BUILD

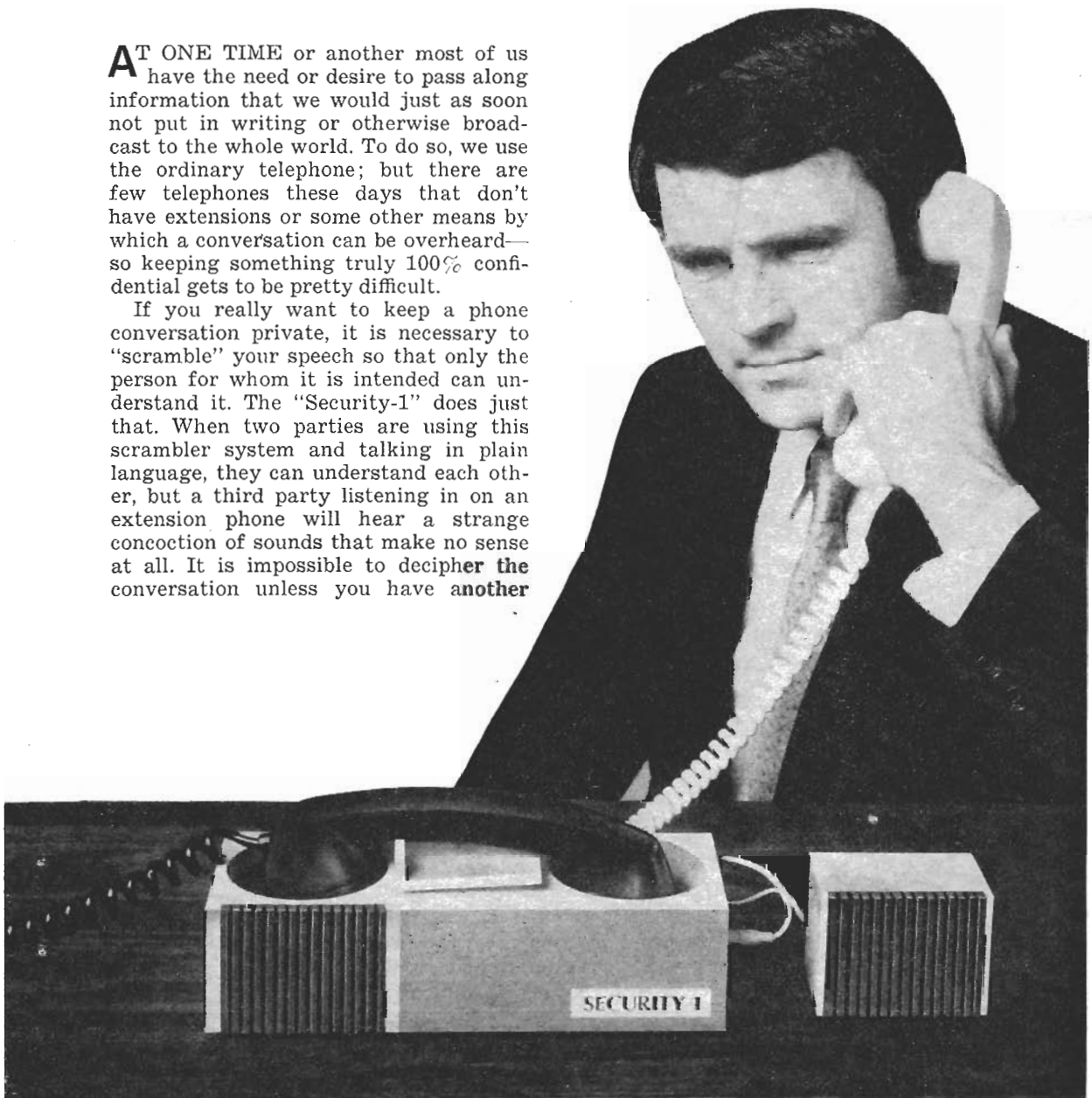
SECURITY 1

SPEECH SCRAMBLE YOUR TELEPHONE CONVERSATIONS

BY J. PINA

AT ONE TIME or another most of us have the need or desire to pass along information that we would just as soon not put in writing or otherwise broadcast to the whole world. To do so, we use the ordinary telephone; but there are few telephones these days that don't have extensions or some other means by which a conversation can be overheard—so keeping something truly 100% confidential gets to be pretty difficult.

If you really want to keep a phone conversation private, it is necessary to "scramble" your speech so that only the person for whom it is intended can understand it. The "Security-1" does just that. When two parties are using this scrambler system and talking in plain language, they can understand each other, but a third party listening in on an extension phone will hear a strange concoction of sounds that make no sense at all. It is impossible to decipher the conversation unless you have another



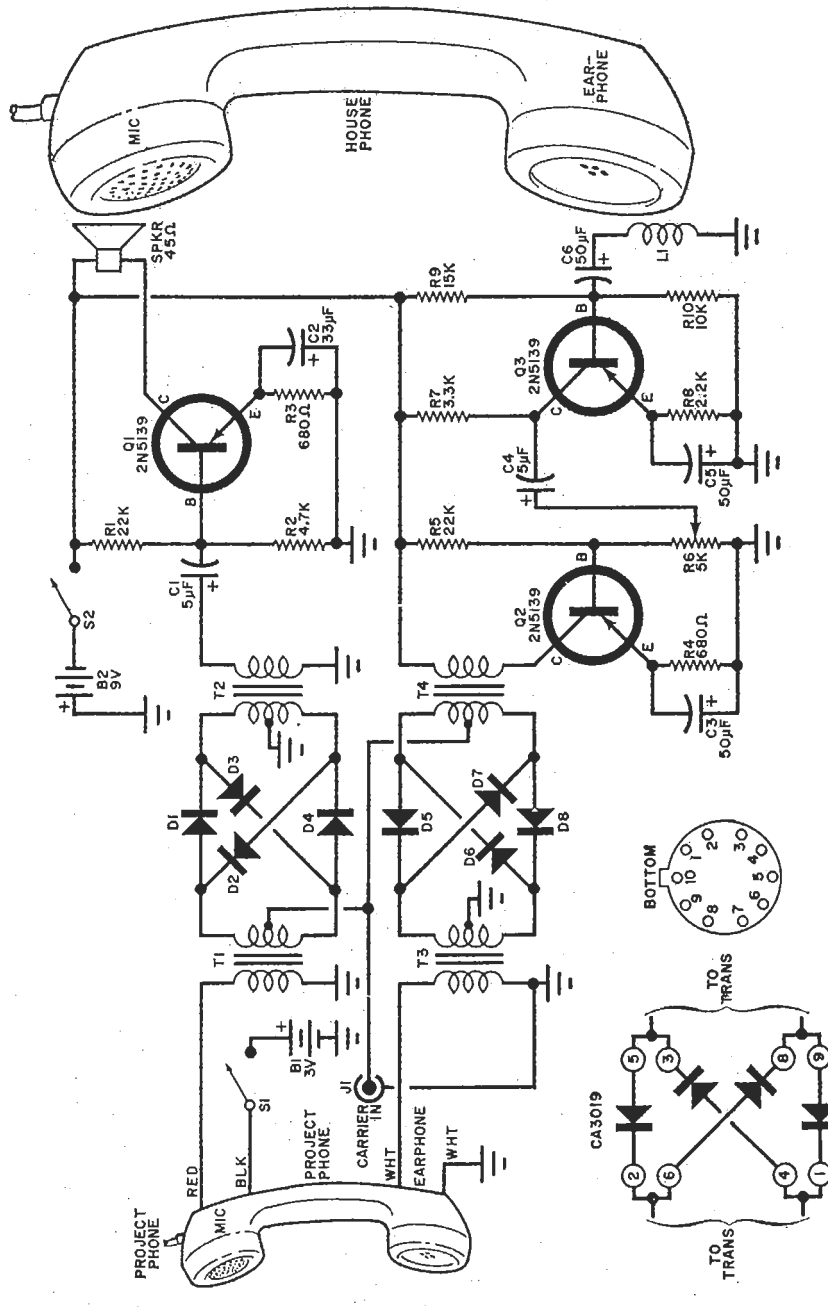


Fig. 1. An RCA CA3019 IC may be used in place of the diodes shown. The transistors and most of the components, including two transformers may be salvaged from the commercial telephone amplifier. L1 is built into the plastic container.

PARTS LIST

B1—C or D cell (2)
B2—9-volt transistor radio battery
C1,C4—5-μF, 15-volt electrolytic capacitor
C2—33-μF, 10-volt electrolytic capacitor
C3,C5,C6—50-μF, 15-volt electrolytic capacitor
D1-D8—Small-signal silicon diode (1N34A or similar or use RCA CA3019 IC)
J1—Earphone jack
L1—Telephone induction coil pickup (Lafayette 99E10340 or similar)
Q1-Q3—Small-signal pnp transistor (2N5139 or similar)
R1,R5—22,000-ohm
R2—4700-ohm
R3,R4—680-ohm
R7—3300-ohm
R8—2200-ohm
R9—15,000-ohm
R10—10,000-ohm
All resistors ¼-watt
R6—500-ohm PC potentiometer
S1,S2—S.p.s.t. switch
T1-T4—500-ohm to 500-ohm center-tapped transformer (Lafayette Argonne AR162 or similar)
Misc.—Telephone amplifier (Radio Shack 43-230 or similar, optional), surplus telephone, battery holders, transistor radio earphone cable and connector, audio signal generator, radio, mounting hardware, etc.
Note—A printed circuit board, etched and drilled, is available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216 at $4.50.

scrambler and know the electronic key being used. The Security-1 requires no electrical connections to the telephone—all coupling between the scrambler and the telephone is made by magnetic induction and acoustic means.

Besides the scrambler devices, the users at each end of conversation must have conventional audio sine-wave generators capable of delivering about 1 volt, tunable between 1 and 3 kHz. These are used as the scrambler sources. If a scrambling scheme that is almost impossible to decode is desired, the audio output from a conventional transistor radio (through the headphone connector) may be used as the scrambler source. In this case, of course, both parties must be able to tune their receivers to the same broadcasting station.

The basic principle of the Security-1 employs what is known as a balanced ring demodulator—the same circuit being used for both coding and decoding. This particular circuit has been employed for many years by the telephone company and radio amateurs for the generation of single-sideband suppressed carrier signals. Because of the strange sounds coming from the scrambler, the same basic circuit may also be used for experimenting with far-out music. One electronic instrument can be substituted for the speech input while an audio generator or another electronic instrument could be used for the scrambling source. Although not tested by the author, such a system should produce some really weird effects.

Each end of a scrambler system requires two telephone hand sets: the conventional house telephone (called the "house phone" here) and another handset (called the "project phone"). The project phone can be any surplus telephone handset that has a conventional carbon microphone and dynamic earphone with a connecting cable.

Construction. The mechanical construction of the scrambler involves making a mounting for the house phone so that a pickup coil and small loudspeaker can be placed in close proximity to the earpiece and microphone, respectively, of the house phone. It is best to prepare this mounting first and then construct the electronic portion of the scrambler and fit it into the support.

The prototype shown in the photos uses a commercially available plastic telephone amplifier for the cabinet. You can build any type of cabinet (preferably of wood) slightly longer than the telephone handset and a few inches deep. If you build your own cabinet, lay the house phone handset down on the upper surface and mark the locations of the microphone and earpiece. Cut out holes of the correct size so that the phone drops smoothly into place when it is in position.

Using appropriate mounting hardware and spacers, mount the small 45-ohm loudspeaker under the microphone hole so that it is about half an inch from the house phone microphone when the phone is placed on the support. Mount the induction pick-up coil in the usual fashion to the earpiece. Any of the low-cost telephone pickup induction coils, available at most electronic supply stores, can be used here.

If you decide to use the commercial

"Build Security 1" (March 1970). In the Parts List on page 29, *R6* should be a 5000-ohm potentiometer, not 500 ohms. The schematic diagram is correct.

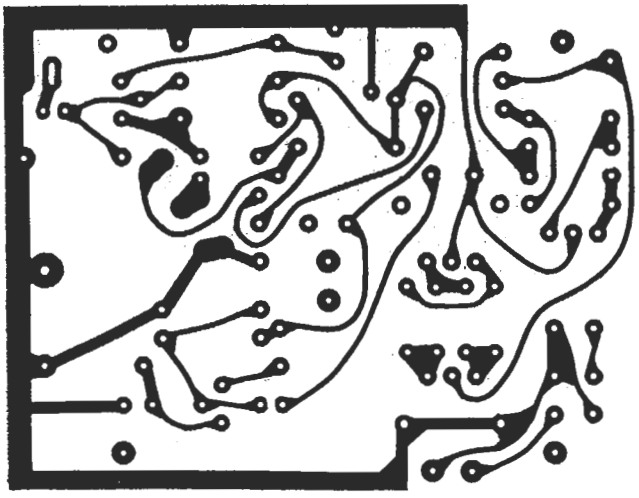
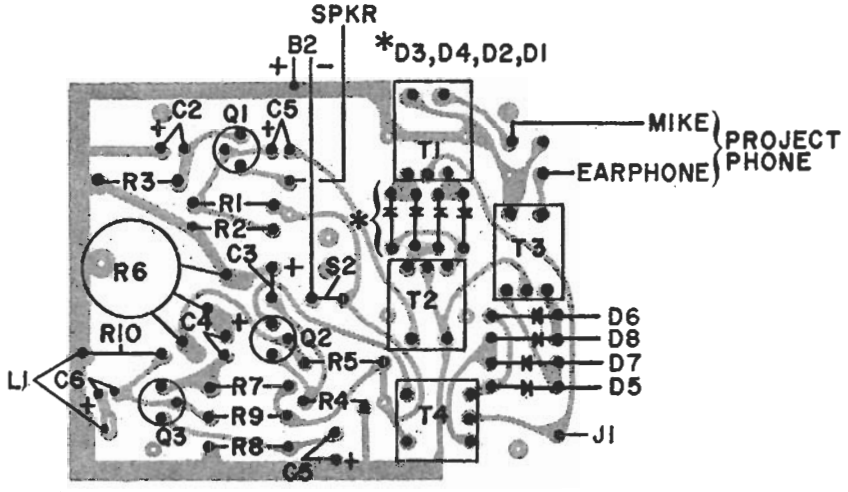


Fig. 2. Actual size foil pattern for the scrambler. This layout can be used only with subminiature transformers such as the Lafayette TR98 or similar types.

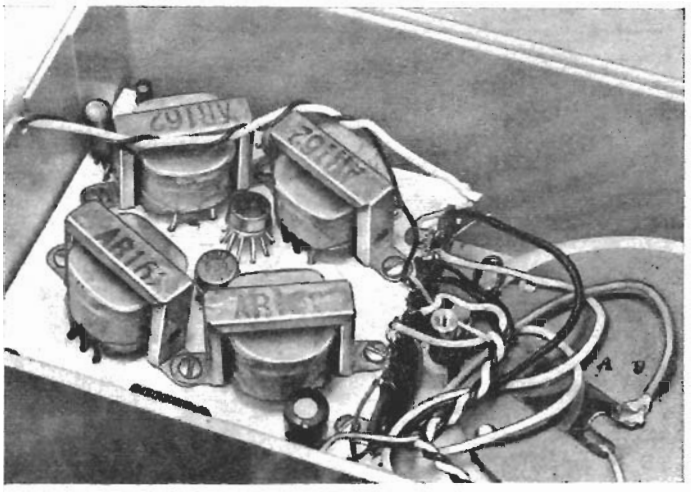
Fig. 3. Component installation on the board. The bulk of the components, including the transistors, can be salvaged from the printed circuit amplifier that comes with the commercial unit.

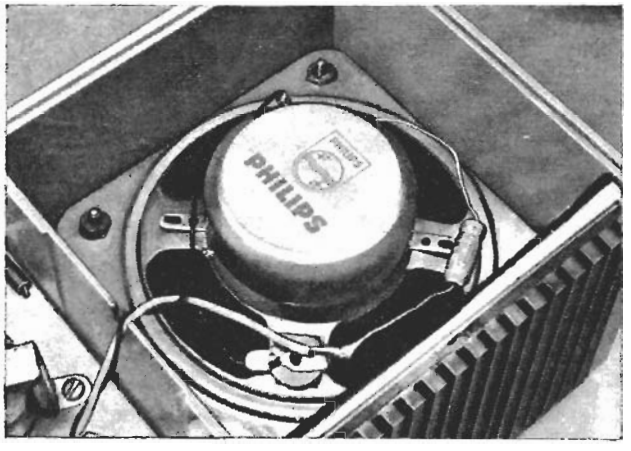


telephone amplifier set (see Parts List of Fig. 1) you will find all of these holes already made. You will also find an induction coil built into the earpiece hole. Remove the bottom cover of the cabinet, and remove the plastic insert from the microphone chamber. Then remove the built-in audio amplifier. Do not remove the induction coil. Also remove the small loudspeaker from its plastic cabinet. Using appropriate hardware and spacers, mount the loudspeaker in the microphone chamber as previously described. Although a 45-ohm speaker is specified in the Parts List, you can use the low-impedance speaker that comes with the built-in amplifier. In this case, also remove the speaker output transformer from the PC board and wire it to the speaker, using a pair of leads to run the primary back to the circuit.

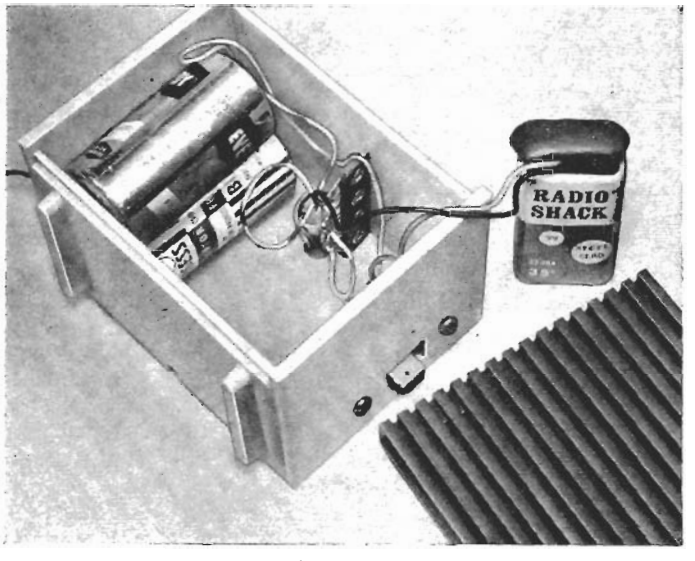
In both the commercial and homemade cabinets, once the speaker has been mounted, use foam rubber to pad the perimeter of the microphone hole so that the house phone microphone fits snugly in place. You can also insert foam-rubber sound-deadening material under the speaker to keep the acoustic energy within the mike chamber. In the commercial unit, leave the earphone jack in place; in the homemade unit, mount an earphone jack on one wall.

The circuit for the scrambler is shown

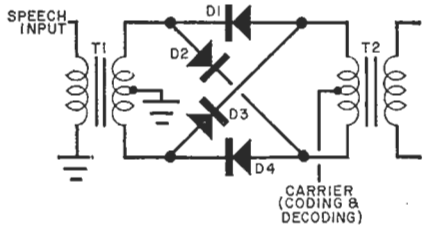




Three views of a non PC board prototype. The photo above shows the use of an IC for each diode bridge, and the larger-sized transformers. The speaker (left) is a 45-ohm type that is mounted on standoffs within the old microphone chamber. The batteries and power switch were contained in the old loudspeaker housing.



HOW IT WORKS



With no speech applied to the primary of *T1*, when the applied encoding carrier is positive going (with respect to ground), the currents in the primary of *T2* and the secondary of *T1* (through diodes *D1* and *D4*) are out of phase so that no carrier signal is developed in the secondary of *T2*. When the encoding carrier is negative going, the same thing happens as the current flows through diodes *D2* and *D3*. Thus none of the encoding carrier gets through output transformer *T2*.

When speech is applied to the primary of *T1*, the audio voltage across the secondary of *T1* unbalances the diode modulator. The resulting signal across the secondary of *T2* consists of a series of pulses whose polarity and repetition rate are determined by the carrier voltage and whose amplitude is determined by the instantaneous amplitude of the speech signal. If this output is viewed on a spectrum analyzer, it is seen to contain only an upper and a lower sideband.

If the encoding carrier is assumed to be a 3000-Hz tone and the speech frequency is assumed to be a 100-Hz tone, then the output would contain both a 3100-Hz upper sideband and a 2900-Hz lower sideband. If a filter is used to cut off signals above 3000 Hz, then only the lower sideband remains. When the input speech frequency is changed to 200 Hz, the output will be 2800 Hz. Thus the modulator inverts the incoming speech frequency, making it completely unintelligible to the unwanted listener.

Decoding uses the same circuit as encoding, and the system works as long as the same carrier signal is used at both ends.

in Fig. 1. The four diodes in each half of the circuit may be either individual units or an RCA CA3019 integrated circuit.

The actual size foil pattern for the printed circuit is shown in Fig. 2 and component installation is shown in Fig. 3. If you are using the commercial telephone amplifier, most of the required components can be removed from the built-in amplifier including the transistors, volume control, and on-off switch, to be used in the scrambler. The driver transformer for the push-pull output stage can also be salvaged and used as *T2*. If you do not choose to use the PC board, perf-board construction may be used, making sure that the overall board will fit within the enclosure.

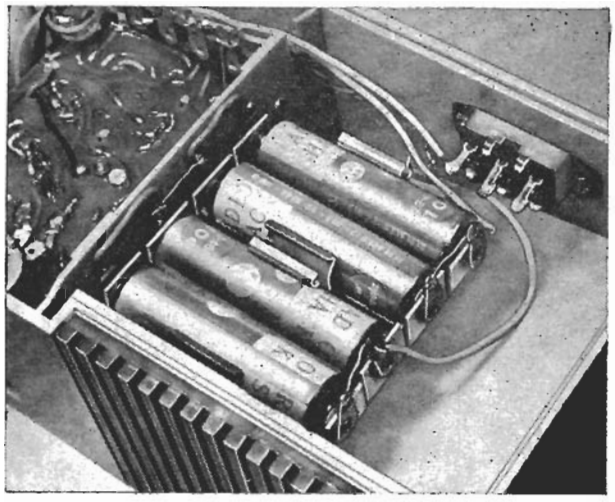
The completed board is mounted on standoffs within the homemade cabinet or on the existing standoffs in the commercial unit. Once the board has been installed, drill a hole in the side of the enclosure large enough to pass the four-lead cable from the project phone. In most phones, the two white leads are from the earpiece, while the black and red leads are from the phone microphone.

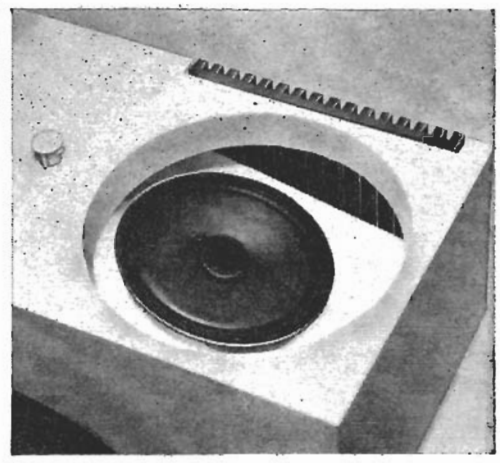
The 9-volt battery is mounted as it comes in the commercial unit, while a pair of C-cell holders are placed within the microphone chamber. A small s.p.s.t. on-off switch is also mounted within the mike chamber. In the homemade version, mount the batteries where convenient.

Testing. The scrambler can be tested without using the house phone. Disconnect both leads supplying the project phone mike to input transformer *T1*. Connect the loudspeaker output from any radio to the input terminals of *T1* and tune the radio to an "all news" station—or one that has more speech than music. If you use a conventional radio, disconnect the speaker connections to the output transformer secondary and use the secondary to supply *T1*. If you are using a transistor radio, use the earphone jack that usually is provided. When the earphone connector is plugged into its jack, the internal speaker is automatically disconnected. Remove the earphone and connect the cable ends to the input of *T1*. Turn the radio volume down.

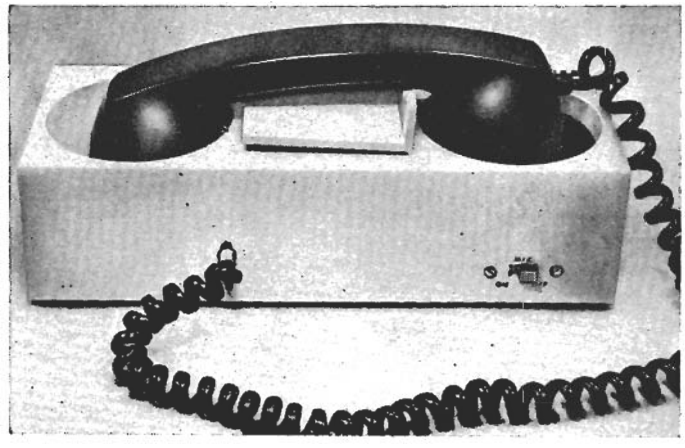
Connect a conventional audio sine-wave generator through a transistor radio earphone plug and cable to the coder input jack on the scrambler, making sure the feed is properly grounded. Set the audio generator to about 1 kHz, 1 volt. Turn on the scrambler power switch *S1*. Slowly turn up the radio volume. Garbled speech will be heard from the built-in speaker.

By adjusting the radio volume control or the signal generator output level control, the garbled speech can be heard at its best "quality." If you adjust the signal generator frequency to about 3 kHz,





In the PC board version of the scrambler, four AA cells were used in place of the two C cells as microphone power. The speaker that came with the commercial unit (8-ohms) was used in conjunction with the output transformer that came with the built-in amplifier. The speaker is mounted on a piece of heavy cardboard at an angle to make good acoustical contact with the house phone microphone. The use of a PC board, and the smaller AA cells, enabled mounting all batteries within the plastic housing. The 9-volt battery is mounted in the same position as it was in the commercial unit, under the cover at the bottom.



the garbled speech will change. As you will soon notice, the best scrambling for the human voice takes place at about 1 kHz.

To test the unscrambler, connect the radio to the project phone earpiece leads and a transistor radio earpiece to the secondary of *T3*. When the project phone is placed in its correct position with the earpiece in the proximity of (or attached to) *L1*, scrambled speech will be heard in the radio earpiece. If audio tone breakthrough is encountered, the value of capacitor *C3* may be changed to reduce the level of this unwanted signal.

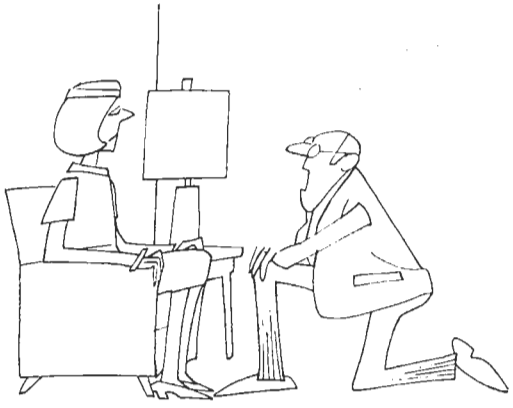
Once both halves are working properly, connect the circuit up for operation as shown in Fig. 1.

Use. Obviously, to use the scrambler, two units must be made—one for each end of the conversation.

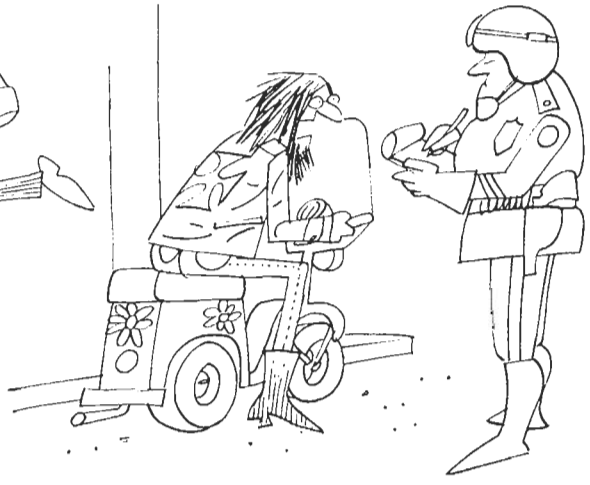
Using the house phone normally, dial the desired number and instruct the other end to "scramble." Make sure you have pre-arranged with him the audio frequency to be used on the signal generators. Each end then places the house phone on the housing with the holes correctly located. Either party can readjust his audio-generator frequency to clear up the speech at his end. -30-

Hobnobbing with Harbaugh

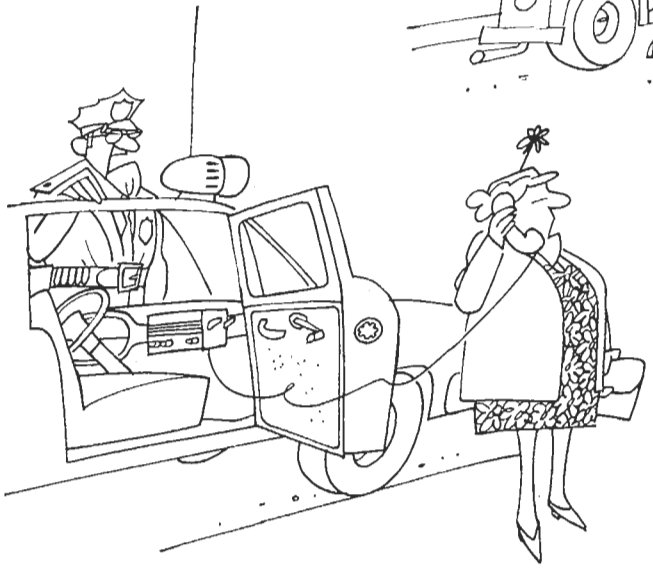
Sorry, Nancy, I'm going steady with WPE6XPN.



I'd like you to marry me later. Right now, DX conditions on 21 MHz are too good.



No, but I had a CB license once.



Madam!