A 6-METER SPECTACULAR—Part II

"SIMPLE-SIXER" CONVERTER

Part II is a 6-meter crystal-controlled converter that digs right down into the external noise level picked up by your antenna rejects intermediate frequency range signals—and at the same time is simple to build and adjust. When used with the "Bonus 100" transmitter to be described in the next issue and a rotary beam antenna, some surprising contacts can be made.

—Lighthouse Larry

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The idea for this twin crystal receiver, which uses two of everything except grounds and pairs of triodes, came from Editor L. Anderson, Moorpark, California. The three-band 15-450-meg broadcast band type variable capacitor, shown at right, tunes both detector circuits and the series-tuned ground circuit. Detectors are both type 730058A; the miniature size keeps the circuit small without sacrificing performance. A tap switch is recommended to make the ground circuit tuning track. After a station is tuned in, some interesting variations in carrier and audio signal strength can be obtained by tuning the stage in Vari-logistic coils L1 and L2. A definite reduction in signal strength was noted when one crystal diode was disconnected after first peaking all the adjustments for maximum signal with both parts of the circuit working. If you try this test, do not expect to detect any starting differences by ear. In making these tests, I find that an excellent method is a peak-to-peak audio voltmeter and the low voltage ranges on a vacuum tube voltmeter are necessary to evaluate the merits of most circuits. Reacting the extra antenna 8 feet from my original best antenna was a simple task because Mother Nature correctly placed the necessary trees at the test location.

Pinetworks are getting into the act in every corner of amateur radio these days! If you haven't thrown away those old 3- or 4-gang broadcast set variable capacitors that probably have been jacking around in your junk-box for several years, stick them into this Canadian pinetwork crystal receiver dreamed up by K. J. Remp, VE3AJY, of Armstrong, Ontario. A single-gang capacitor with a few 550-meg fixed capacitors that can be switched across it with a tap switch also will work for both C1 and C2, pictured at the right. If you have plenty of No. 20 wire, tap switches and amblo- fon, you can build your own coil by winding 180 turns, tapped every 10th turn, on a 1/8-inch diameter form. Or, substituting a Vari-logistic coil will give you just about the same results, but look at all the fun you will miss by not winding and tapping those 180 turns. Both radio voltage and direct current through the headphones were somewhat higher than with a conventional tuned circuit because of an improved impedance match at both ends of the pinetwork when properly adjusted.

Here's an idea, also pictured at the right, for making a combination signal trace and crystal radio receiver, submitted by J. H. Walfy, of Waukesha, Wisconsin. The circuit is built into a small plastic box about 3 x 3 x 1 inches, with a probe on one end made from a 1/8-inch long brass machine screw. If your pet crystal receiver circuit can be squeezed into a small box, use it instead of Mr. Walfy's simple one inside just a section of a plug. The 550-meg coupling capacitor from the probe to the coil is necessary to keep DC voltages out of the circuit when tracing a plate-collector signal. The ground clip lead should be connected to the chassis when signal tracing or use earth ground for crystal receiver operation. An outside antenna should be hooked on the probe when using this gadget as a radio.

All ideas submitted before December 1, 1955, will be eligible for publication in the OPERATION CRYSTAL Column. [See G-E Ham NEWS, Volume 10, No. 1, for details.] Do not send in your own words! Submitters of the three ideas published in each issue receive certificates for $10 in G-E electronic tubes. Construction and simple exten tests of an outstanding nature are also eligible. All material submitted must be free of patent restrictions and becomes the property of G-E Ham NEWS.

Danny Bird
SIMPLE-SIXER

CONVERTER

Here's a 6-meter crystal-controlled converter designed to simplify the shack for the radio enthusiast who has found that 6 has a fascination for most hams and is now ready for equipment that will enable him to explore the interest possibilities of the 35- to 33-meter range to the fullest.

Why use a cascade circuit on 6 meters? The lower noise figure of this type circuit over conventional pentode RF amplifier will not be noticed at many locations where at the local noise level is high. But, local noise may be substantially lower during those early daylight or late evening hours when tropospheric-bending propagation is often present. That last 2 or 3 dB reduction of internal noise in this converter will help you complete many extended ground wave contacts during those periods.

The stability problem encountered in using a converter with a tunable oscillator for this hand is easily licked by using the fifth overtone of an 8-megacycle crystal to provide a 40-megacycle mixing signal with out resorting to frequency multipliers after the oscillator. The resulting 10- to 14-megacycle intermediate frequency range was selected after surveying the tuning ranges of most popular communications receivers. BC-546 and BC-96 receiver owners will find that crystal oscillator output frequencies of 40.5 and 41 megacycles respectively, will allow the 6-meter band to be covered in one tuning range.

The electrical bandwidth tuned dial on receivers having them can be plugged to make the main tuning dial read the correct tuning range if you wish to use a crystal not precisely 8 megacycles.

Performance requirements for the receiver into which you plan to feed the output of this converter can be described by the old saying, "The merit of a radio receiver is not in its 100 microvolts of background noise, but what it can do with 1000 microvolts."

If your receiver is sufficiently well shielded to be almost "dead" in this range with the antenna and ground disconnected, you are already in business.

Replacing the receiver antenna terminal with a coaxial cable jack will reduce unwanted signal pickup in the equipment when the antenna is not in use, and that jack could be mounted on a small aluminum box that encloses the antenna terminals if you do not wish to feed your receiver. (If you solve the problem of tightening the antenna terminals in a small box, you might consider the antenna described in the description to our "Tricks and Topics" column.)

CIRCUIT DETAILS

The antenna input impedance measuring arrangement shown in the schematic diagram, Fig. 1, is also used in the O.S.R. HAM NEWS" "Big Sheet" (Volume 1 No. 4, for details), simplifies adjustment of the antenna coupling to the RF amplifier input circuit (C1-C5).

The double-tuned tank circuit shown below at "A" is electrically the equivalent of circuits "B." These units are easily made from a single taped length of B & W Manganin wire. Alternate turns are omitted, so that the ends connected to tank are at right angles to each other. The central two turns are 23/4 inches long and the two side ends 1 1/2 inches long, the short side turns being 1 1/4 inches wide, with a 1/4-inch wide space at the top and bottom. Two small 1/4-inch wide flanges are formed on the side adjacent the top of the chassis so that the mounting side is 2 inches long, the short wall 1 1/2 inches wide, with a 1/4-inch wide wall at the top and bottom, the two long side flanges are formed on the side adjacent the bottom of chassis so that the mounting side is 2 inches long, the short wall 1 1/2 inches wide, with a 1/4-inch wide wall at the top and bottom. The shield should be mounted at all connections except the wire from plate of 6L6 to 6L6 cathode terminal in lower end of RF, are completed. The lead passes through a 1/4-inch diameter hole in the

the state sections of a Johnson type M midget batter-

body variable capacitor. The two units used in the RF amplifier grid (L4-C5) and plate (L5-C5) circuits were sharply-tuned to provide a flat-topped response curve about 4 megacycles wide when the converter was matched with standard standard receiver RF alignment equipment. Three tank circuits also have good filter characteristics, which help with noise and spurious signals in the 10- to 14-megacycle intermediate frequency range from feeding through the converter.

The simplified cascade RF amplifier circuit using a 6AD4 gives the same results as that of the 6V6. The single megacycle test signal fed into antenna jack 3, as a more complicated circuit using an extra tuned circuit be-

The picture shows an overtone crystal oscillator. The pi-network (L1, C1, C2) feedback arrangement allows considerable flexibility in crystal choice. Inexpensive third-overtone 24-megacycle or most 8 megacycle fundamental frequency crystals have satis-

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Fig. 1—Schematic diagram.

PARTS LIST

C1, C2—2.2-8.0-mfd 160-volt variable capacitors (Johnson 987011 Cat. 160-2036)
C3, C4—1.5-120-mfd variable micropedal capacitor (Eli Mcens Cat. 355)
C5—1.0-8.7-mfd single midget variable capacitor (Johnson 98704 Cat. 150-104)
RFC, RFC—Curtiss 2-30 RF Chokes
Xtal—Quartz crystal, 8,000 or 24,000 megacycles
All capacitors in new, 200-mfd disc ceramic
All resistors 15-watt, other sizes otherwise specified

COL TABLE

L1, L2 and L3 made from B & W phonograph, Type 3007, 3/8-inch diameter, 16 turns per inch
L4—9 turns with 1/8-inch leads, tapped at 4 turns from entrance of
L5—10 turns with 1/8-inch leads, center-tapped
L6—C10 Type 15-3 blank coil form close-wound with 90
L7—14 turns with 1/8-inch leads
L8—C10 Type 15-3 10-megacycle coils, 200-turn (Cambridge
Thermaphat Corp.)

Fig. 2—Cutting diagram of the 8-meter converter.

DRILL LEGEND

A—hole—No. 32 spaced to
B—hole—No. 36 for har-
C—hole—1/8-inch diameter
D—drill—1/8-inch diameter
E—drill—1/8-inch diameter for crystal
F—drill—1/8-inch diameter
G—drill—1/8-inch diameter
Fig. 3—Bottom view of the 8-meter converter showing placement of the shield around the intermediate frequency amplifier and positioning of coils.

Fig. 4—Intermediate frequency amplifier compartment view.
shield, mounted in the compartment view, Fig. 4. The gaging terminals on L2 and L3 should not be moved when assembling and wiring these coils or the fine wire leads may be damaged.

All resistors except the cathode bias and grid-to-ground units mount on the three 4-terminal Cinch-Jones 2000-4 mounting strips placed at convenient locations. By-pass and coupling capacitors fasten directly on their associated parts and to ground terminal lugs placed under all the 4-40 x 0.1-inch long machine screws holding the tube sockets, coaxial cable connectors and terminal strips to the chassis.

All heater, plate power and gain control connecting leads run near the corners of the chassis. However, keep these wires and all other wires at least 4-inch away from these corners so that the other half of the case can be assembled without interference.

Duplications of back-pass transformers L1-C2 and L2-C3 is simplified by making the coils from standard Minadur material and using the miniature butterfly variable capacitors for fine tuning adjustments. The coil set for L4 should be wrapped as shown in the coil table on page 6 by bending in the coil-turn at each side of the tap enough to prevent it from becoming shortened. The wire from the back-pass capacitor is soldered to the proper coil-turn. One lead of a 47-ohm resistor also connects to the coil tap. The other end of this resistor extends to the plate voltage lug on the interstage terminal strip. The other by-pass capacitor lead connects directly to the plate ground lug on C2. The ends of the coil then connect to the plate lugs on C2 with leads just long enough to allow the coil to clear the capacitor rotor when it is tuned. The completed transformer assembly is pictured in Fig. 5.

Transformer L1-C2 is assembled in the same manner except that a short length of wire is attached to the coil-tap for a direct ground connection to the tap lug on C2. Measure the coils have no short turns before mounting the completed assemblies on the chassis. One mother coil on C4 connects to plate pin 6 on the 6SK7A, the other lug goes to pin 5 of the 631 mixer through a 1000-ohm coupling resistor. Corresponding lugs on C5 connect to pin 3 on the 6SK7A and through a 15-µfd coupling capacitor to the ungrounded lug on C3. All RF and by pass connections should be made with shortest possible wire lengths.

**ADJUSTMENT PROCEDURE**

Power should be applied to the converter end the heater voltage measured before inserting the 6SK7 mixer-coupler tube. Next, a tube shield is placed over the 6SK7 and an appropriate crystal plugged into the proper socket. With C5 set about one turn from maximum capacity, plate voltage is now applied. A No. 48 or 49 (2.5 volt, 60 ma) pilot bulb with a 1-inch diameter wire top soldered to the base terminals or a small neon bulb, is then held near L2, and C3 is slowly tuned until the maximum capacity until oscillation stops, then toward minimum capacity until oscillation again begins. The oscillator frequency should next be checked with a calibrated wavemeter or receiver tuning the 6MK5c oscillator range to insure that the oscillator is working on the correct frequency. Settings of C5 will now give maximum capacity for overdrive crystals and should not turn one turn from maximum for fundamental crystals. Self-oscillation may be noted near the maximum capacity setting of C5 when the maximum feedback is used.

The output of the converter is now connected to the grid through a length of coaxial cable and the 6SK7 intermediate frequency amplifier tube and shield inserted. A 250-ohm grid-tip oscillator is used, covering both the 30 to 45 and 55 to 80 megacycle ranges is ready for tuning up and the oscillator circuit itself. Then, the converter crystal oscillator is working, the station receiver can be used to check the calibration on both ranges of these instruments, L3 and L4 should be peaked at 11 and 13 megacycles respectively, using a signal fed into pin 3 of the 6SK7 mixer.

The bottom half of the box should now be assembled and the 6SK7A tube and shield inserted. A short length of 3/dia coaxial cable is then plugged into the antenna connector and a 58-ohm composition resistor wired across the other end. The signal source coupled to this cable is then set to 53.5 megacycles and C3 is tuned for maximum signal. The antenna input circuit, L1-C2, antenna matching capacitor C1 and neutralizing coil L2 can next be adjusted for lowest noise figure using a noise generator, such as the one described on page 2 of the September-October, 1954, issue of QST. If a noise generator is not available, C1 is adjusted for maximum signal when the test source is set to 50.5 megacycles.

Then, the gain is adjusted for minimum signal from the test source by temporarily disconnecting heater voltage from the 6SK7A. Adjustment of L2 for best noise figure and the signal null is fairly broad at 50 megacycles. The best power lead is again connected to the 6SK7A and C3 is set for maximum signal at 50.5 megacycles. C4 is then set for a slight readjustment of maximum response after matching the antenna impedances. A satisfactory condition was obtained on the test set on a laboratory-type noise generator back and through the alligator clips.

A shielded power connection cable will minimize interference from other stations in the 1.14-megacycle band and be diametrically amputate until a 1/4-in. RF choke was wired in the positive plate lead outside the converter case at the terminal strip. Most reception can only be obtained in a 150-ohm Hi-Fi amplifier. An efficient antenna is used. A large loop antenna, such as a 2 x 3 yard piece of 4 x 4-inch element. Yagi antennas, pays high dividends on the 50-megacycle band. They can be mounted on a 4 television antenna mast sections and a 1/4 wave ground plane in the center. The antenna should be set a few inches from ground plane just below the top bay. Each bay can be made from a "stretched" barge-wire channel 7 television antenna.
Sweeping the Spectrum

Calling all would-be transmitters! If price has prevented you from trying some of the audio and low-frequency RF transmission circuits recently published, the Semi-conductor department of the G-E Transistor Division has come to your rescue with a new, inexpensive PMF transistor, the 1N167. They are now available on a display card at most G-E electronic tube distributors in a convenient package of two. Included in the package, which sets for little more than a cent of garnet, is a booklet showing several simple audio voltage amplifiers, speaker output amplifiers, radio practice oscillator, radio receiver and TV antenna orientation meter circuits. They require only a few parts, plus two to four ordinary flashlight cells for power. Use them for a microphone preamplifier which will have no hum problems from AC tube heaters. They will operate in RF applications up to 20 megacycles. Try a package soon.

Remember the flood of complaints and ideas I received for the Tricks and Topics Column four or five years ago about the "How to get the net on the almost in-accessible belt trick?" A tip-sized example of a similar situation recently caught my attention in the Camera Tube section of the G-E Color Tube Factory here at Schenectady.

In the assembly of the GL-5830 image-orthicon type television camera tube, the large assembly must be lowered through the neck to its final position near the faceplate with the tube standing on end. Then, small clamping screws must be carefully tightened, using screwsdrivers 14 inches long, without having any tool stick inside the tube during this operation.

A drilling of this assembly can be simplified by the fact that the target could be 1 1/8 x 1/16 inch thick glass, 3/8 inch inside diameter, 1 1/2 inches wide, and made of any grade of glass. The tube clamps fit the small shoulder of the neck and the clamping screws tighten these clamps into a series of notches that cannot be removed with the tube. This is only one of many precision operations necessary to assemble the 216 parts of a tube that engineers throughout the tube industry probably agree is about the most difficult to manufacture.

Response to my request for opinions on how you liked the ideas for the G.E. HAM NEWS QSL card (shown above again just in case you missed the picture of it in the last issue) has been terrific. Your answers rolled in by letter, postcard, QSL card and radiogram—overwhelmingly . . . YES! Consequently, packages of 500 QSL cards now are available, for only one dollar, delivered postpaid to you door. We have had the printer wrap them, ready to ship, in packages of 500. Please order them in that quantity, or multiples of it. At this price, we cannot accept orders requesting C.O.D., shipment or billing at a later date. Always enclose full remittance with your order.


Several short-wave listeners favored our adjustable QSL card, adding another idea to the list of suggested uses we printed in the last issue. Note that there is plenty of space above and below the big form for your call numbers, address and other information. 500 cards remains available to those who expressed interest in this project by sending in their comments—A MILLION THANKS!!

-Southside Barry
NOMINATIONS NOW OPEN
FOR 1955 EDISON AWARD

The Fourth Annual Edison Radio Amateur Award will give you an opportunity to recommend for
high honors an amateur who has rendered important public service. One pneumatic trophy, a $200 check, and court-side recognition await the 1955 winner. The panel of judges will consider only candidates nominated by letters from you and others. Start now to make your selection and assemble the facts for your nominating letter. Read the Award Rules below.

Rules of the Award

WHO IS ELIGIBLE: Any man or woman holding a radio amateur's license issued by the F.C.C., Washington, D.C., who in 1955 performed a meritori-
ous public service in behalf of an individual or group. The service must have been performed while the candidate was pursuing his hobby as an amateur
within the continental limits of the United States.

WINNER OF THE AWARD will receive the Edison trophy in a public ceremony
in a centrally located metropolitan city. Expenses of his trip to that city
will be paid. $500 GIFT. Winner will be presented with a check for this amount in recog-
nition of the public service he has rendered.

WHO CAN NOMINATE: Any individual, club or association familiar with the
service performed.

HOW TO NOMINATE: Include in a letter the candidate's name, address, full
letters, and a full description of the service performed. Your letter must be
postmarked not later than January 2, 1956.

BASES FOR JUDGING: All entries will be reviewed by a group of distinguished
and impartial judges. Their decisions will be based on (1) the greatest
benefit to an individual or group; (2) the amount of ingenuity and sacrifice
displayed in performing the service.

JUDGES WILL BE

E. SOLAND HARRIMAN, Presidi-
ent, The American Red Cross.

HERBERT HOOVIN, JR., the Uni-
des Secretary, U.S. Department
of State.

EDWARD M. WEBSTER, Commissi-
ioner, Federal Communications
Commission.

GOODWIN L. DOILAND, Presi-
dent, American Radio Relay
League.

Winner of the Award will be announced on or before Thomas A. Edison's birthday, February 11, 1955.

Employees of the General Electric Company may nominate candidates for the Edison Radio Amateur Award, but are not
permitted to receive the Award.

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