TRANSISTORIZED TREMOLO

... adds "color" to musical instruments

By A. E. DONKIN, W2EMF

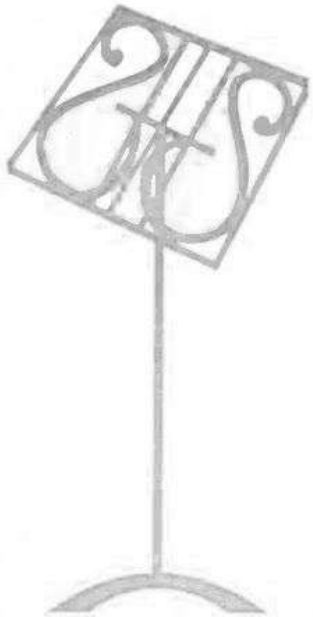
GOT A MUSICIAN in the family? You can delight him (or her) *and* your friends by constructing this little electronic tremolo. Reasonably easy to build, it makes a perfect addition to an electric guitar. Add a suitable mike, and you can use it with almost any musical instrument.

Like other tremolos, this device produces a "throbbing" effect on the sound of an electric musical instrument which is played "through" it. Unlike some versions, however, this circuit is transistorized and battery-operated, with several resultant advantages.

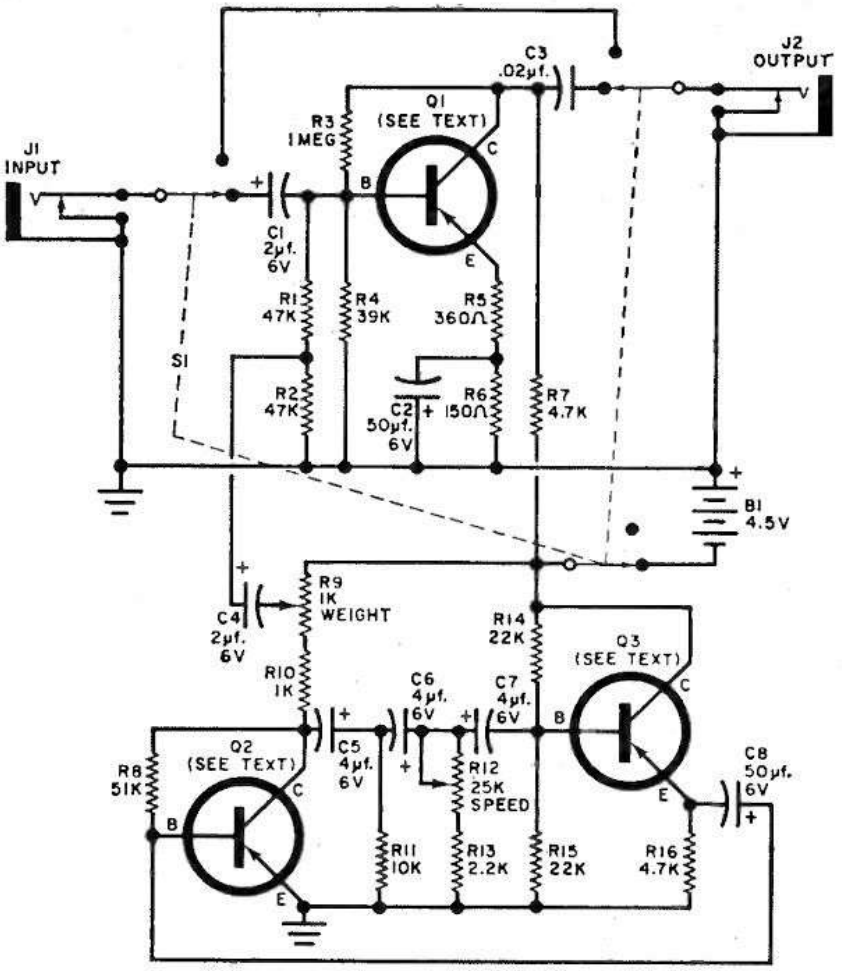
For one thing, the number of components is reduced; and so, too, is the cost. In addition, the unit is small enough and light enough to be attached directly to the musical instrument; this means that it can be readily controlled by the musician himself. Finally, the battery power supply substantially reduces the possibility of hum in the amplifying system.

About the Circuit. The transistorized tremolo is connected between the output of an electric musical instrument and an audio amplifier. It functions by varying the amplitude of the electrical signal from the musical instrument at a rate of about 5 to 15 times per second.

In the circuit shown here, transistor *Q1* is connected as an amplifier and is biased to draw very little collector current. To match the impedance of a magnetic instrument pickup, its input impedance has been increased by leaving



TREMOLO



Most components in the tremolo circuit are mounted on a piece of Vectorbord, with only the battery holder, jacks, potentiometers, and switch installed on the metal chassis itself (see photo at right). Although potentiometer R12 controls the "speed" or frequency, substituting other values for R11 will alter the basic frequency, as explained in text.

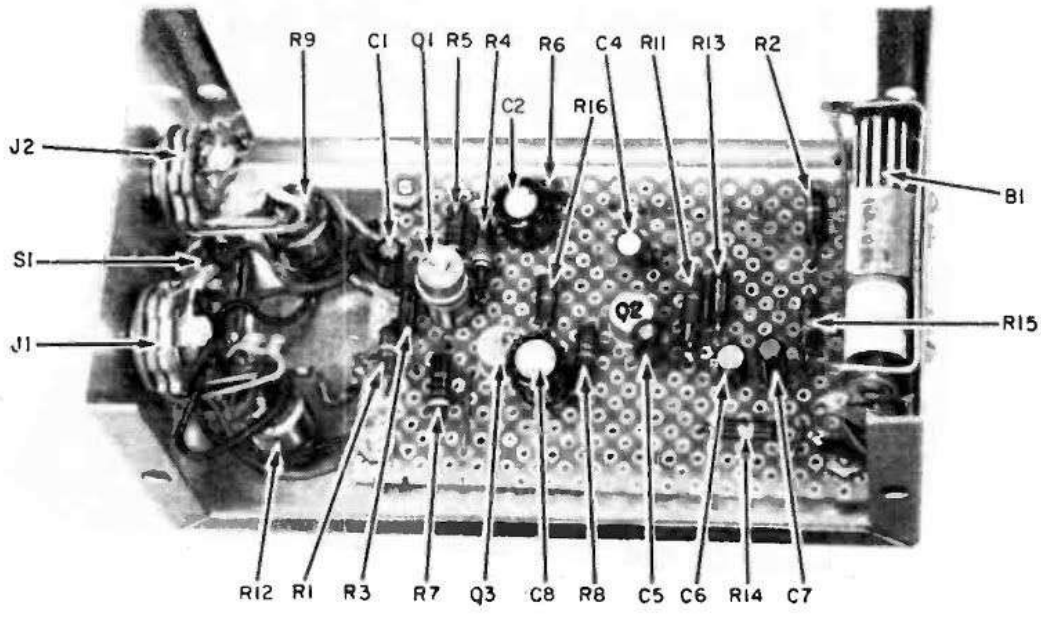
a portion of the emitter resistor unbypassed (*R5*).

Since transistor *Q1* is operated in the low-current region, its gain varies rapidly with changes in collector current. A low-frequency (5- to 15-cycle) signal is superimposed on the d.c. bias for this stage via resistors *R1* and *R2*, causing the collector current (and hence the gain) to vary.

Transistors *Q2* and *Q3* operate as a phase shift oscillator to generate the 5- to 15-cycle signal. Transistor *Q2* is a common-emitter amplifier supplying the phase shift network, and *Q3* is an emitter follower to adjust impedances and provide positive feedback. The frequency of the phase shift oscillator is adjusted by varying one "leg" of the phase shift network (potentiometer *R12*); the depth or "weight" is controlled by adjusting potentiometer *R9*.

Construction. Layout of the transistorized tremolo isn't critical, but it's still a good idea to follow the author's parts placement as nearly as possible. A $2\frac{7}{16}$" x $3\frac{1}{2}$" piece of Vectorbord facilitates mounting the smaller components, and Vector terminals can be used as tie-points where needed.

Potentiometers *R9* and *R12*, jacks *J1* and *J2*, switch *S1*, and the battery holder should be mounted in the utility box first, leaving as much room as possible for the Vectorbord assembly (be sure to allow enough clearance to insert and re-



PARTS LIST

B1—4.5-volt battery (three Burgess Type 7 "slim" penlight cells in series or equivalent)
C1, C4—2-μf., 6-w.v.d.c. miniature electrolytic capacitor
C2, C8—50-μf., 6-w.v.d.c. miniature electrolytic capacitor
C3—0.02-μf. miniature paper capacitor
C5, C6, C7—4-μf., 6-w.v.d.c. miniature electrolytic capacitor
J1, J2—Phone jack, shorting type
Q1, Q2, Q3—Audio transistors, pnp type (Lafayette SP-239 or equivalent)
R1, R2—47,000 ohms
R3—1 megohm
R4—39,000 ohms
R5—360 ohms, 5%
R6—150 ohms
R7, R16—4700 ohms
R8—51,000 ohms, 5%

All resistors ½ watt, 10%, unless otherwise noted

R9—1000-ohm miniature potentiometer, linear taper
R10—1000 ohms
R11—10,000 ohms
R12—25,000-ohm miniature potentiometer, linear taper
R13—2200 ohms
R14, R15—22,000 ohms
S1—3-pole, double-throw slide switch (Lafayette SW-94, with one section unused, or equivalent)
1—5¼" x 3" x 2⅛" aluminum utility box (Bud CU-2106-A or equivalent)
3—Battery holders (Keystone Type 137 or equivalent)
1—2 3/16" x 3½" piece of Type 85G24EP Vectorbord
Misc.—Type T28 Vector push-in terminals, miniature knobs for R9 and R12, wire, solder, hardware, etc.

move the batteries). The Vectorbord should then be cut and drilled, after which the other components can be mounted.

Although the transistors in the author's model are of the "2 for 98 cents" variety, they function quite satisfactorily. For optimum results, the transistors should be interchanged in the circuit, and *Q1* selected for lowest noise (*Q2* and *Q3* aren't particularly critical). If the transistors are installed in either sockets or Vector terminals, they can be "selected" after the Vectorbord assembly has been wired into the Minibox.

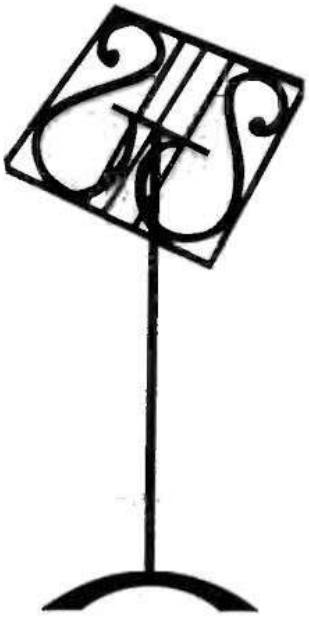
When wiring, be sure to "heat sink" the transistor leads with a pair of long-nose pliers. You may want to use the same treatment for the electrolytic capacitors, just to be on the safe side; in addition, the polarities of the electrolytics must be observed.

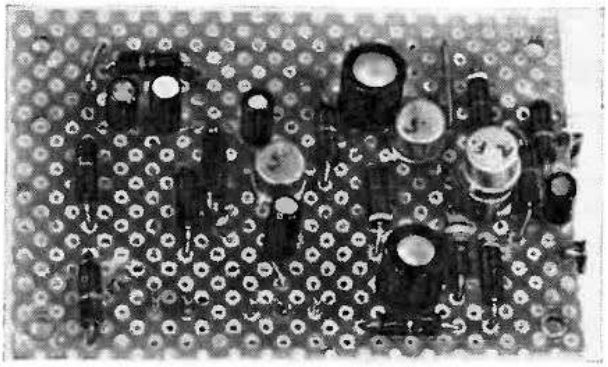
After the wiring is completed, the Vectorbord should be fastened to the top of the box with ¼" spacers, and the leads from it to the balance of the circuit soldered in place.

Check-Out and Operation. The unit is ready for testing. Install the batteries, again observing polarity, and turn the unit on. To check for oscillation of *Q2* and *Q3*, simply measure the collector voltage of *Q2* or the emitter voltage of *Q3*. A rapid fluctuation indicates that the oscillator is operating properly.

Now insert the tremolo between the

TREMOLO





Here's how the Vectorbord subassembly should look when it's ready to be installed in the chassis box.

Hooking up the transistorized tremolo is simplicity itself—just plug the electric guitar or other musical instrument into jack J1 on the tremolo and connect an audio amplifier and speaker to jack J2.

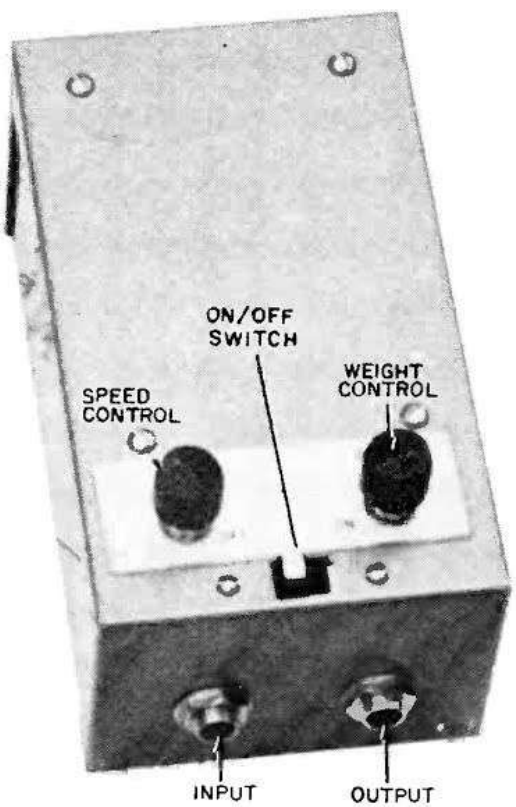
output from the musical instrument and the input to your amplifier, as shown. The "weight" control, *R9*, should be adjusted until a "throbbing" is noticeable in the amplifier output; don't advance the "weight" control too far or you may cause a "thumping" sound in the speaker. The "speed" control, *R12*, governs the rate of tremolo and should be adjusted to suit your taste.

If desired, the range of adjustment of the "speed" control can be modified by adding a resistor in parallel with *R11*, since reducing the effective value of *R11* will increase the speed. In the author's model, *R11* was paralleled with a 1000-ohm resistor for an effective value of about 900 ohms.

Possible Troubles and Cures. The simplicity of the circuit is some insurance against trouble. If the components and wiring seem to be okay, lack of oscillation may be due to low *beta* in *Q2* or *Q3*, although the requirements for this portion of the circuit aren't very exacting.

"Thumping" can be reduced by experimenting with smaller values for capacitor *C3*. The final value for this component depends to some extent on the amplifier you happen to use, but don't reduce the capacitance too much or you'll cut out most of the low frequencies.

Since the amplifier stage (*Q1*) is operated at low collector current, the amplitude of the input signal is limited, and large signals will cause distortion. Even so, most guitar pickups won't overload *Q1*. But if distortion does occur, you should be able to correct it by reducing the output level of the instrument and increasing the gain of the amplifier accordingly. —30—



The transistorized tremolo, all wired up and rarin' to go. See text for instructions on adjusting speed and weight controls.