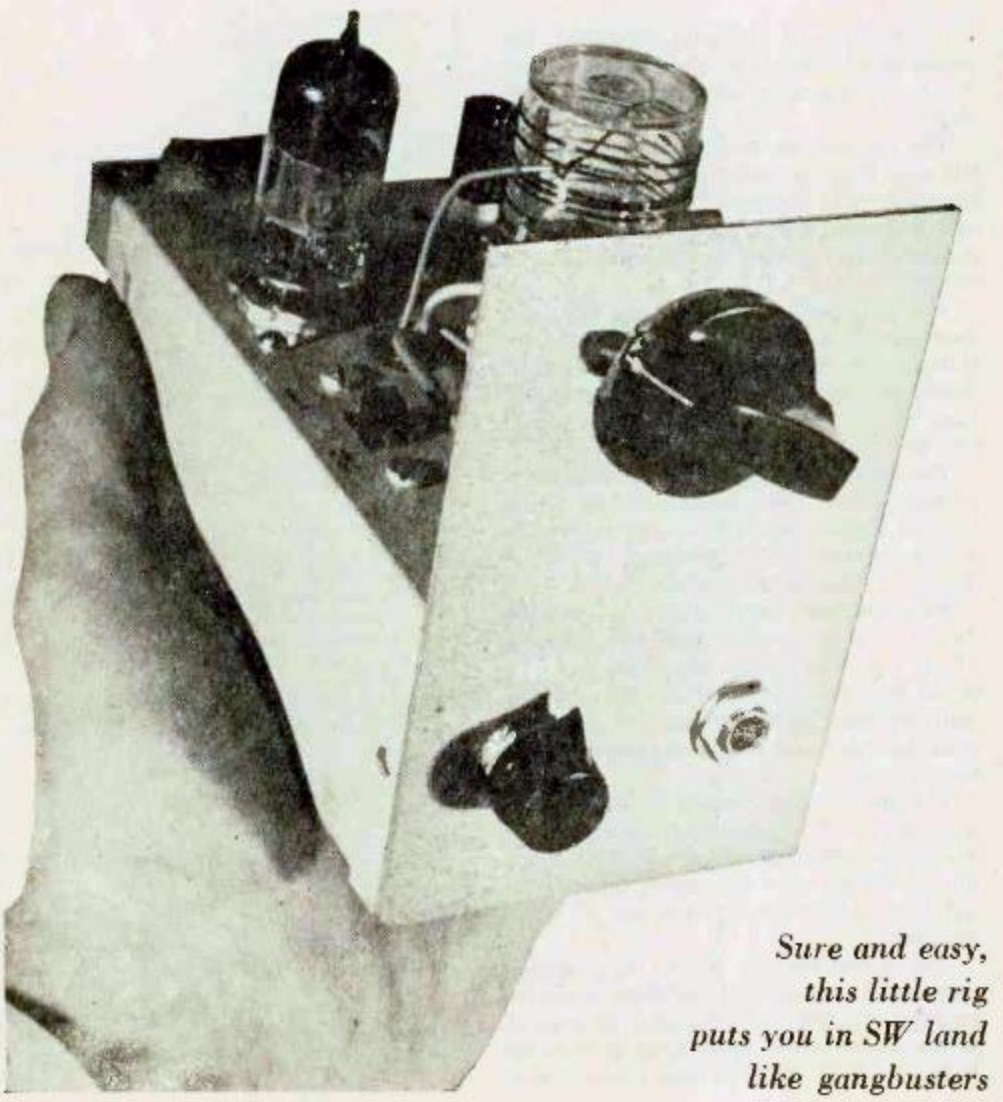
By Robert E. Kelland

# NEOPHYTE 1

**Many newcomers** to experimental electronics never get off the ground because of one or both of these reasons: their first project is too involved and difficult to adjust for proper operation; or the project is extremely simple and the results not rewarding enough to sustain sufficient interest to pursue other projects.

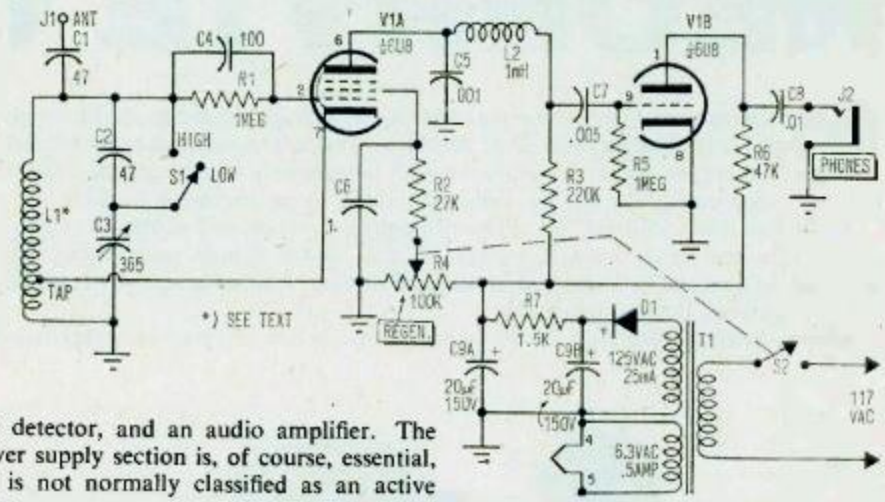
With these facts in mind, we present Neophyte 1 which will work for any beginner who can read schematic diagrams and follow simple instructions. No involved adjustment or alignment is required to hear shortwave stations from all over the world on this one-tube radio.

**What's With It.** Neophyte 1 may be broken down into two stages—a regenera-



*Sure and easy, this little rig puts you in SW land like gangbusters*

*Schematic of Neophyte I shows conventional regenerative detector circuit followed by a stage of audio. Note how band is changed simply by switching capacitor C2 in and out of tuning circuit.*




tive detector, and an audio amplifier. The power supply section is, of course, essential, but is not normally classified as an active stage.

The circuits are traditional. A regenerative-type detector, although no longer in use in commercial equipment, still finds plenty of applications where budget-minded experimenters and space requirements are involved.

The detector, besides extracting the audio from the carrier signal, also provides a considerable amount of audio amplification. It would certainly take more than half of one tube to do this using other conventional circuits.

The amplified signal from the detector is coupled to the audio amplifier stage where its level is increased still further to operate a pair of standard high-impedance headphones with adequate volume.

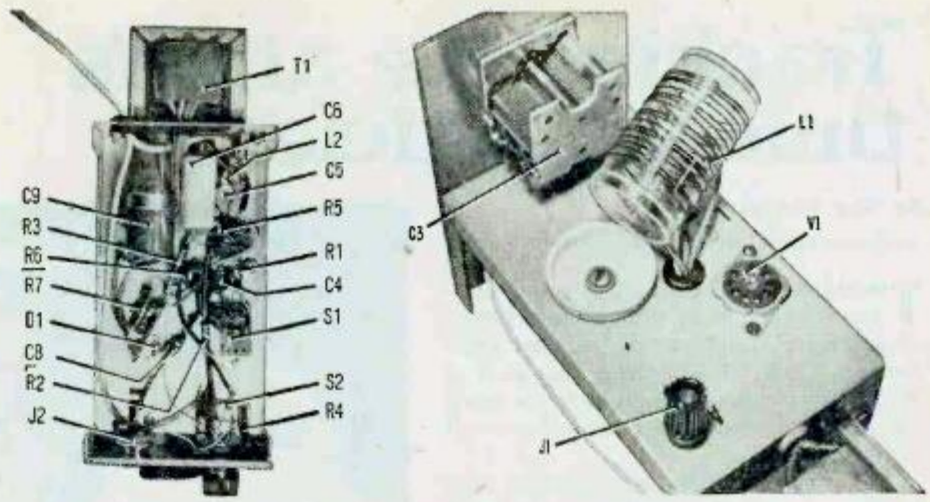
**Wherewithal.** Starting at the antenna jack in the schematic, you will notice a 47-pF capacitor (C1) connected between it and the tuned circuit. This capacitor prevents antenna loading effects and results in smoother operation of the regenerative feedback circuit.

The tuned circuit consists of coil L1, tuning capacitor C3 and a fixed capacitor, C2. The single-pole-single-throw switch S1 shorts out C2 when closed and places C2 in series with the variable tuning capacitor C3 when it's open.

The closed position places more capacitance in the circuit and therefore tunes the receiver to a low frequency shortwave band. When the switch is open, total capacitance is less than 47 pF maximum (the value of

### PARTS LIST

C1, C2—47-pF disc ceramic capacitor
C3—10 to 365- or 10 to 410-pF variable capacitor
C4—100-pF disc ceramic capacitor
C5—.001-uF disc ceramic capacitor
C6—0.1-uF capacitor
C7—.005-uF disc ceramic capacitor
C8—.01-uF disc ceramic capacitor
C9A, C9B—20-20-uF 150-VDC dual section electrolytic capacitor (Radio Shack 272-105 or equiv.)
D1—400-piv., 200-ma or better silicon rectifier diode (Radio Shack 276-1126 or equiv.)
J1—Insulated binding post (Radio Shack 274-736 or equiv.)
J2—Headphone jack (Radio Shack 274-293 or equiv.)
L1—Wound from #22 AWG enamel covered copper wire (see text)
L2—1-mH radio frequency choke
R1, R5—1,000,000-ohm, ½-watt resistor
R2—27,000-ohm, ½-watt resistor
R3—220,000-ohm, ½-watt resistor
R4—100,000-ohm linear taper potentiometer with s.p.s.t. switch S2
R6—47,000-ohm, ½-watt resistor
R7—1500-ohm, 1-watt resistor
S1—S.p.s.t. slide switch
S2—Mounted on R4
T1—Power transformer: 117-VAC pri., 125-VAC, 25-mA; 6.3-VAC, 0.3-A sec.
V1A, V1B—6U8A vacuum tube
1—5¼ x 3 x 2⅛-in. aluminum minibox Radio Shack 77-0683 or equiv.)
1—High impedance (2000-ohm or more) headphones
Misc.—9-pin tube socket, scrap aluminum for front panel, knobs, grommets, line cord and plug, terminal strips, screws and nuts, etc.




*At left, parts arrangement in Neophyte is compact but uncluttered. Coil at right is wound on plastic pill bottle as shown.*

C2) and this provides a second, higher frequency shortwave band. Using the specifications given for the coil and the capacitor values, Neophyte 1 covers from about 3 to 7 MHz on the low band, and from about 9 to 12 MHz on the high band. Other frequencies, higher or lower, may be covered by changing the value of C2 and the number of turns in L1. If you use variations, experimentation with the "tap" may be necessary.

**Audio Extraction.** As mentioned before, the first, or pentode section, of the dual section tube extracts the audio from the received signal and passes it to the triode audio amplifier stage. However, plenty of unwanted radio frequency signals also appear at the plate of the pentode section and they must be dispensed with for proper operation. The radio frequency choke L2 and bypass capacitor C5 are placed in the circuit for this purpose. The choke blocks or "chokes" higher frequencies, but allows lower audio frequencies to pass; conversely, the bypass capacitor blocks low frequencies and bypasses unwanted RF to ground. The result is a relatively clean audio signal appearing between the grid and cathode of the audio section for additional amplification.

*Neophyte 1 will provide many hours of entertainment receiving the most active shortwave bands.*

**Regeneration.** The current in the detector stage must flow through the lower portion of coil L1 and up to the cathode where it divides between the plate and the screen grid. The screen grid is connected to the positive (B+) supply through a limiting resistor and potentiometer R4. By changing the resistance of the pot, the screen voltage is varied and the tube current changes. The pot thereby varies the current through the tapped portion of the coil. The degree of current flow determines the amount of signal that is coupled to the upper portion of the coil which, in turn, determines the amount of feedback. The potentiometer is called a regeneration control, and it, as its name implies, controls the regeneration or feedback of the signal voltage.

**Building Neophyte I.** All parts mount on or in a 5¼ x 3 x 2⅛-in. aluminum minibox. A small piece of scrap aluminum measuring 3 x 4½-in. is used for the front panel. Follow the photos to locate mounting positions. *(Continued on page 134)*

## Neophyte I

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Start by cutting the large holes first, and finish up with all the small holes using the parts themselves for templates. The panel is secured to the box by the phone jack and regeneration control mounting hardware.

The power transformer T1 is mounted on the rear of the minibox. Two holes are made to pass the transformer leads inside the box for wiring. Make sure that all holes and mounting plans are such that the other half of the chassis box will fit in place without obstruction.

**Cool Coil.** A 1 x 2-in. long plastic pill vial is put to use as a coil form. The plastic cap of the vial serves as the coil form "socket" and is mounted on the chassis with a nut and bolt.

The coil consists of 17 turns of #22 AWG enamel-covered copper magnet wire. A tap is made 4 turns from the bottom or ground end of the coil.

The turns of the coil are spaced to cover approximately 1¼ inches. The #22 wire is stiff enough to be self-holding and cement is not needed. Minor frequency adjustments may be made later by adjusting the spacing between the turns.

Hookup wire brought through a grommet-protected hole in the minibox connects the coil to the proper circuit points. The band switch S1 is mounted on the top of the minibox, but a layout variation on the front panel will allow enough mounting space there.

When all components are wired in the circuit, make a careful check to insure that no short circuits exist and that there is proper clearance for the bottom of the chassis box.

**Fire It Up.** Turn Neophyte 1 on and check that the tube lights. Then make sure nothing is smoking or overheating. Connect an antenna to the jack and advance the regeneration control to a point just before the set breaks into oscillation. Turn the band switch to the high band and tune for a station. Readjust the regeneration control for best reception. Receiving conditions will be best after dark so don't be discouraged if you turn the little Hertz-grabber on during daylight hours and don't find much action. Try various inside antenna lengths and use the best one. A high outside antenna will be best for long-distance reception. ■

## It Looks Like A Transistor

*Continued from page 56*

ated by heat reduces the width of the depletion layer, thus allowing the current to increase by causing the effective gate-channel voltage to change at the rate of about 2.2 mV per 1°C. If we arrange the bias so that $Id/gm$ is about 0.3, the two effects will tend to cancel out and we have a reasonably stable amplifier.

**What Else.** Of course, this is only part of the FET story. We have been talking only about devices in which the channel is of *n*-type material, but naturally there are *p*-channel FETs, too. And though it is possible to make up rule-of-thumb FET amplifiers which will work by selecting a suitable value for the drain load and choosing the bias for stability, for the best results we have to be as meticulous over design details as with transistors or tubes.

On the whole though, FET amplifiers are a little easier to design than their transistor equivalents. And though the FET has its limitations, its high input resistance enables us to avoid many of the circuit complications that have to be introduced when we wish to couple a transistor amplifier to a high impedance signal source. Against this, we have not yet developed FETs with the high voltage capability of a tube or the high power range of a transistor. And the frequency range of a normal FET is limited because it has a fairly high input capacitance.

**Next.** At the present state of the art then, the FET is most widely used to couple signals at not too high a level and at a reasonable frequency from some high impedance source to a conventional transistor amplifier which does the real donkey work. A simple example is in the first stage of a preamplifier following a capacitor microphone. For this kind of purpose, it offers a simple solution to a very tricky problem.

Other current applications for the FET are in transistorized VTVMs (high input resistance) and receiver front-ends (rapidly replacing the nuvistor).

To get better acquainted with the practical side of the FET and how it works, have a look at the article on page 51 in this issue on building an FET radio.

Meanwhile, though the FET has power and frequency limitations, it seems highly probable that this new little polly seed may soon into a great sunflower grow. ■