THE TOUCH-A-TONE

BY CHARLES D. RAKES

ONE OF THE biggest fads sweeping the rock music world is sound produced purely by electronic means. Electronic organs, drums, and castanets abound. The "Touch-A-Tone" electronic instrument described here is a different all-electronic musical instrument. It resembles a banjo and is held in much the same manner, but there all similarity ends.

Capable of producing a range of four full octaves (one below and three above middle C) in organ-like tones, the Touch-A-Tone has eight note contacts and an easy-to-reach octave selector switch. It has a built-in speaker and battery supply and a variable-rate tremolo control (6 to 36 beats per second) to add color to the music. Optional features that can be added are a variable-depth control for the tremolo circuit and a headphone jack for solitary listening.

Playing the Touch-A-Tone is very simple. With one hand, the player selects any of the eight note contacts and also touches a metal strip (located on the rear of the neck of the instrument). He then uses the thumb of his free hand to touch or "pick" a third contact located at the base of the neck.

Learning to play the Touch-A-Tone is simplicity itself—you can master "Yankee Doodle Dandy" in a matter of minutes.

About the Circuit. The tremolo circuit is comprised of *Q1* and its associated components (see Fig. 1). This is a variable-rate, low-frequency generator, the output of which is coupled to the input of mixer-amplifier stage *Q3*. Potentiometer *R2* adjusts the rate of the generated signal at the player's discretion, and *S1* engages or disables the tremolo circuit.

Transistor *Q2* is the heart of the four-octave tone generator. Capacitors *C3-C6* and resistors *R43-R50* comprise the generator's frequency determining network. Switch *S3* selects the desired octave range, and the player simultaneously touches the touch bar and one of the note keys (1-8) to activate the proper transistor touch switch for the note he wishes to play. Then, with his free hand, the player also contacts the thumb touch knob.

The output of *Q2* now feeds into the input of mixer-amplifier *Q3* where it mixes with the tremolo beat (if the tremolo circuit is active) and is amplified. The output of *Q3* is taken off the wiper contact of *R11* and is coupled to audio amplifier *Q7* via *C9*.

Transistor stages *Q4-Q6* operate as a touch switch; until it is switched open by touching the thumb touch knob, the gate of *Q3* is clamped to ground, allowing no output from the mixer-amplifier.

The eight direct-coupled touch switch circuits select the proper resistive value for the tone generator. Each circuit consists of a pair of transistor stages: *Q8/Q9, Q10/11,* etc., through *Q22/Q23*. Diodes *D1* through *D8* provide isolation for the touch switch circuits.

The touch bar is used to supply B+ to the inputs of each touch switch as it is selected. This positive voltage is applied through the body resistance of the player!

Construction. Since the physical layout of the Touch-A-Tone is not dictated by strings or critical dimensions, you can build the circuit into almost any housing that suits your taste. Just make sure that all touch contacts are within easy reach.

Although the circuit can be assembled on a piece of perforated phenolic board with push-in terminals for soldering, the use of a printed circuit board is recommended (see etching guide and component placement in Fig. 2). The PC board reduces assembly time and minimizes the chances of wiring errors.

Mount the components on the board in the following order: fixed resistors, capacitors, output transformer *T1,* and diodes and transistors (before installing *Q3,* cut off the case lead). The last components to be mounted should be the eight trimmer-type potentiometers for *R43-R50*.

When mounting the transistors and diodes, heat sink all leads whenever heat is applied. Also, leave about ¼" of space between the bottoms of the transistors and the top of the circuit board. Then carefully check the polarities of the electrolytic capacitors, diodes, and transistors, and the orientation of *T1*. Flip over the circuit board and make sure that all leads are properly soldered to the foil; resolder any connections that appear "grainy." After making sure that

PARTS LIST

B1—12-volt d.c. power source (eight 1.5 AA cells connected in series)
C1—1-μF Mylar or paper capacitor
C2—0.03-μF paper capacitor
C3—0.377-μF paper capacitor (see text)
C4—0.19-μF paper capacitor (see text)
C5—0.1-μF paper capacitor (see text)
C6—0.057-μF paper capacitor (see text)
C7, C10-C18—0.47-μF paper or Mylar capacitor
C8—100-μF, 15-volt electrolytic capacitor
C9—10-μF, 15-volt electrolytic capacitor
C19—250-500-μF, 15-volt electrolytic capacitor (see text)
D1-D9—1N4003 or 1N4004 diode
Q1,Q2—2N2646 unijunction transistor
Q3—Field effect transistor (Motorola HEP-801)
Q4-Q6,Q9,Q11,Q13,Q15,Q17,Q19,Q21,Q23 — Bipolar transistor (Motorola HEP-725)
Q7—2N2102 bipolar transistor
Q8,Q10,Q12,Q14,Q16,Q18,Q20,Q22 — Bipolar transistor (2N3638 or Motorola MPS3638)

All resistors ½-watt:
R1—39,000-ohm
R3,R8—270-ohm
R4—22-ohm
R5—See text
R6—680,000-ohm
R7—1-megohm
R9—27-ohm
R10—1.5-megohm
R12,R15,R16,R19,R21,R22,R24, R25,R27,R28,R30,R31,R33,R34, R36,R37,R39,R40,R42—3300-ohm
R13,R14,R20,R23,R26,R29,R32, R35,R38,R41—10,000-ohm
R17—150,000-ohm
R18—4.7-ohm

R2—150,000-ohm potentiometer
R11—5000-Ohm potentiometer
R43-R50—PC-type miniature potentiometer (see text)
S1,S2—S.p.s.t. switch (for R2 and R11)
S3—S.p.4t. rotary switch
SPKR—3.2-ohm, 3" loudspeaker
T1—400:4-ohm, 300-mW output transformer (Allied Radio Corp. No. 54A2367, or similar)
1—11½"-diameter x 3½"-deep wood bowl
8—1"-diameter chrome-plated drawer pulls
1—Spoon-shaped, chrome-plated drawer pull
1—Chrome-plated lever knob
Misc.—Control knobs (2); 32" x 4" x ¾" piece of redwood; hardboard panel; dual AA-cell battery holders (4); 9" x 4⅞" perforated phenolic board with push-in solder terminals (or see text for printed circuit board); rubber cement; #6 hardware and solder lugs; spacers; aluminum or brass stock for touch bar; speaker grille; phone jack (optional); color-coded hookup wire; solder; etc.

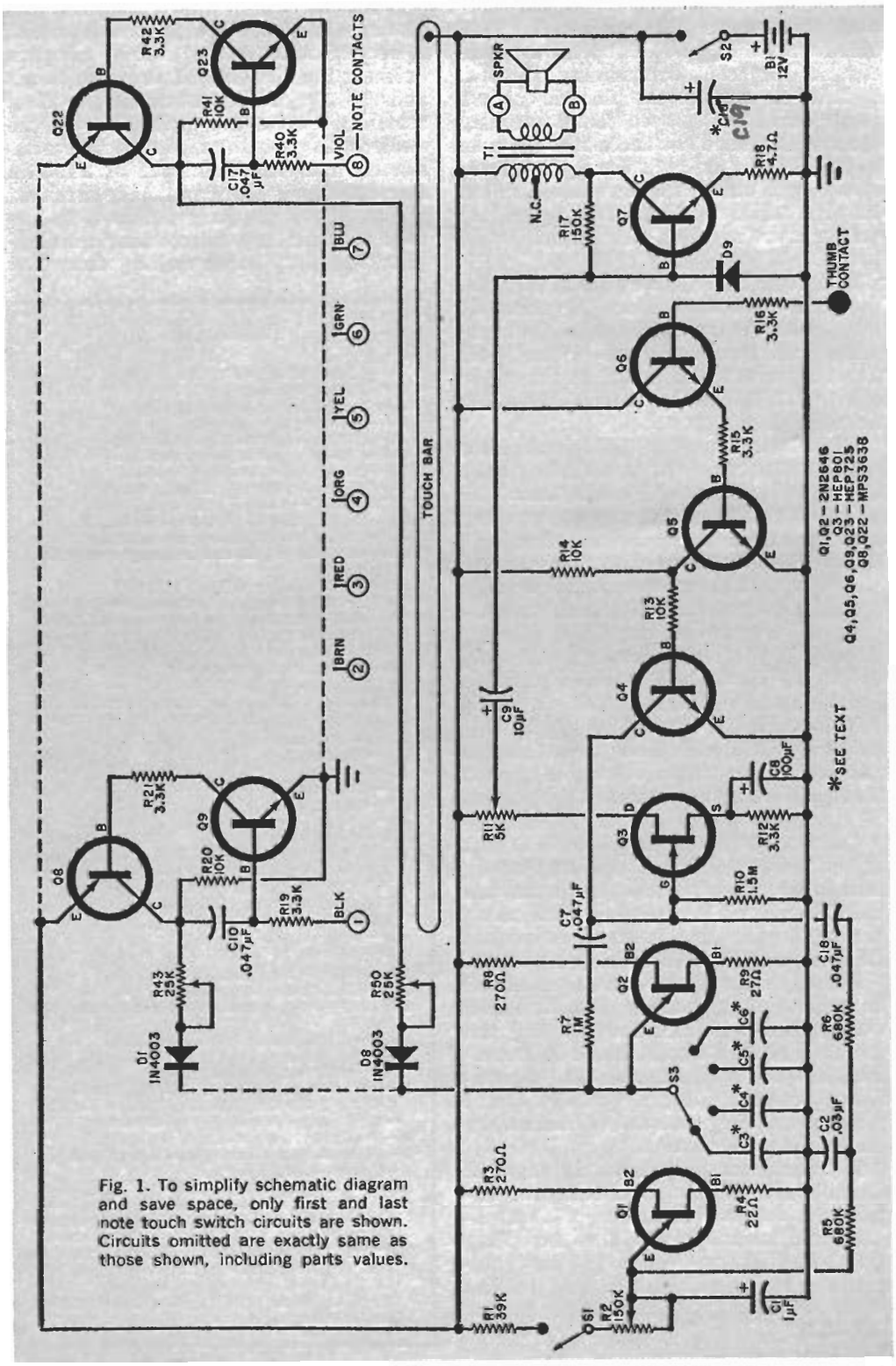


Fig. 1. To simplify schematic diagram and save space, only first and last note touch switch circuits are shown. Circuits omitted are exactly same as those shown, including parts values.

"The Touch-A-Tone" (March 1970). The electrolytic capacitor shown in Fig. 1 near *S2* is *C19*, not *C18*. Also, in Fig. 2, the capacitor labeled *C17* at lower left should be *C19*.

no solder bridges exist between closely spaced foil conductors, set the board aside.

Now lay a piece of hardboard wall paneling face down on a flat surface. Set the wood bowl rim down on top of the paneling and strike a pencil line on the paneling around the circumference of the bowl. Remove the bowl and set it aside. Then, working carefully with a sabre saw or router, cut out the circular piece and sand the rough edges. This piece will be the front panel of the instrument.

Now, referring to Fig. 3, finish fabricating the front panel according to the dimensions given. This done, set aside the front panel, and fashion the neck of the instrument from redwood or other decorative lumber. When the neck piece is cut to size with the desired outline, route out a 3/16"-deep by 3/8"-wide groove down the center of the rear to provide a channel for the touch contact wires.

Drill eight equally spaced 1/8" holes through the center of the groove in the neck piece. Then place a #6 solder lug on each of the eight screws provided with the drawer-pull "touch contacts," and mount a drawer pull at each hole location.

Solder a length of hookup wire to each of the solder lugs (measure these wires from the solder lug to the base of the neck and add 8" to each length). If possible, use color-coded wire for easy contact lead identification. A good code to use is black, brown, red, orange, yellow, green, blue, and violet for contacts 1 through 8, respectively.

Mount a 16¾"-long by 3/8"-wide (almost any thickness between 22 gauge and 1/4") strip of aluminum about 1/4" to one side of the center groove (see Fig. 4), using 3/8" woodscrews. Connect an 8" length of white hookup wire to the screw nearest the bowl end of the neck piece. Then carefully cut a shallow groove with a sharp knife between this last connection point to the center groove, and route the white wire through both grooves.

Anchor the neck to the front panel with three sets of 6-32 hardware. To do this, first center the spoon-shaped drawer pull at the base of the neck, and fasten it there with a screw equipped with a #6 solder lug to which a 6" length of gray hookup wire has been soldered.

Mount the speaker and grille, volume and tremolo controls, and octave selector switch in their respective holes (and the optional headphone jack, if used), as shown in Fig. 4. Pass a 1½" oval-head machine screw through the center hole on the front panel, slide on a lockwasher, and screw all the way on a 1" threaded spacer. Slide on the circuit board, foil pattern down, follow with another lockwasher, and screw onto the threaded screw stub another 2⅛" length of threaded spacer. (Note: If you cannot obtain the second spacer in the required length, try sandwiching a few flat washers between the board and a shorter spacer to obtain the proper final length. In this case, substitute a 2" oval-head screw to start with.)

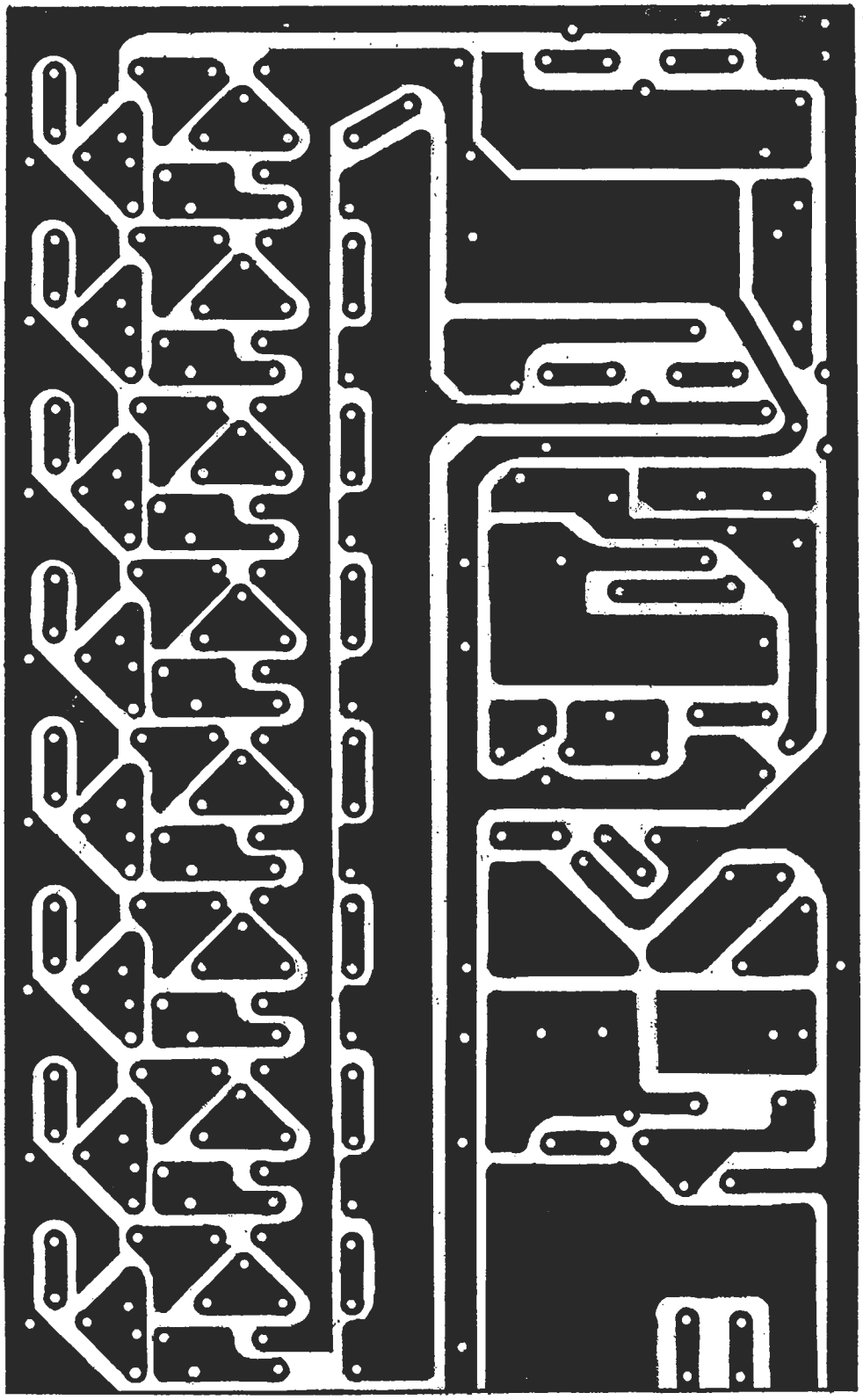
Now referring to Figs. 1 and 2, interconnect all components and assemblies. If you are using the optional headphone jack, reroute the wiring from the output of the transformer through the jack as shown in Fig. 5, then to the speaker.

When connecting the color-coded wires from the various touch contacts to the circuit board, leave about 1" of slack and clip away any excess. Then to finish initial assembly, wire the battery holders for a series hookup, and connect the loose ends of the wires from the positive and negative holder contacts to the appropriate points in the circuit.

Tuning. To make the method of playing the Touch-A-Tone similar to that of a guitar, the instrument must be tuned so that the high-frequency notes are played by touching the contacts nearest the

	FREQUENCY IN HERTZ*			
	FIRST OCTAVE	SECOND OCTAVE	THIRD OCTAVE	FOURTH OCTAVE
R43	2093	1047	523	262
R44	1976	988	494	247
R45	1760	880	440	220
R46	1568	784	392	196
R47	1397	698	349	175
R48	1319	659	329	165
R49	1117	587	294	147
R50	1047	523	262	131

**As observed from oscilloscope patterns or read from frequency counter.*



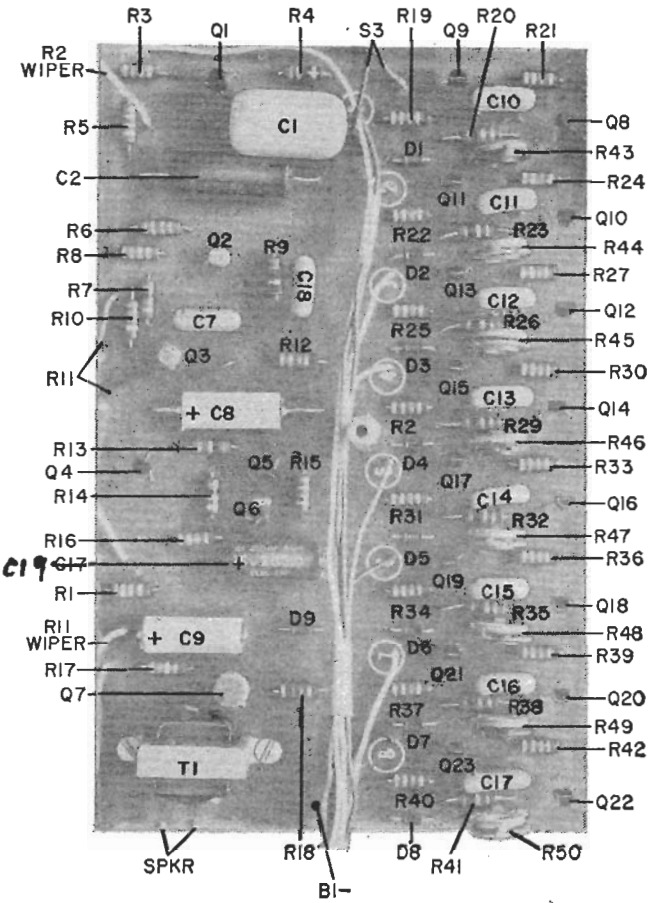


Fig. 2. Actual size printed circuit etching guide is shown on opposite page; component placement on board is shown at right. Refer to packages or cases for transistor lead identification.

bowl. Each successive contact away from the bowl should diminish the frequency of the note generated.

The simplest method of tuning the instrument is to use a frequency counter. However, if a frequency counter is not available, you can use an audio generator and oscilloscope. In fact, if you are a musician and have a good ear for pitch and access to a properly tuned piano, you can even tune the instrument by ear.

To prepare for tuning by either of the electronic methods, make sure the tremolo is off. Take the output of the Touch-

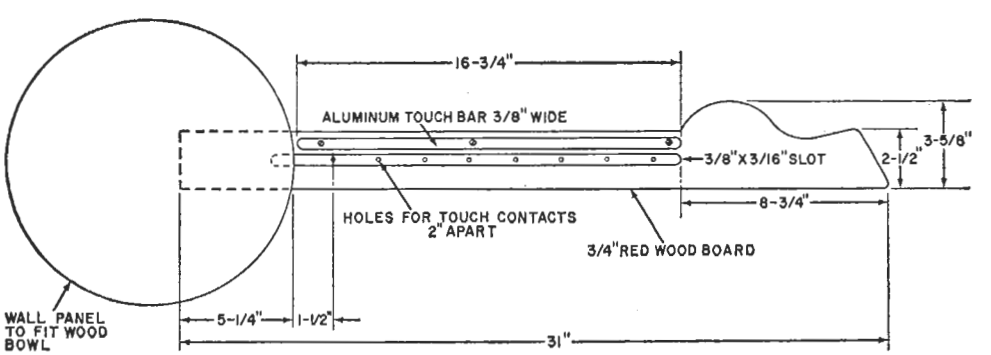


Fig. 3. Cut wall panel to fit outer circumference of bowl used. Locate holes for note touch contact mounting as shown, aluminum touch bar slightly above groove.

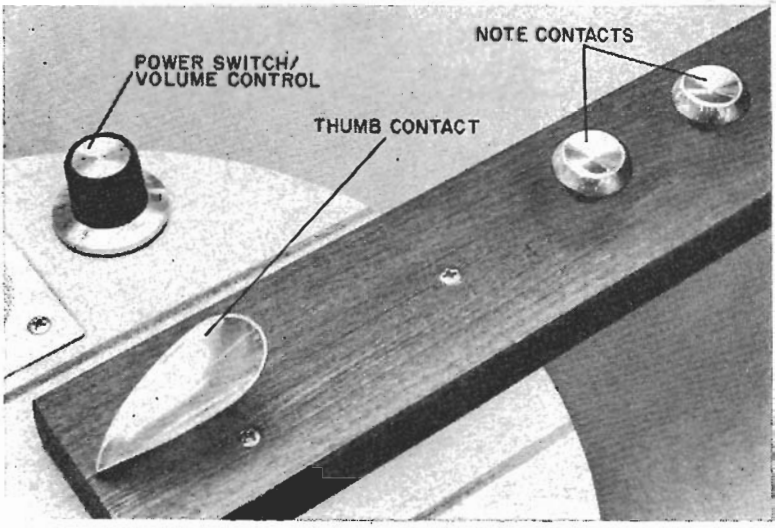


Fig. 4. Neck piece attaches to wall panel with three screws. Locate spoon-shaped drawer pull at base.

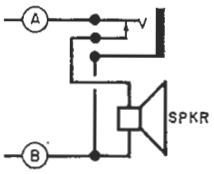


Fig. 5. Wire headphone jack as shown; connect to points A and B in schematic.

A-Tone from the speaker terminals. First, solder a 0.047-μF capacitor (*C6*) in position 1 of octave selector switch *S3*. Then connect one clip lead between B1+ and the thumb touch contact, and another clip lead between B1+ and contact 1 on the neck of the instrument. If you are using the frequency counter, simply set *R43* (see Fig. 2) for a reading of 2093 Hz on the frequency counter.

Now, move the second clip lead to contact 2, and set *R44* for a reading of 1976 Hz. Continue moving the second clip lead and adjusting the proper trimmer potentiometers for the frequencies indicated under the "First Octave" column in the table on page 69.

To use the oscilloscope/signal generator method of tuning, set up the clip leads as described above. Then connect another pair of leads between the output of the Touch-A-Tone and the horizontal input and ground of the scope. Connect

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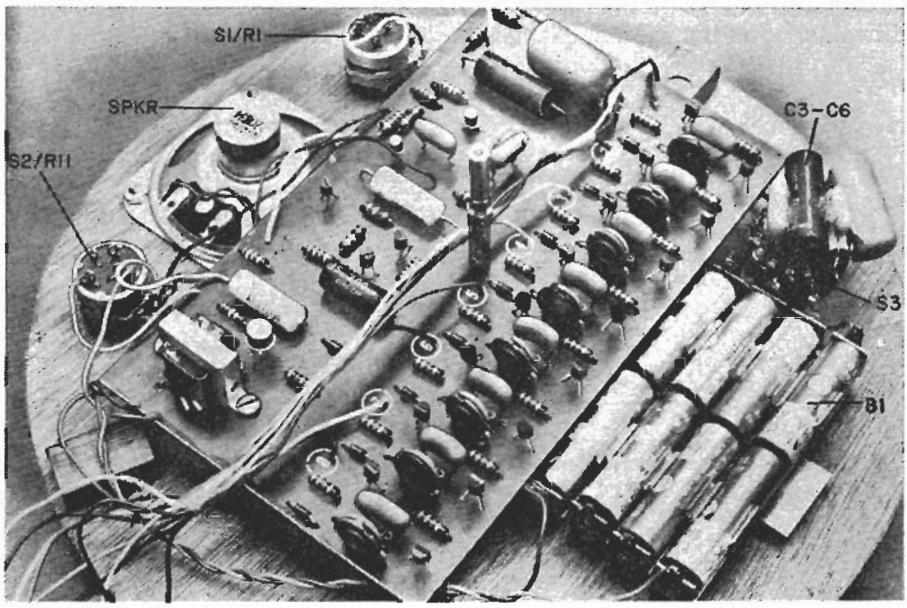
One suggested layout for controls and speaker on the front panel is shown in the photo below. If headphone jack and variable-depth tremolo are to be used, mount them near R1 and R11.



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(*Continued from page 72*)

a final pair of leads between the output of the audio generator and vertical input and ground of the scope.

Now, first tune the audio generator to the frequency listed under the "First Octave" column in the Table, and adjust the setting of the proper trimmer potentiometer to obtain a circle on the screen of the scope. (Note: if you have a meter available, set the output signal level of the instrument to the same signal level of the generator.) The circle indicates that the Touch-A-Tone and audio generator are tuned to the same frequency. Also, remember that as you move from one trim pot to another, you will have to move the appropriate clip lead from touch contact to touch contact.

When you are finished tuning the first octave, you can, if you desire, replace the trimmer potentiometers with fixed resistors of appropriate values to obviate periodic retuning. If you leave the pots in place, readjustment about twice a year will be sufficient.

Next, install a 0.1-μF capacitor (*C5*) in position 2 of *S3*. Parallel connect a 0.15-μF capacitor with a 0.04-μF capacitor to make the specified 0.19-μF value for *C4*; connect this assembly in position 3 of *S3*. In like manner, to make the 0.377-μF value specified for *C3*, parallel-connect a 0.33-μF capacitor with a 0.047-μF capacitor, and solder this assembly into position 4 of *S3*.

If you do not want the variable-depth control for the tremolo circuit, simply install and solder a 1.5-megohm resistor in the *R5* position on the circuit board. For variable-depth, mount a 1.5-megohm potentiometer in a convenient location on the front panel of the Touch-A-Tone. Solder one end of a 680,000-ohm, ½-watt resistor to the wiper lug of this potentiometer. Then connect the free end of the resistor to one of the *R5* holes in the board, and a length of hookup wire between the right lug of the pot (viewed from the rear) and the other *R5* hole.

Assemble the instrument, and you are ready to play a tune. With a little practice, it will not be long before you are playing like an old pro. -30-