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Build a 1930's Style Radio Transmitter

This single-tube AM transmitter allows you to re-live days long past by letting you broadcast your own program material to any standard AM receiver!

BY JOSEPH C. SMOLSKI

Dust off that old broadcast receiver and re-create the golden age of radio! Experience historic moments from the world of sports like Bobby Thompson's home run! Re-live the Hindenberg disaster, and other newscasts that rocked the world! Thrill to classic radio drama, like "The Shadow," "Jack Armstrong," and "The Lone Ranger!"

Impossible, you say? Not with this easy-to-build AM transmitter. You can put it together in one evening using common hand tools and readily available parts. Teamed with a cassette player, you can re-broadcast taped vintage-radio shows to Grandma's old console. Or, if you prefer, you can hook it up to any other high-level program source and broadcast it to any nearby (new or old) AM receiver.

Right Out of The 1930's. In the years immediately preceding World War II, manufacturers sold accessories—known as "phono oscillators" or "wireless record players"—for playing phonograph records through radio sets. Although those products must have seemed pretty "high-tech" at the time, they were nothing more than simple low-powered AM transmitters.

Most of those low-powered AM transmitters are gone now, but you can build one yourself at a very low cost. The unit, dubbed the *1930's Radio Transmitter*, described in this article is patterned closely after the phono transmitters of yesteryear. Its design makes only two concessions to the passage of time. A modern silicon rectifier is used in the power supply instead of a vacuum tube and a ferrite-core-oscillator coil is used instead of an air-core coil. Air-core coils were typical of pre-war construction. The rest of the circuit is quite authentic, and it behaves exactly the way its forerunners did some fifty years ago!

How It Works. Our AM transmitter is built around a single 12SA7 pentagrid converter, which was designed for broadcast-band receivers. Although never intended for transmitter service, it was nonetheless used in some phono oscillators. Introduced prior to World War II along with a host of other octal-based tubes, it quickly became standard in US-built, AC/DC operated radios, and it remained so through the early 1950's. The long-term popularity of that tube type accounts for the fact that it is still available today.

The 12AS7 was typically used in superheterodyne receivers as a frequency converter. In that application, the 12SA7 worked like two separate tubes; a local oscillator and a mixer. Refer to Fig. 1A. The signal from the local oscillator was applied to grid 1, while the incoming RF signal was applied to grid 3 (the signal grid). Within the tube, the RF signal was mixed with the oscillator signal through a process called electron coupling. Electron coupling was accomplished via the electron stream, which is common to all the elements within the tube. The two signals would combine to produce a third signal, which oscillates at the desired IF.

The tube configuration used in the 1930's Radio Transmitter is similar. However, in the transmitter (see Fig. 1B), grid 1 is connected as a Hartley oscillator. The Hartley oscillator was used to generate a carrier. As shown, an audio signal (rather than RF) is applied to grid 3, and impressed on the carrier. That signal was then fed through the plate circuit and radiated into the air via the antenna.

Figure 2 shows a complete schematic diagram of the transmitter. A suitable signal is applied to the circuit via the AF IN terminals, and applied to grid 3 at pin 8 of V1. A Hartley oscillator, consisting of L1, C2, C3, C4, and R1, provides the carrier signal. The audio is impressed on the carrier and that combination is fed to the antenna via C1.

Power for the circuit is provided by T1, D1, and C8. Transformer T1 is a dual-secondary unit. One secondary winding of the transformer feeds a line-level voltage to a conventional half-wave rectifier, consisting of D1, the output of which is filtered by C8. The other winding of T1 provides 12.6 volts for V1's filament or heater.

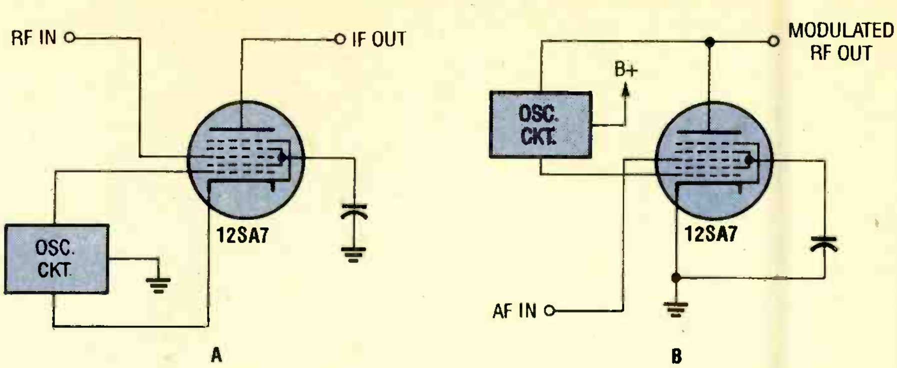

Fig. 1. The 12AS7, typically used in superheterodyne receivers, was configured as a frequency converter as shown in A. When used in a radio transmitter, however, the 12AS7 was configured as shown in B.

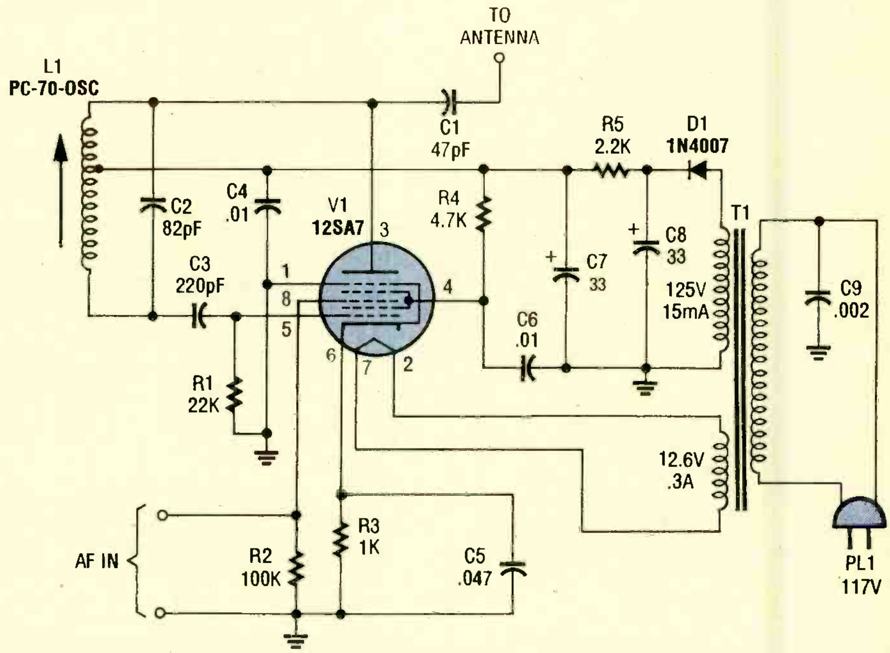

Fig. 2. Here's a complete schematic diagram of the transmitter. In that circuit, an audio signal is applied to grid 3 at pin 8 of V1 via the AF IN terminals, and is mixed with the output of a Hartley oscillator.

Construction. Construction of the 1930's Radio Transmitter is a snap. Unlike most modern projects, it has no metal chassis, nor does it require a printed-circuit board. That means that there are no metal parts to drill, and you can forget about foil patterns and messy chemicals. The whole assembly is built on a piece of pineboard. That type of construction was used by radio manufacturers and experimenters alike during the 1920's. In fact, that type of construction continued to be used by experimenters long after it was replaced by metal in commercial products.

The first step in putting your transmitter together is cutting a 6½-inch length of 1- × 4-inch pinewood. The base board should then be sanded and coated with a wood finishing product like Minwax Puritan Pine, or a clear finish like polyurethane, before proceeding. Allow the finish to dry, and then move on to the electronics construction phase of the transmitter.

Before you begin wiring the transmitter, a word of caution is in order: Keep in mind that this circuit not only operates at much higher voltages than do solid-state circuits, but that it's also AC line powered. That means you *must* exercise care in its construction and caution during its operation. When operating the transmitter, it is especially important that no one comes in electrical contact with either side of the transformer primary. To that end, **be sure to sleeve the leads of C9, and cover any other conducting surface.**

In addition, the transmitter's plate-supply voltage can easily reach 160 volts or more. **So don't let your body touch the B+ supply and circuit ground at the same time.** If you are worried about shocks, you can house the entire transmitter inside some kind of protective enclosure. That's a particularly good idea if you have small children lurking about. Now back to our project.

Refer to Fig. 3 as a general layout diagram. Drill mounting holes in the baseboard. Since the circuit components will be connected to solder lugs held in place by sheet-metal screws, the holes should be drilled with a bit that is smaller than the hardware and should not go all the way through the base board. In essence, what you need are pilot holes. Drill two mounting holes for T1 at one end of the baseboard. Go

PARTS LIST FOR THE RADIO TRANSMITTER

RESISTORS

(All resistors are ½-watt, 5% units.)
R1—22,000-ohm
R2—100,000-ohm
R3—1000-ohm
R4—4700-ohm
R5—2200-ohm

CAPACITORS

(All capacitors are 200-WVDC units, unless otherwise noted.)
C1—47-pF, ceramic-disc
C2—82-pF, ceramic-disc
C3—220-pF, ceramic-disc
C4, C6—.01-µF, polyester film
C5—.047-µF, polyester film
C7, C8—33-µF, 250-WVDC, axial-lead electrolytic
C9—.002-µF, 1000-WVDC, ceramic disc

ADDITIONAL PARTS AND MATERIALS

V1—12SA7-GT, vacuum tube
D1—1N4007 or similar 1-amp, 1000-PIV silicon rectifier diode
T1—Dual secondary (125 @ 15 mA/12.6V @ 0.3A) power transformer
L1—PC-70-OSC universal replacement BC-oscillator coil (Antique Electronic Supply)
Wooden baseboard, ½-inch wooden spacer, #6 × ⅜ inch pan-head sheet metal screws (10), #6 × ¾-inch pan-head sheet metal screws, #6 × 1½-inch, round-head wood screws, #6 ground lugs (8), Fahnestock clips (3), cable clamp (1), wire nuts (2), 8-inch bus wire, AC molded power plug with line cord, wire, solder, hardware, etc.

Note: A complete kit of parts (stock #K-488) for this project is available for $19.95 + $3.50 S&H from Antique Electronic Supply (6221 S. Maple Ave., Tempe, AZ 85283; Tel. 602-820-5411). AZ residents must add sales tax. Contact them directly for individual parts availability, cost, etc.

The Radio Transmitter, with its baseboard-mounted components, which is representative of the construction technique used during the 1920's, is patterned closely after the phono transmitters of yesteryear.

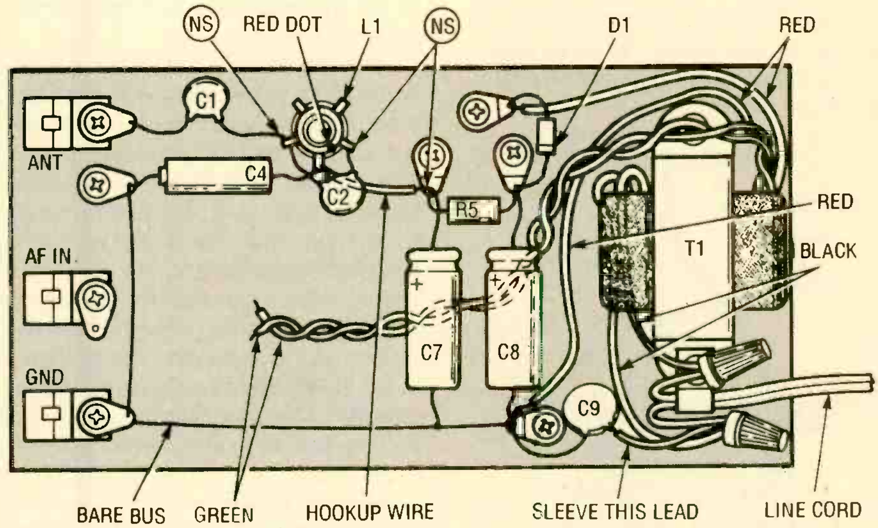

Fig. 3. This general layout diagram shows where many of the circuit components will be located. When wiring the circuit, the points labeled NS should not be soldered at this time as other components will be connected to those points later.

to the other end of the baseboard and drill four more holes; one for the antenna connection, two for the audio input (labeled ANT and AF IN, respectively in Fig. 3), and another for the terminating point of the ground bus.

With the board oriented as shown in Fig. 3 (with the antenna/AF inputs to the left), drill three holes in a triangular configuration in the area (near the top edge) where D1 is shown connected to solder lugs. Then go to the bottom edge of the baseboard, and drill another hole opposite the three solder-lug holes. Next return to the top of edge of the board and drill a 9⁄32-inch hole to a depth of about ¼ inch (to the left of the three solder-lug holes) where L1 is located.

Once the drilling is complete, you can start mounting components, beginning with the #6 solder lugs and Fahnestock clips (which are spring-loaded wire clips). The Fahnestock clips are used for the audio-input, antenna-out, and ground connections. Secure the clips and solder lugs directly to the surface of the board with #6 × ⅜-inch, pan-head sheet-metal screws. Next connect a bare bus wire as shown in Fig. 3. That wire will serve as a grounding point for the circuit components.

Now begin assembling the circuit guided by Fig. 2 and Fig. 3. Take your time and position each component as shown in Fig. 3. It will make the final assembly much easier if you do. When the time comes to mount coil L1, carefully remove the metal clip from the coil form and insert that end of the form into the 9⁄32-inch hole that you drilled in the baseboard. Then connect and solder all of the parts shown in Fig. 3, except those marked "NS." Those are to be connected but *not soldered* until later. It is important to hold off on soldering those joints because you will be hooking more wires to those points in the next step of the assembly process.

Before you do any more wiring, get the board ready to accept the tube socket. Refer to Fig. 4. First cut a ⅝-inch diameter hardwood dowel to a length

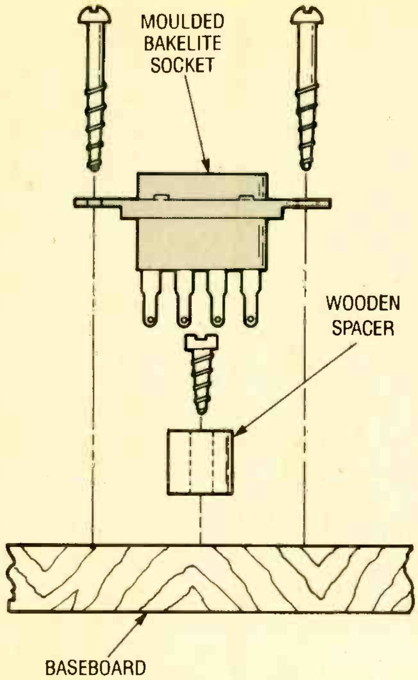

Fig. 4. Once the wiring outlined in Fig. 3 is complete, prepare the baseboard to accept the tube socket. The socket rests atop a ½-inch length of ⅝-inch diameter hardwood dowel.

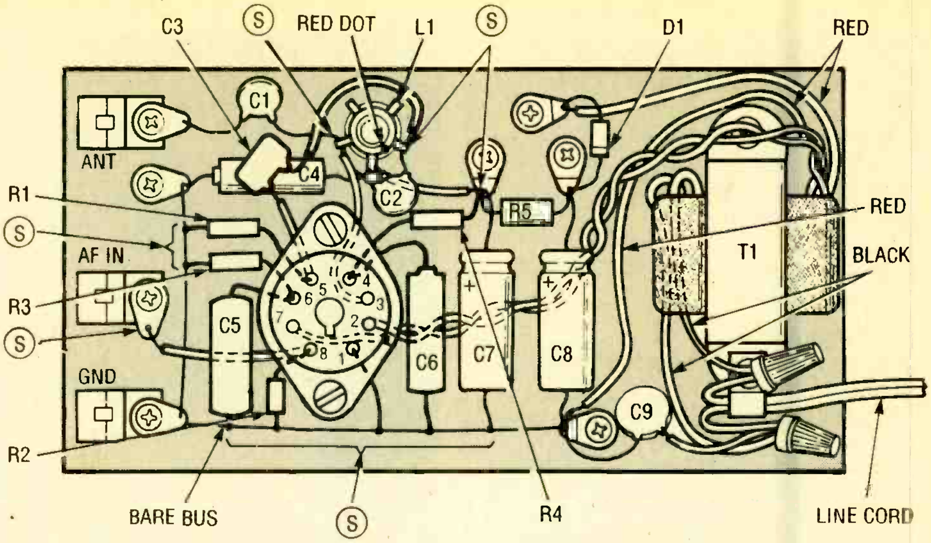

Fig. 6. Mount the tube socket, using two 1½-inch, #6 round-head wood screws. After that, make all of the connections shown here to complete the transmitter.

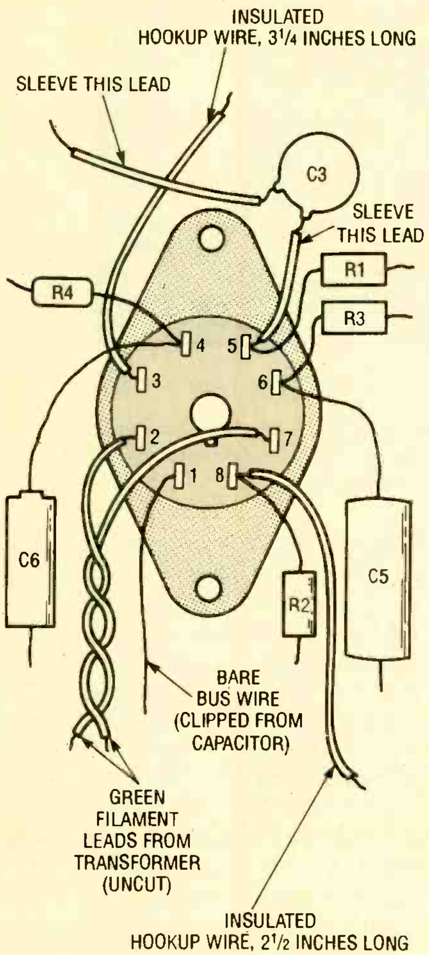

Fig. 5. Before mounting the tube socket on the board, wire C3, C5, C6, R1–R4, and the three connecting wires to the socket.

of about ½-inch, and drill a hole straight through its center, large enough to pass a #6 sheet-metal screw. It is important to cut the ends square. It helps if you have a miter box.

The wooden dowel acts like a pedestal, and provides the necessary clearance between the socket terminals and the surface of the baseboard. The socket should be a molded bakelite type and not the phenolic wafer type. Screw the dowel section to the baseboard using a #6 × ¾-inch sheet-metal screw. Rest the socket on top of the spacer with the keyway pointed in the same direction as shown in Fig. 5. Place two marks on the board directly under the holes in the metal saddle that surrounds the socket. Use those marks to locate two 3/32-inch pilot holes in the baseboard. When the time comes to mount the socket, two long screws in those holes will hold the socket securely on top of the wooden spacer.

Wiring the Tube Socket. It is much easier to wire the tube socket before it is mounted on the board than it is to do so afterward. For that reason, we'll now focus our attention on accomplishing that task. Begin by turning the socket upside down, so that its solder lugs are facing upward, and connect all of the leads shown in Fig. 5. Be sure the keyway is pointed in the direction shown, so that the parts that are to be connected to the socket subassembly line up properly with the parts on the baseboard.

Take your time, paying particular attention to lead length and position, especially if the components used to build the transmitter differ slightly in size or shape from those pictured. Be absolutely sure that everything is hooked up to the right terminals. Connect and solder the filament leads from the power transformer last. Make certain that all of the connections on the tube socket are securely soldered before proceeding.

Final Assembly. If you have followed all of the instructions in sequence, you have already drilled the holes necessary to mount the tube socket and associated parts. Mount the tube socket (as shown in Fig. 6), using two 1½-inch, #6 round-head wood screws. After you have mounted the sub-assembly, make all of the remaining connections (refer to Fig. 6). That will complete your transmitter. Check all of your wiring carefully before going on.

Testing Your Transmitter. First, plug the 12SA7 into its socket and connect a modulating source (AF voltage) to the AF IN terminals. You should be able to modulate the carrier with almost any high-level-audio source. The earphone output jack of a cassette tape player or the speaker terminals of almost any radio or record player should do just fine. If you have an audio oscillator, that is even better. When tuning in the transmitter for the first time, it's easier to pick out a continuous tone than it is to identify music or speech.

After hooking up whatever audio source is available, apply power to the circuit. After a brief warm-up period, adjust the transmitter. Tune an AM receiver to a quiet spot on the dial, somewhere between 1100 and 1600 kHz. Place the transmitter near the receiver's loop antenna. If it has no loop antenna,

(Continued on page 91)

SIMPLE MUSIC CIRCUIT

(Continued from page 63)

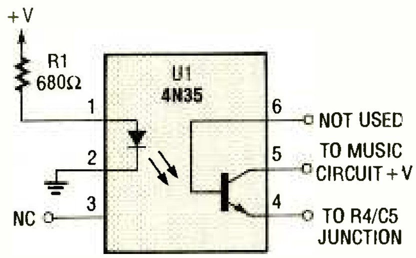

Fig. 5. Optoisolator/couplers, such as the one shown here, can replace S1, thereby allowing the SSMC to be triggered by some other electronic device. Other optoisolator/coupler units, containing various output devices, can also be used in the circuit depending on the intended application of the circuit.

ing card. To use the circuit in a greeting card, simply replace S2 or S1 with 2 conductors separated by some sort of thin insulating material (such as a piece of plastic). Then when the card is opened, the insulator is removed from between the two conductors, allowing them to touch and start the melody.

Other applications may require some other switching arrangement. For instance, to use the circuit as an automatic door annunciator, replace switch S1 with a normally-open magnetic alarm switch in such a way that when the door is opened, the switch contacts close, triggering the Super-Simple Music Circuit.

The circuit can also be used with a mechanical clock by attaching a small magnet to the back of to the minute hand, and a normally-open magnetic reed switch for S1 at, say, the 12 O'clock position. Then when the minute hand (with magnet attached) swings into the 12 o'clock position, the contacts of the reed switch close, triggering the circuit and playing a tune.

An optoisolator/coupler could be used in place of S1 to allow the Super-Simple Music Circuit to be triggered by some other electronic circuit (see Fig. 5), by connecting the output of the optoisolator/coupler in place of S1, and connecting the +V end of R1 to the desired trigger source.

Whatever the application, the Super-Simple Music Circuit's small size, low price, versatility, and ease of assembly will accommodate just about any of your music and project needs. Feel free to experiment with it, and, above all, have fun! ■

1930'S TRANSMITTER

(Continued from page 60)

bring the receiver's antenna lead near the transmitter. Turn the receiver's volume up high and then tune the transmitter slowly by adjusting the slug in L1 until you hear the modulating signal. If the signal is distorted, reduce the level of the modulation until the distortion disappears.

Once the transmitter and receiver are tuned to the same frequency, you can separate them and check signal propagation. You should not need to attach a radiating antenna to the transmitter. If necessary however, you may attach a short length of wire, up to six feet or so, to the ANT terminal of the transmitter to increase its range. Keep that lead as short as possible to avoid illegal radiation. Re-adjust L1's tuning slug with any change in antenna length.

Like many pre-war phono oscillators, this circuit covers the upper portion of the broadcast band. If you want to lower the frequency range over which the transmitter may be tuned, increase the value of C2. Conversely, if you wish to raise its operating range, you may do so by decreasing the value C2.

The number of uses you can find for this little "radio station" are limited only by your imagination. For example, you can use it to monitor what's going on in a nearby room without running wires. With two of them, you can set up communications. With a tone generator and a key, you can make it into a wireless code-practice oscillator. With some slight modifications, you can even make it into a CW (continuous wave) transmitter and send code! If you want to, you can change the value of C2 enough to shift the carrier frequency above or below the broadcast band. By doing that to the transmitter, and by using a suitable receiver, you can make it hard for anyone to intercept your transmissions.

Students can put this little device to good use, too. With some ingenuity, the circuit could become part of an award-winning science-fair project! If you have a working antique radio, you can transmit tape-recorded vintage-radio programs to your old set. Grandma was probably surprised enough when you got her relic radio running again. Imagine her face when you tune in a "live" broadcast from 40 or 50 years ago! ■