mm motion Projecto-Viewer, l. n., \$25; Griswold 16 mm HM 6' film splicer, \$10, perfect. H. M. Lester, 270 W. End Ave., New York 23, N. Y.

**TRADE** — SX-16 revr. and matching speaker in good cond. for all-band mobile revr. in good cond.; Shure S556 dynamic broadcast mike, A-1 shape, for all-band mobile xmitter. Have bridge 612 tube checker with chart, \$45. Viola Basham, Peterson, W. Va.

**FOR SALE** — Riders volumes 12, 13, 14, 17, 18, \$5 each with indexes; Sams 38 thru 66, \$15 for lot, all in excellent cond. Eugene Szymanski, 1114 Clover Lane, Chester, Pa.

**FOR SALE** — NC-125 National radio, 2 years old, 4 bands, speaker extra, perfect cond., cost \$195; sell \$125 complete, plus shipping. Henry I. Orloff, 565 North Alexandria Ave., Los Angeles 4, Calif.

**SELL OR TRADE** — E-Z Kuts remote control lawn mower 21" reel type. Need GM tube tester, marker or sweep gen. Carl G. Haesloop, 7022 "A" St., S.E., Washington 27, D. C.

**FOR SALE** — CREI course, Practical and Advanced Radio Engineering, Aeronautical Radio and Advanced Math. Complete and in new cond. W. B. Donahue, Box 51, Aberdeen, S. D.

**FOR SALE** — Power xformer 1120 v CT @ 600 ma; 5 v filament at 6 and 2 amp; 6.3 v at 3 and 0.3 amp, \$6.75; 1000 assorted micas and ceramicons, \$13. S. S. Brody, 211-10 73rd Ave., Flushing 64, N. Y.

**TRADE** — Schick 20 razor with original head in case and manual, for power transformer that delivers from 500 to 750 v. VDC at 350 ma and up. L. D. Ewy, 3216 S/W 65, Oklahoma City 19, Okla.

**URGENTLY NEEDED** — Cash paid for TS-323 heterodyne frequency meters and HP 608 series sig. generators. Write giving details to Bolton Laboratories, Inc., Bolton, Mass.

**WANTED** — Hi-Fi equip.: tuner, amplifier, record player, speaker or baffle. Swap only. Have unused custom quality pushbutton intercom system, misc. parts and hardware. L. Buddine, 1700 West High St., Haddon Heights, N. J.

**FOR SALE** — Perfect Heathkit linearity pattern gen., modified as LP-2 with instructions, \$19; Heathkit FM tuner, FM-3, excellent cond., little used, aligned 100%, \$22. Joseph F. Dineen, 9 Winter Terr., Westwood, Mass.

**SELL OR TRADE** — BC-375, 223AX, other electronic equip, 11 x 14 view or copy camera and other photo equip. Want 35 mm and 4 x 5 cameras. Wm. Hansen, 165 Silverbrook, Niles, Mich.

**SWAP** — Berlant Associates Concertone 1401 portable tape recorder with 10" reels and Photofacts for over \$100, or cash plus C.E. 10B, Gonset Super 6, or 3-30 test equip. W. C. Thomas, 3529 S. Drew Valley Rd., Atlanta, Ga.

**FOR SALE** — NRI Communication Course, no kits or experimental lessons. Postpaid \$25. R. McClintock, 4325 Wyoming St., Kansas City 11, Mo.

**SWAP OR CASH** — CRT checker; sig. gen.; sweep gen.; other test equip for binoc's, guns, or cash. J. C. Nelson, 1511 E. 38 St., Erie, Pa.

**SWAP** — Zenith hearing aid (A3AN) for Corona 3 or Remington 5 portables. R. D. Smith, 440 E. 105th St., IA, New York 29, N. Y.

**WANTED** — Graflex Speed or Crown Graphic 4 x 5 camera with tripod, in good operating cond. State type lens. D. B. Fritz, 3608 St. Lawrence Ave., Reading, Pa.

**SELL OR TRADE** — H-W Bandmaster deluxe TBS-50D with 6-12 v mobile and 110 AC fixed supplies antenna, and heavy-duty mount, mike; Gonset Noise Silencer with Gonset 3-30 converter; 16" disc recorder. All like new. Best offers. R. Townsley, 5919 Almaden Lane, Oakland 11, Calif.

**FOR SALE** — Slightly used Eastern Amp. Corp. 10 m. mobile transmitter, self contained power supply, 2E30 tubes, press-to-talk, instant heating tubes, 6 v., with diagrams and instructions. Best offer with 27.33 xtal. Frank M. Mülle, 315 Salem St., New Milford, N. J.

**FOR SALE** — Heath A-7E amplifier, working, \$16 postpaid. Ed Videka, 33-40 89th St., Jackson Hts., L. I., N. Y.

**WANTED** — Simpson 221 Roto Ranger in good cond., with or without hi volt. probe. Trade radio, TV or special purpose tubes, Eastman FB25 16 mm sound projector. R. N. Eubank, 1227 Windsor Ave., Richmond 27 Va.

**WANTED** — RTTY equip.; SSB adapter for Collins 32V2. Leo Meister, River Rd., Nutley, N. J.

**WANTED** — Book on telescope making. Will trade Riders vols. 7 & 13; F Modulation, Ghirard's Modern Radio Set, tubes, 3-gang TRF condensers. Evans Radio, Ola, Ark.

**FOR SALE** — DX100, excellent cond.; HQ100 & high gain 160AV all-band vertical. Separately or all. Best offer job. Anthony J. Assenza, 18 Berry St., Milford, Conn.

**FOR SALE** — 2-meter ground planes with coax connector, \$2.75; 10-meter wonder bars, \$2.65; TBY with power supply, antenna, mike, headset, manual, post-paid. Robert Cooper, 2861 Corning St., Los Angeles 34, Calif.

**TRADE** — Sun Combustion tester and Tach-Dwell tester for VFO; mobile converter; tape recorder; or 16 mm sound projector. E. L. Sly, 7921 E. Augusta, Spokane 6, Wash.

**NOTICE** — Any commercial licensee for position in radio station. Write for further info. E. J. Welitzer, 2143 82 St., Brooklyn, N. Y.

**WANTED** — Heathkit OL-1 scope; 250 w. AM xmitter, audio console; tape recorders; modulation and frequency monitors (1340 KC); turntables, remote-control equip. for new broadcast station in Florida. Edward C. Allmon, Box 3932, Georgia Tech, Atlanta, Ga.

**WANTED** — B & K 400 CRT rejuvenator tester. State cond. and price. R. P. Frohwerk, 4330 SE Woodward, Portland 6, Ore.

**FOR SALE** — TV booster-converter, channels 2 thru 82, for VHF-UHF; Anchor TV booster 2 thru 13. E. Holbauer, 938 School St., Chicago 13, Ill.

**WANTED** — Unused electronic tubes. Will pay cash and shipping charges. C. D. Gensler, 512 Broadway, New York, N. Y.

**FOR SALE** — Like new Colorceptor antenna CL-4X with power pack made by Winegard Co., gold anodized finish, \$25 tob. R. Lackner, 2029 Bradley, Chicago 18, Ill.

**WANT** — Hickok instruments. Will sell 315 Eico, 15" amplifier; Rider V-14; Sams 1-315, \$225, all TV. Jack Moser, R 1, Lewisburg, Pa.

**FOR SALE** — Unused S-1 Saturn 6 mobile antenna; Tecraft 220 mc, 5 element; IRE Proceedings 1950 thru '57, excellent cond.; Tech-Master 14" TV less cabinet. P. Bedrosian, 452 East King, Lancaster, Pa.

**WANTED** — Hallicrafters rcvr. S-38B or similar. Will swap 8 x 30 power prism binoculars, coated lens, brown leather carrying case, used one month. Have cash also? John Arnold, Wilson St., Bluffs 3, Ill.

**FOR SALE** — 16" Philco table model TV standard coil tuner, 23 tubes, a buy at \$19.95. Will ship anywhere. Jones TV, 147 High St., Pottstown, Pa.

**WANTED** — Good comuni-Q Booster 12 v. for 6-meter communicator. Cash or swap. Also need brute force line filter. Lee Singleterry, Sr., 1914 Bollinger Rd., Seattle, Wash.

**FOR SALE** — Heathkit 1. n., AR-3 communications rcvr., best cash offer. D. Landesberg, 179 Marcy Ave., Brooklyn 11, N. Y.

**TRADE** — Slightly used Eico 352 bar gen.; 5 good 807 tubes; Modern Oscilloscopes and Their Uses by Ruiter. Want used trumpet or coronet. Louis Mulieri, 372 83rd St., Brooklyn 9, N. Y.

**FOR SALE** — Heath AR-3, 4 months old, perfect working order, \$25. Stan Kosciuk, 206 Hawthorne Ave., Newark 8, N. J.

**SELL OR TRADE** — Zenith transoceanic portable L-600, chassis 6L40. Want 5" oscilloscope. L. L. Pickle, 7817 Spur Pl., El Paso, Tex.

**SWAP** — Navy TBY8 transceiver, 28 to 80 mc, 1. n., less batteries, includes 9' whip and carrying case. Want 16 mm sound films. H. W. DeArmond, 17081/2 Whipple Ave., Redwood City, Calif.

**WANTED** — Disabled person needs discarded books, magazines, radios, etc. Will pay postage. Bob Rochester, 123 Hunnicutt St., N.W., Atlanta 13, Ga.

**FOR SALE** — Custom made Scott 3-piece, 23-tube, 4-band rcvr, all chrome plated including tube covers. Best offer. D. A. Morin, Box 41, No. Syracuse, N. Y.

**FOR SALE** — Books: Math for Electricians and Radiomen, by Cooke; Basic Electronics Test Instruments, by Turner; Alternating Current Fundamentals, by Prentice; Mandls' TV Servicing; Introduction to Circuit Analysis, Knight & Felt. Salvatore LoNigro, 14 Madeline Ave., Clifton, N. J.

**FOR SALE** — Ampex 612 tape recorder in original carton, plays stereophonic tapes as well as half and full track, \$250 or best offer. William Sahakian, 31 Franklin St., Chelsea 50, Mass.

**FOR SALE** — Heathkit battery eliminator, excellent cond., \$25. Milton Leiser, 305 E. Mt. Eden Ave., New York 57, N.Y.

**WANTED** — Hickok 770 scope, other Hickok equip; Pyramid CRA-2 condenser and resistor analyzer. Paul Capito, 637 W. 21 St., Erie, Pa.

**SELL** — Books: Principles of Radio Engineering, Glasgow; Measurements in Radio Engineering, Terman; Radio Engineering Handbook, Henney; Mathematics for Radio and Communication, Maedel, all for \$7, perfect, postpaid. Robert Cough, 29-29 213th St., Bayside 60, N. Y.

**FOR SALE** — E200 sig. gen., \$22; TV chassis from trade in sets, \$10 ea. fob. Ace TV, 5341 Cordelia Ave., Baltimore 15, Md.

**SELL OR TRADE** — "TV for Radio Men" by Noll; 125 OST; 63 Radio-TV News; Heath tech bulletins; 46 ARRL handbooks. No reasonable offer refused. J. Marshall, 455 Washington Ave., Dumont, N. J.

**TRADE** — Heath AT-1, AC-1, AR-2 with manuals Navy ARB rcvr. (150kc-9mc) with control box, fil. xmr., needs 250 vdc. Want test equip., parts, books. Ira Glickstein, 21 Brighton 5th Lane, Brooklyn 35, N. Y.

**WANTED** — Buckingham 7-tube radio made in 1930, serial no. 24282. Will pay \$50. Joe Silhavy, 1850 West York St., Blue Island, Ill.

**WANT** — Good complete portable radio. Have expensive Hamilton or Wittnauer wrist watch. Levriett, 816 Broxton, Jacksonville, Fla.

**FOR SALE** — G.E. YGS-3 AM-FM sig. gen., \$75; Precision 3' scope, \$20; noise suppressor pre-amps, Fisher, \$25 and Scott, \$15; Acro trans ultra-linear TO-300, \$15; Thordarson AM hi-fi tuner, \$15; LC1A speaker, \$85; etc. Carl Hovland, 151 Hartford Tnpk., Hamden, Conn.

**FOR SALE** — QST 1936-38, 1943, 44, and 1948 thru 1955, \$1.60 per year prepaid. Fair cond. L. M. McGee, 501 E. Wyatt, Herington, Kan.

**FOR SALE** — Tank sets BC 683 rec' 27 to 39 mc for 12 v., \$40; for 110 v. complete with power supply, \$55; also BC 603, price same. Joseph P. Murray, 12 Adams St., Charlestown, Mass.

**FOR SALE** — Riders manuals 6 to 12 with index, good cond., \$25 cod. A. G. Johnson, R 1, Box 203, Spencer, Ind.

**SELL OR SWAP** — Image orthicon, ikonoscope, both good but not broadcast quality; Pentron tape recorder and 2" pocketoscope. Can use photo equip. Moses Gershuny, 4905 Ave. K, Brooklyn 34, N. Y.

**FOR SALE** — Simpson 488 field strength meter, in perfect cond., earphones included, \$70. Will send cod. Lauck Electronics Service, Box 553, Glenwood Springs, Colo.

**WANT** — Test equip. for transformer from diathermy input 110, output 30,000 (good for kilowatt xmitter) and high voltage condensers 002 and 005 mid; also Coyne TV course. George Ledoux, 23 Walker Rd., New Britain, Conn.

**SELL OR SWAP** — Weston 813 C-15 micro-amp meter relay in original carton; 1' 5-0-5 ma panel meter; Precision 914 tube checker, exc. cond.; Stancor P-3025 transformer. Joseph Ebersson, 2116 Morris Ave., Bronx 53, N. Y.

**WANTED** — RME model DB-22A pre-selector; National HFS radio rcvr. with power supply. M. J. Oprendek, 123 Benita Ave., Youngstown 4, Ohio.

**FOR SALE** — Hi-Fi system incl. Heath FM-3A, WA-P2, Dynakit Mark 2, Universal 3-way system, \$300. 1. Batch, 4555 Richardson Ave., Bronx 70, N. Y.

**WANTED** — Need 8BP4 CRT, good cond., reasonable, good tape recorder. Have 5 x 7 portrait camera or code oscillator with 10 tapes to trade. V. R. Valley, 4329 Banks St., New Orleans 19, La.

**FOR SALE** — Granco T160 UP coaxial FM-tuner, little used, \$20; VTM McMurdo-Silver Vomax, \$25 and 906 AM-FM sig. gen. (needs small adjustment), \$25, both with instructions. Armand Russo, 163 Sherman Ave., New York 34, N. Y.

**FOR SALE** — C-D 110PA5 converter, \$5; Roto-Show window display rotator, \$15; RF amp. w/813 and B & W coils 80-10, needs work; 600 VDC FS, 50 w. mod. xmr., \$75. Al Hellman, 83-55 Woodhaven Blvd., Woodhaven 21, N. Y.

**WANTED** — Speakers and speaker frames. Write full details. Walter R. Whitcomb, 911 NW 31 St., Oklahoma City 18, Okla.

**WANTED** — For cash, NC-183D, HR050T1, SX-100, or rcvr of equal quality in good cond. R. H. Strahle, 409 Lilac Lane, Fort Collins, Colo.

**WANTED** — C3/A 5684 Thyatron tubes antenna coupler and/or SWR bridge. For cash or trade for '53 Emerson 21" TV, Heath Q multiplier. G. A. Shaw, 1530 Grove St., Burlington, Iowa.

**FOR SALE** — Measurements 59 Gridper, 1. n., \$125; Heath impedance bridge model 1B-2, 1. n., \$45. A. P. Smith, 3223 N. Linder, Chicago 41, Ill.

**FOR SALE** — Presto "Y" professional 16" disc record and playback, A-1 shape, 78 and 331/3 in two portable cases. Cost over \$775, make offer. Want freq. meters, Lampkin BC 221, Link Motorola in good shape Will pay cash. Don Clark, 16 W. Pacific St., Blackfoot, Idaho.

**SELL OR TRADE** — Hallicrafter SX25 with speaker in excellent cond. Best cash offer or trade for rifle, revolver or camera. William S. Grossman, 6324 N. Troy, Chicago 45, Ill.

**FOR SALE** — 2 meter crystal control converter, W2AZL design, with spare tubes and power supply, \$65; 522 transmitter in nice cabinet with power supply, \$50. Pick both up for \$100. R. E. Johnson, 3 Washington Pl., Cranford, N. J.

**FOR SALE** — Perfect SCR 595-AZ model ABK 150-180 mc. I.F.F. codo transceiver — 10 tubes and dynamotor on 2 chassis in 1 cabinet, \$10 job. Stephan Kaufmann, 63 Carlyle Rd., West Hartford 7, Conn.

**SELL** — Diffusicone 12" speaker, 2-way difaxial, 1. n., 40-14,000 CPS, 30 w. Pick up for \$15 or mailed postpaid \$17. Jack Berry, 1360 E. 7 St., Plainfield, N. J.

**FOR SALE** — Christy appliance service course, \$5; radio parts and science fiction mags for sale or trade. My list for yours. McGhee, 463 81st St., Niagara Falls, N. Y.

**FOR SALE** — Rec-O-Cut L-34 Rondine Jr., transcription turntable, \$35, plus postage. E. Foreman, Box 461, Mobile, Ala.

**FOR SALE** — UTC 3A equalizer, \$55; Magnacord 93X5 tape playback amplifier and power supply, \$30; Model 12 keyboard and printer teletypewriter, 110 v. sync motors, \$85; Arthur Marko, 429 East 70th St., New York 21, N. Y.

**TRADE** — Complete 1957 Fish Breeding Course, for service equip, tape recorder, all-band rcvr. or what have you? Edward H. Svoboda, Wilber, Neb.

**FOR SALE** — Mohawk pocket tape recorder, \$249; 1948 Wireway and transmitter, \$35; 1954 Webcor tape recorder, \$45. Sherman Kaufman, Unit E4B, University of Conn., Storrs, Conn.

**WANTED** — Inverter for 6 v DC to 110 v AC about 100 w continuous. Cash or swap electronics parts. Dick Rogers, 28 Bellamy St., Boston 35, Mass.

**SELL OR TRADE** — Early books and catalogs on electricity and wireless 1785-1922. Send for list. R. G. Raymond, 5353 N. Lynch Ave., Chicago 30, Ill.

**WANTED** — Radio marine gear for 12 v. operation or conversion; radio telephone, echo sounder, gas sniffer, portable radio direction finder. D. Robbins, 25 Kensington Circle, Chestnut Hill, 67, Mass.

**FOR SALE** — QST's, 1920-'30, 30c each, 1931-'50, 20c each, postage paid. Have many other titles. John Landa, Clayton 2, Ga.

**WANTED** — For cash, instruction books for TS-251, TS-14, TS-146, and information leading to source of supply for blank calibration books for LM and BC-221 frequency meters. Mobile Calibration Lab., Box 505, Campbell, Calif.

**WANTED** — Scott Radio Lab. rcvr, prewar, Philharmonic or similar model with BC and SW bands. Edward C. Bertolet, 538 Mission St., South Pasadena, Calif.

**FOR SALE** — Hickok light meter with case, \$10; ATR 6 v. battery eliminator, 115 VAC input, \$20. Albert Hart, 207 N. Raymond St., Griffith, Ind.

**FOR SALE** — Two 630 10" TV's, table models, good working cond., \$19.95 each. Thomas Dolan, 16 Foster Ave., Valley Stream, N. Y.

**FOR SALE** — Altec 629-A speaker system: 600-B Diacone speaker and 622-B slanting front wall cabinet, 1. n., \$30, guaranteed. Les Davies, 258 Marlboro Rd., Wood-Ridge, N. J.

**FOR SALE** — VOM, \$10; Hallicrafter S-40A comm. rcvr., \$50, or equivalent values in Cine camera, 8 mm projector. Charles Wendell, 36 Forest Hill Pkwy, Newark, N. J.

**WANTED** — Collins 75A2, A3 or A4 and/or other Collins gear, for cash or trade other gear. G. Pasquale, 9421 Thornhill Rd., Silver Spring, Md.

**FOR SALE** — 24" horn type outdoor speaker. Also astatic TV booster, 4 controls, best offer. Naomi Imri, R. 1, Box 113, Springfield, S. C.

**FOR SALE** — Meissner 8C FM tuner, \$10; Heathkit WA-P2 preamplifier, \$18. Paul Richter, 1448 Webster Ave., Bronx 56, N. Y.

**WANTED** — McMurdo-Silver Masterpiece 3, 4, 5, or 6, for cash or swap tubes never used in original cartons. John Furey, 807 Reed St., Olean, N. Y.

**FOR SALE** — Set of micrometers — sizes 1, 2, 3, 4, 5, and 9 inch, reasonable; C-4 Argus 35 mm camera, \$20. Roland A. Staples, Main St., R 2, Box 5, Ehot, Maine.

**WANTED** — War surplus Delco Remy P-1 24 v. air craft gen. Richard Meates, 72 Bocket Rd., Pearl River, N. Y.

**FOR SALE** — Radio Service business, stock and building, established in 1930. Want to retire. Wonderful opportunity. Price, \$10,000. Connor's Radio Service, Jerome, Idaho.

**WANTED** — Precision 912 tube tester. State price and cond. Have Pilot T-601 and Meissner 8-C tuners for trade. J. R. Blundin, 214 W. 2nd St., Mt. Carmel, Pa.

**WANTED** — Heathkit all-band rcvr. AR-3 in good cond. Seymour Weiss, 1535 Undercliff Ave., Bronx 53, N. Y.

**FOR SALE** — Latest Simpson 383A capacoh-meter; Precise 630 KA gen.; C-D bridge BN (10 mmf-50mf), all l. n., with manuals. Neil Sandow, 2121 74th St., Brooklyn 4, N. Y.

**FOR SALE** — Fort Monmouth Army Signal Corp. course in Central Office Telephone Equipment Repair, \$20. Robert J. Reidy, 1307 Neison Ave., Bronx 52, N. Y.

**FOR SALE** — RCA WF11A geiger counter with batteries, external probe, bead test kit, battery charger, ore specimen kit, calibrated radium standards, Pro-Geigerscope, ultra violet testers, handbook, other accessories, l. n., \$150. M. Bobbe, 275 E. 168 St., Bronx 56, N. Y.

**WANT TO BUY** — Hi-Fi equip. in good cond. Local only. Name price, model, and when purchased. Albert Casario, 2220 Wallace Ave., Bronx 67, N. Y.

**WANTED** — Golde reflex 349, 2 1/4 x 2 1/4 projector or Brumberger and Heiland synchro-custom or Pres model SR flash for cash or trade 8" 150-c-150 VDC Weston in case, etc. Vick Siech, 703 La Plaisance St., Monroe, Mich.

**TRADE** — Oct. 42, May 48, issues Capacitor for two of following: Nov. 42, Apr. May 45, Sept. 46, May 47. Have "Series-String" tester, \$3.50 prepaid. Toll House, Box 46, West Cornwall, Conn

**SELL OR TRADE** — Sig. gen. 1-208-B, 115 VAC or 12 VDC, 1.9 to 4.5 and 19 to 45 mc; transceiver TR-4-A, 144 to 148 mc; Millen 90651 grid dip meter; receiver CBY 46104, 1.5 to 3 mc 28 v. Robert L. Keisel, R 1, Box 136, Arlington, Tex.

**TRADE** — GWY-2 6 m xmitter; MBF xceiver; TA12-D; ARB; ARC-5's; BC454; Stewart-Warner 305; complete Photography course; 10-12" 78 rpm changer with base; Heath Q-multiplier; 6 amp 28 v. power supply. R. Crocker Carbon-dale, Pa.

**FOR SALE** — Heathkit TC-2P port. tube tester with TV picture tube test adapter, includes acorn socket, \$50, in excellent condition. Michael Bilgrel, 146 Hewes St., Brooklyn 11, N. Y.

**FOR SALE** — Heathkit O-4 oscilloscope. W. Skalski, 280 Carlton Ave., East Rutherford, N. J.

**FOR SALE** — Hickok 288X crystal controlled sig. gen.; Eico 221 VTVM; Motorola S-21 batt. elim.; Underwood 12" standard typewriter, all reasonable. Jim's Radio & TV, 37 Macrace St., Grandville, Mich.

**SELL OR SWAP** — 5" Hickok 425 scope, l. n., \$100 or good tape recorder. J. Eastwood, 868 Center Dr., Franklin Square, N. Y.

**WANTED** — Complete 6 meter mobile rig. C. L. Reynolds, 214 South Elwood, Tulsa, Okla.

**WANTED** — Commercial mobile all-band xmitter or communications rcvr. Will trade HT 17 novice transmitters; Simpson 260 multimeter; Millen 10035 illuminated vernier slide dial. Martin Schiff, 12 Burbank St., Yonkers, N. Y.

**TRADE** — B & W 80 JEL; Bud 80 OEL coils, plus two 80-meter crystals, for U. S. or foreign stamps or covers. W. G. Milnes, Jr., 27 Becker, Manton 9, R. 1.

**FOR SALE** — Simpson 230 VOM, \$25, guaranteed ok; 2 KW variac, \$25, or \$45 for both, job. Fred Kloepper, 649 W. 23rd St., Lawrence, Kan.

**SELL OR TRADE** — Make offer for Riders Radio manuals, vols. 1 thru 15. Leon Braun, 1111 E. Elizabeth Ave., Linden, N. J.

**WANTED** — In-circuit cap. tester; Wintroxin sweep circuit analyzer; crystal marker gen. Modern Electric Sales Service, Marion, Ky.

**WANTED** — For cash broken or burned-out Weller soldering gun, any size. State make and price. J. L. Ferreira, 1153-F School Ave, Patrick AFB, Fla.

**SELL OR TRADE** — Muntz 17" TV 1751, has new pix tube and flyback trans. Needs little work, \$40 or trade for most any instrument of equal value in good working order. T. J. Harp, Box 217, Old Ocean, Tex.

**SELL OR SWAP** — Like new Superior VOM 570A; 2 TV boosters; TV & radio books and manuals. Need 7 x 50 binoculars. S. Kordek, 1 Arch St., N. Brookfield, Mass.

**WANTED** — SCR-522 rcvr. converted for continuous tuning from 100 to 150 mc with AC power, and conversion data for same. Have RAK-7 low frequency rcvr.; Heath A7-B amplifier; Audio magazines. P. L. West, 201 E. Liberty St., Martinsburg, W. Va.

**FOR SALE** — All Heathkits: Capaci-Tester, \$9; C-3 condenser checker, \$7; VTVM V-7 with hi voltage probe, \$22; vol. 1, 2 Pix-O-Fix TV Trouble Finder guide, \$1. E. Giroux, 735 Park Ave., Hoboken, N. J.

**WANTED** — TP400A TV projection tube. Write your offer for a quick cash deal. C. Wachspress, 78-15 68th Rd., Middle Village 79, N. Y.

**TRADE** — Silvertone single play, 4-speed phonograph 7236C, chassis number 567-33012 for Hallicrafter SX62A communications rcvr. Clifton Johnson, R 6, Box 950, Visalia, Calif.

**FOR SALE** — Ultrasonic speaker system, perfect, \$20; Livingston universal arm, complete with GE cartridge, and diamond stylus, \$20; Rek-O-Kut LP 743 turntable, 3 speeds, \$25. Harry J. Bunn, 1352 New Jersey Ave., Marysville, Mich.

**FOR SALE** — W3DZZ 3-band beam, used about 6 months. Best offer, local preferred. H. Geberth, 19 Midwood Pl., Roosevelt, N. Y.

**WANTED** — Service and facilities for reprocessing TV projection picture tube, type TP400A. State offer and price. William Ringle, 36-20 168th St., Flushing, N. Y.

**SELL OR TRADE** — Intercarrier remote control transformers: Thoradarsen 6749, 6754; UTC NS292; Kenyon KLG, P-21, P-12; TV magazines; 35 mm color film; 630 tuner. Anthony Vanone, 137 Burbans Ave., Haledon, N. J.

**NEED** — Three EC348 rcvrs., not converted. State price and cond. Rex Clark, Princeton, Mo.

**SWAP** — 49 issues National Radio News from Aug. '47 to Jan. '57, (8 issues missing) and Mallory UHF converter, for TV tubes or ? Chick Kuesser, 2329 Park Ave., St. Louis 4, Mo.

**FOR SALE** — GE TV 800, \$15; Hallicrafter 17-824, \$15; RCA radio, 5 tube, \$5, COD. J. Kozma, 12450 NW 5 Ave., Miami 50, Fla.

**WANTED** — For cash, standard brand tubes in original cartons. A-1 TV Service, 1198 Haddon Ave., Camden 3, N. J.

**FOR SALE** — Heavy gauge enclosed cabinet racks, 6', 200 lbs., \$60 each; Stencil-Hoffman R5MS professional type tape recorder, A-1 cond., make offer. B. Watson, 96-01 133 Ave, Ozone Park 17, N. Y.

**FOR SALE** — Transmitter, in shielded metal cabinet on dolly. Complete power supply, meters, pre-amp, and microphone. Best offer over \$100 accepted plus crating and shipping. Heath Grid Dip meter; Heath antenna impedance meter. Mrs. W. T. Robenalt, Longview Ave., Zanesville, Ohio.

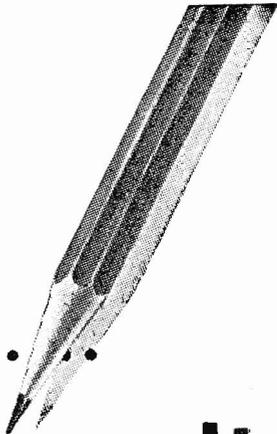
**WANTED** — Good 5 M. scope and sweep marker gen. Dwight Philbrick, O'Neill, Nebr.

**SELL OR TRADE** — Number 5 Riders TV manual, \$10. H. M. Love, 20108 Detroit Rd., Rocky River 16, Ohio.

**SALE OR TRADE** — 288 radio-TV tubes, 1. n., parts, Sams manuals 1-5. Want old coins, antique auto items. Harold Garrett, 711 South N. Y., Sedalia, Mo.

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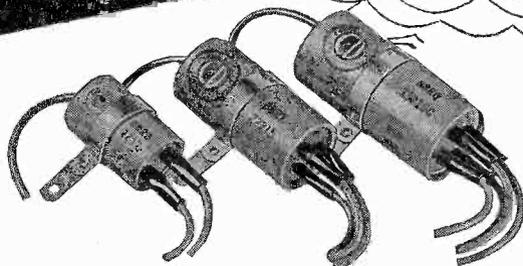
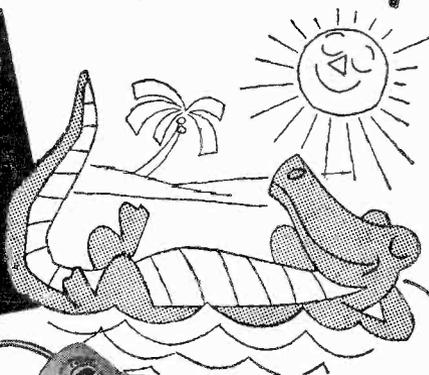


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