Chapter 10

Signal Launcher

SPEED is an essential characteristic of the modern servicing technique. To attain speed, the radio service technician must have a thorough knowledge of fundamental electronic theory and circuits. He must also have suitable test equipment and know its limitations and use.

One common trouble-shooting method is signal substitution (or signal injection). This requires a signal generator. Starting from the speaker end, a signal is applied to each stage or group of stages, and, progressively, the result is noted in some manner in the output. A limitation is that the signal generator and the receiver tuning dial must usually be preset. For rapid trouble-shooting, a *universal-frequency signal source* is desirable, since no dial-twiddling will then be necessary. Such a signal source can be had from any extremely distorted low-frequency generator. Most often a square wave having a fundamental frequency approximating 1,000 cycles is used. Multivibrators have been used in the past to obtain this.

Such a signal source is useful since a distorted wave has not only fundamental frequency energy but harmonic energy as well. Any complex wave can be broken up into a Fourier series representing a series of sine waves harmonically related. The number of harmonics and their amplitude is a function of the original wave-shape. When the output of the distorted wave is applied to a circuit, the circuit will choose and pass only those frequencies it can handle.

Thus, an i.f. amplifier will pass essentially the intermediate frequency. Only audio-frequency components will pass through an

a.f. amplifier. This principle can be used to simplify trouble shooting.

A suitable instrument

A test instrument of the universal-frequency type which can be used for trouble shooting and alignment too is described in this chapter. A multivibrator circuit having a fundamental frequency of approximately 1,120 cycles is used. The output waveform provides strong signal energy over a wide frequency range.

The Signal Launcher unit is compact and self-contained, being

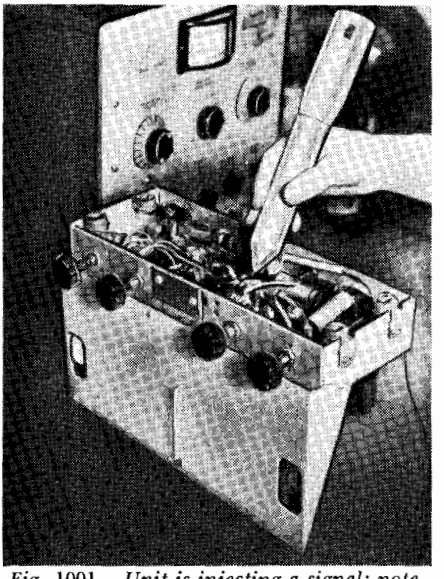

Fig. 1001. *Unit is injecting a signal; note ease of handling*

mounted in a probe-projectile type housing. It is light, small enough (see photo in Fig. 1001) to be held in one's hand, and battery operated, necessitating no dragging wires or cable. The life of each battery is practically equal to its shelf life. One of these units has been in operation for three years and the original batteries are still used. The unit might be kept in operation by using discarded batteries from battery portable receivers.

At the fundamental frequency, the r.m.s. output is 2.4 volts and less, of course for high harmonics. Most bands of an all-wave receiver and the i.f. stages of FM receivers are covered.

Fig. 1002 shows the schematic circuit. A type 3A5 7-pin miniature battery tube is employed. A No. 1 flashlight cell provides

filament voltage. Note that the series filament connection is used although only 1.5 volts is applied. The B-supply is 22.5 volts, and can be one section of an Eveready type 467 (or 457) Minimax 67.5-v battery. Since first building this instrument, smaller batteries are being marketed. These provide more output, since they furnish 30 volts (Eveready 413, Burgess U20E). All resistors are ⅛ watt, although larger sizes are easier to obtain. The two blocking (coupling) capacitors are mica, postage-stamp size. The output is taken through a .001-μf ceramic capacitor.

The output waveform is shown in Fig. 1003. This wave-shape was selected to provide optimum output over a wide frequency range. The output signal is applied to the circuit under test in a single-ended manner; i.e., only the probe tip is used. No return connection is necessary.

Making the case

The housing may be any handy shape or design. Thus, a square could be used.

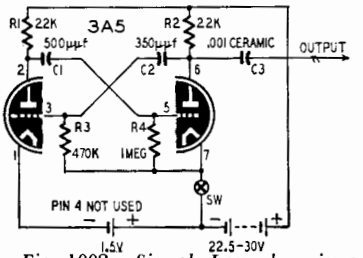

Fig. 1002. Signal Launcher is a multivibrator.

Fig. 1003. Complex square wave.

The container shown was made from 1/16-inch sheet aluminum in two sections. Fig. 1004 shows the physical layout and dimensions of both sections before forming. The sawtooth edges are formed by cutting out with a hack-saw or tinsnips and finishing with a file. Part A is formed to have an inside diameter of approximately 1 inch by rolling around a 1-inch dowel or pipe, hammering lightly if necessary. Part B is formed around a 1½-inch dowel. A section is cut out to provide space for mounting a slide switch. This can be riveted in place.

Aluminum soldering or welding of the outside seam of each piece preferably should be done with the forming dowel in place. Solder only along edges Y-Z and Y'-Z'. Aluminum soldering generally is difficult, but excellent results can be obtained by using

aluminum solder and a small torch. Stearic acid is useful as flux. The dowel forms now may be removed and the inside seam also soldered but only at the ends. The most difficult task follows. This is gently bending the triangular edges of section A between X and Y to a point, rounding at the same time. If a lathe is handy, the

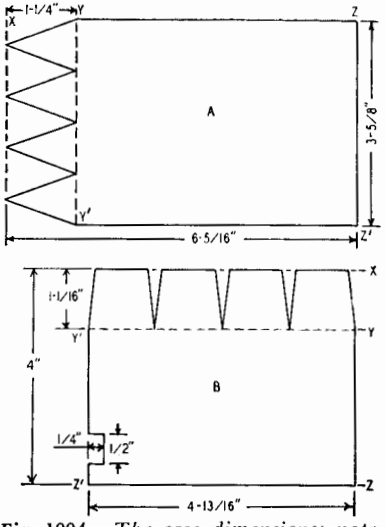

Fig. 1004. *The case dimensions; note cutout for switch.*

wooden dowel previously used may be turned to have approximately the same taper as the desired finished product. By properly inserting the dowel, the aluminum may be formed nicely by hammering. The four new seams should now be soldered.

Materials for Signal Launcher

Resistors: 2—22,000, 1—470,000-ohms, 1—megohm, ½-watt.

Capacitors: 1—350 $\mu\mu$f, 1—500 $\mu\mu$f, mica; 1—.001 μf, ceramic.

Miscellaneous: 1—3A5; 1—battery (1.5-volts); 1—22.5—30-volt B-battery; 1—slide switch; aluminum tubing; 1—miniature 7-pin socket.

If the unit appears rough at this point, sandpaper and a bit of elbow grease will miraculously transform it into a smooth, professional job.

Point X is longitudinally filed toward point Y until a hole is large enough to admit the lead from C3, insulated except at the very tip by means of a length of spaghetti.

The portion of section B between X and Y is now similarly formed except that the trapezoidal edges form a tapered cylinder which fits snugly around the pipe end of section A. This completes

the housing except that a cap or plug, as desired, may be fitted over the end of "B." Some constructors may prefer to use standard thin-walled brass tubing. The cylinder-forming process will then be unnecessary. Other alternate schemes such as the one depicted in Fig. 1005 are possible. Here an 8-inch length of 1½-inch

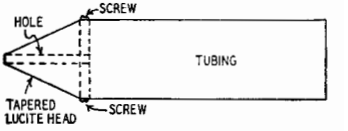

Fig. 1005. Alternative generator housing. This can be a length of tubing with a lucite head shaped as shown in the illustration. This is an easy and practical form of construction.

tubing is used. A small hole is drilled through the center of a short length of 1½-inch lucite, plexiglas, or polystyrene rod. The rod is tapered as shown.

Wiring procedure

The entire unit (see photo, Fig. 1006), may be easily inserted

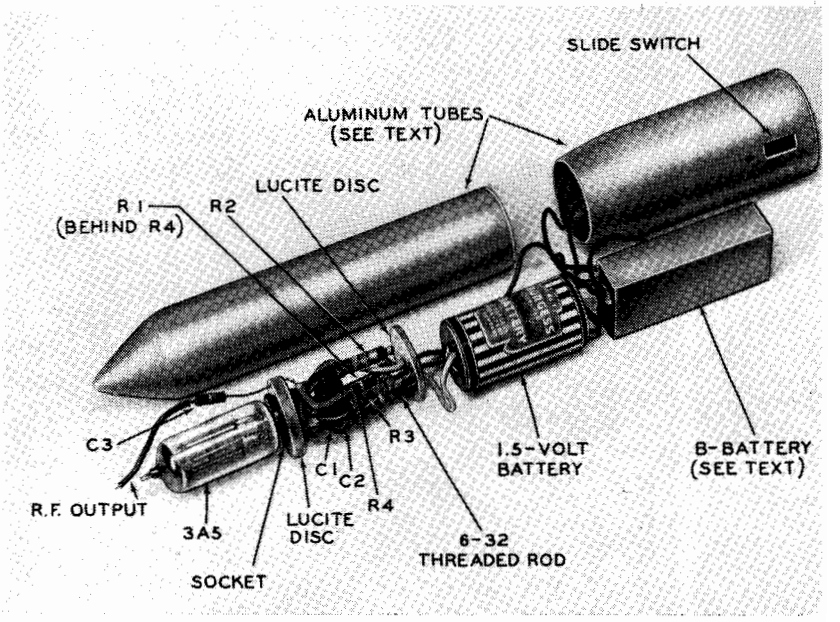

Fig. 1006. An exploded view of the Signal Launcher showing the location of parts.

in—or removed from—the housing. Fig. 1006 shows a 7-pin button type socket mounted in a lucite ring of 1-inch diameter. C1 and C2 are arranged as shown and wired to the socket, their leads furnishing all the support needed. Now R1, R2, R3 and R4 are wired. Another lucite disk, having a ⅜-inch center hole, is now arranged.

Three leads thread through the center hole and connect to the battery and small slide switch mounted in the cutout provided. This is all there is to the wiring. A 2-inch 6-32 headless screw should be arranged as shown to increase the rigidity of the unit.

Using the probe

If no wiring errors have been made the tube and support can be inserted in the housing and the unit should be ready to operate. Check the unit by touching its output to the input of an audio amplifier. A loud clear note should be heard from the speaker.

To become familiar with the operation of the Signal Launcher try it out on a receiver in operating condition. Touch the probe to the plate of the power amplifier. Note the sound and then move progressively toward the front end of the receiver by touching the power-amplifier grid, driver plate, etc., until the antenna is reached.

Having become familiar with the general operation, the final test can be made on an inoperative receiver. The unit cannot be used to check FM and TV front ends, however. Proceed as above until a point is reached where a very weak or no signal is heard. The trouble will usually be found between the last two points touched.