SYNTHESPIN
Rotating Speaker Simulator

THE SPECIAL EFFECTS rotary speaker system is a popular addition to any organ —acoustic or electronic. Usually a "rotary" system refers to a mechanical means of obtaining a vibrato-like sound effect—a gentle undulation of intensity at a rate of 8 to 12 Hz. Even in modern electronic organs, the rotary uses a massive rotating diffuser to disperse the sound from an extra speaker. It is effective, but also massive, noisy, and costly. Described here is a system which achieves nearly the same results with an adjustable all-electronic simulator.

While cost and size are definite advantages, perhaps the best part of the electronic Rotating Speaker Simulator is its versatility. With the controls cranked back, the Simulator adds an interesting, subtle effect to conservative music. But if you're a wild man, you can really twiddle the knobs and wail! Control adjustments can produce anything from "super" bass or treble boost to sounds listeners describe as "shimmering, bubbly or out of sight!"

Theory of Circuit Design. While the frequency shift, or vibrato, effect of a rotary speaker system (see box) is expensive to generate electronically, the total effect can be convincingly simulated simply by placing a bandpass filter between the musical instrument and its amplifier and sweeping back and forth across the bandpass. This is the principle employed in the Synthespin Simulator circuit shown in Fig. 1.

At the heart of the Simulator is an active bandpass filter composed of *R14*, *R15*, *Q2*, and *C7* through *C9* in the feedback loop of the amplifier/buffer combination made up of *Q3* and *Q4*. Transistor *Q1* and its associated components form a low-frequency phase-shift oscillator, the output frequency of which can be set from between about 4 Hz to 12 Hz through the use of speed control *R4*. The signal from *Q1* is attenuated by weight control *R8* and applied to the gate of *Q2* to change the source-to-drain impedance of the FET and, consequently, the center frequency of the pass band.

Photoelectric system *I1/LDR1* is used to bypass the Simulator when the system is not in use. Closing a footswitch plugged into *J3* powers *I1* which, in turn, illuminates *LDR1*. Once illuminated, *LDR1*'s internal resistance drops and forms a signal bypass loop around the filter circuit.

Construction. Since only low frequencies are involved in the operation of the Synthespin Simulator, parts layout during assembly of the project is not critical. Just adhere to the general rules of neatness and good soldering. In particular, keep signal leads as short as possible.

Once the board is prepared, mount the parts in their respective locations, paying particular attention to the orientations of diodes, transistors, and electrolytic capacitors. Use a low-wattage soldering iron to solder the component leads to the circuit board's foil pattern. It is also a good idea to heat sink the leads of the solid-state component to prevent heat damage.

After all components are mounted on the board, solder in place the primary and secondary leads of power transformer *T1* and pieces of hookup wire sufficiently long to reach the front panel controls when the project is fully assembled. Then carefully check the foil side of the board, particularly around the transformer connections, for solder bridges. If any exist, reheat and remove any excess solder to eliminate the bridge.

Mount the controls and jacks in their respective holes; then pass the free end of the line cord through its entry hole and secure it to the rear panel with a strain relief.

Referring back to Fig. 1, connect and solder the free ends of the wires coming from the circuit board to the lugs of the appropriate control and jack lugs. Tin the free ends of the line cord and solder them to the hole locations marked AC on the board. Now, interconnect with lengths of hookup wire the ground leads of *J1-J3* and connect and solder the leads of *LDR1* directly to the signal lugs of *J1* and *J2*. Neatly dress the leads along one edge of the circuit board.

Now, mount *R24* and *I1* on a three-lug terminal strip (no lugs grounded). Position the assembly near *LDR1* so that when the lamp is lit it will illuminate effectively the LDR. Mount the assembly in place with 4-40 machine hardware. Connect this assembly via one wire to the positive side of the power supply on the circuit board.

Finally, mount the circuit board with 4-40 hardware and spacers, and power transformer *T1* with 4-40 hardware only. The project is now ready to be tested.

Setup and Use. Plug the line cord of the Synthespin Simulator into a 117-volt ac outlet. Connect an input and amplifier to *J1* and *J2*, respectively, and a footswitch to *J3*. Turn on the system by rotating *R8* clockwise just past the click. Close the footswitch to test the bypass circuit; *I1* should immediately come on.

Temporarily cover the sensitive face of *LDR1* with a piece of black electrical tape to keep ambient light from interfering with the adjustments to be made. Advance ACCENT control *R20* to about two-thirds of its clockwise rotation and set weight control *R8* fully counterclockwise—but do not click the power off. The maximum effect of TONE control *R11* occurs over about one-quarter of its travel. The extra travel is useful in some effects when the weight control is fully advanced. Adjust *R12* so that the most sensitive area of the TONE control is at the center of the TONE control's travel. You can check out your settings by striking a chord and noting the action of the TONE control as it is rotated.

Trimmer potentiometer *R22* should be swept over its entire range to check the gain of the Simulator. It should then be set so that there is minimum change in volume level as the Simulator is switched in and out of the system (by operating the footswitch). While adjusting *R22*, be sure to remove the tape from over the LDR to permit switching out the Simulator.

To a certain extent, ACCENT control *R20* changes the overall gain of the Simulator. It should be adjusted for unity gain at the accent setting you intend to use most often or for whatever compromise suits your taste. When both internal adjustments (*R12* and *R22*) have been made, uncover *LDR1* and assemble the case.

In use, the best way to get the feel of the controls of the Simulator is simply to play with them. However, a few simple hints will get your started. First, to obtain the Leslie Effect, set the ACCENT control to approximately the center of its travel and rotate the WEIGHT control a small fraction of a turn clockwise. Set the TONE control to the center of its travel and adjust the SPEED control as desired.

Now, when the instrument plugged into *J1* is played, you should get an effect that is something like a tremolo, except that there will be a touch of sweeping pass band in the background. If the effect is not pronounced enough to suit you, advance the ACCENT control.

For super bass/treble boost, turn up the WEIGHT control as far as it will go without turning off the Simulator. Advance the ACCENT control all the way. Now the TONE control can be rotated clockwise for treble boost and counterclockwise for bass boost. Somewhere between the two extremes, the amplifier might break into oscillations, but this can be readily remedied simply by backing off on the ACCENT control slightly.

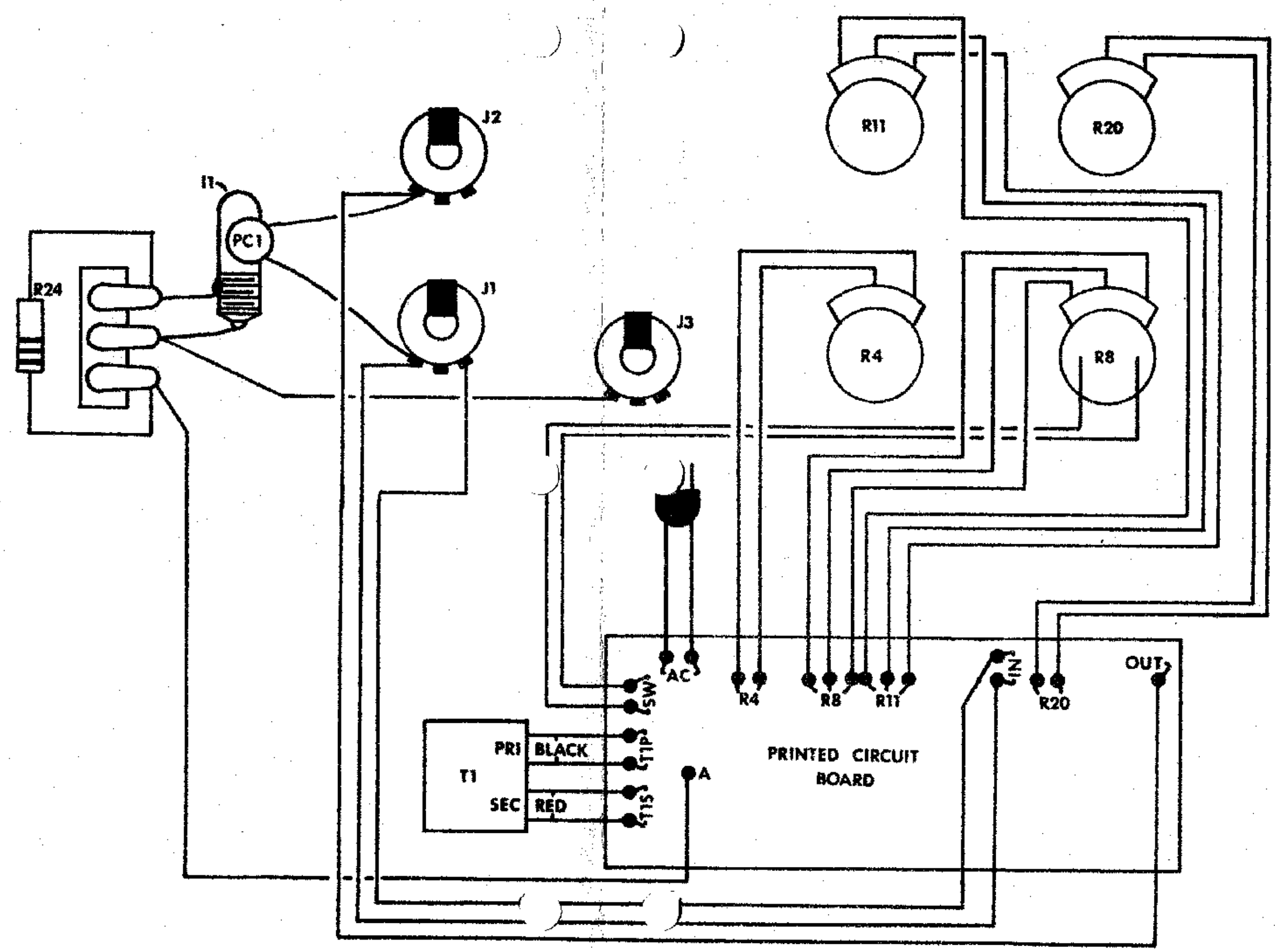
Advancing the WEIGHT control past its midpoint and setting the TONE slightly treble of center can produce an effect quite similar to reverberation if the ACCENT control is advanced to the point that just causes oscillation when a note is struck.

If, during the operation of the Simulator, you notice a loud ac hum level, try reversing the ac line cord plug. This should effectively curb the hum loop.

Beyond the very rough hints outlined above, familiarizing yourself with the Synthespin Simulator will depend on your experimental nature. You will certainly want to experiment to determine just what the Simulator is capable of doing. Go to it.

The Rotating Speaker Effect

In principle, the rotary speaker system is nothing more than one or more loudspeakers mounted at the end of an arm which is rotated by means of a motor. (Other variations use a fixed speaker and employ a rotating "paddle" or baffle, but the principle is the same.) As the loudspeakers swing around in an arc, several things happen to the sound. First, a doppler shift in the apparent pitch of the sound is caused as the motion toward and away from the listener takes place. Next, a variation in sound level is produced as the speaker alternately faces toward and away from the listener. Finally, there occurs a great variety of effects which stem from changes in the acoustics of the system enclosure and the room in which the system is being used occur.



CIRCUIT BOARD / PARTS INTERCONNECTIONS

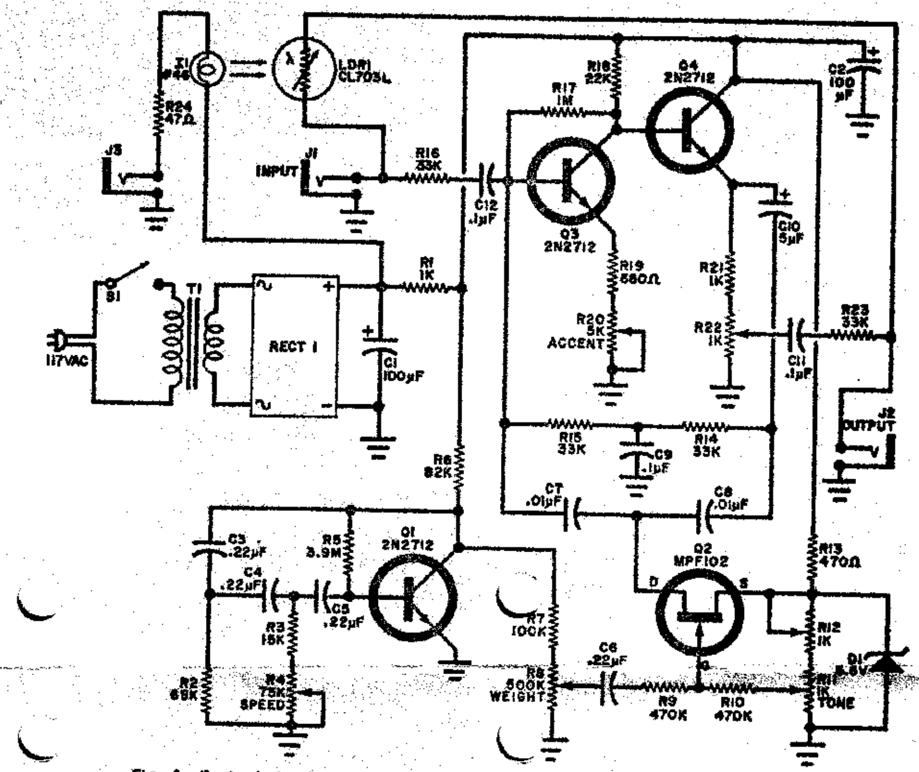
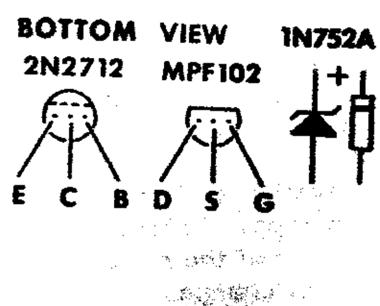


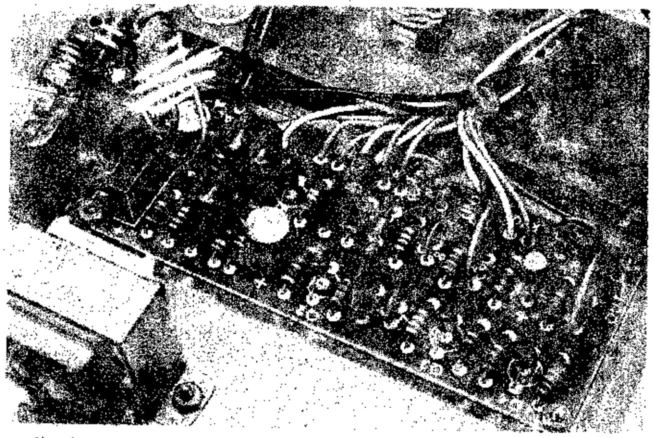
Fig. 1. Footswitch plugs into J3; when closed, footswitch powers I1 which illuminates LDR1. With LDR1 illuminated, input signal at J1 goes directly to J2.

PARTS LIST

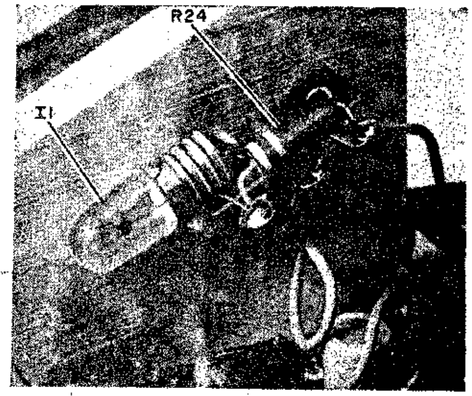
C1—100-μF, 16-volt electrolytic capacitor
C2—100-μF, 10-volt electrolytic capacitor
C3-C6—0.22-μF Mylar capacitor
C7,C8—0.01-μF disc capacitor
C9,C11,C12—0.1-μF disc capacitor
C10—5-μF, 6-volt electrolytic capacitor
D1—5.6-volt zener diode (Motorola HEP603 or similar)
I1—#46 incandescent panel lamp
J1-J3—Open-circuit phone jack
LDR1—Light-dependent resistor (Clairex CL703L or similar)
Q1,Q3,Q4—2N2712 bipolar transistor
Q2—MPF102 or HEP802 field-effect transistor
R1,R21—1000-ohm
R2—68,000-ohm
R3—15,000-ohm
R5—3.9-megohm
R6—82,000-ohm
R7—100,000-ohm
R9,R10—470,000-ohm
R13—470-ohm
R14-R16,R23—33,000-ohm
R17—1-megohm
R18—22,000-ohm
R19—680-ohm
} *½-watt, 10% tolerance*

R24—47-ohm, 10% tolerance, 1-watt resistor
R4—75,000-ohm, reverse audio-taper potentiometer
R8—500,000-ohm linear-taper potentiometer with integral switch
R11—1000-ohm linear-taper potentiometer
R12,R22—1000-ohm trimmer potentiometer with printed circuit solder terminals
R20—5000-ohm linear-taper potentiometer
RECT1—1-ampere, 50 PIV, full-wave rectifier bridge module (Motorola MDA942A-1 or similar)
S1—Spst switch (part of R8)
T1—12.6-volt, 300-mA filament transformer
Misc.—Circuit board; line cord with a strain relief; cabinet; 3-lug terminal strip; control knobs (4); spacers (4); rubber feet (4); 4-40 machine hardware; hookup wire; solder; etc.





eatly dress control and jack wiring to one side of circuit board and lace gether with cable ties or lacing cord. Secure power transformer to chassis th 4-40 machine hardware; add ¼" spacers when mounting board in place.



Current limiting resistor R24 and I1 are mounted on terminal strip fastened to side panel in line with LDR1 when cabinet is assembled. If side panel is metal, use four-lug terminal strip and do not connect R24 or I1 to mounting lug.

RESISTOR COLOR CODING IS AS FOLLOWS:

R1, R21	1K	brown-black-red
R2	68K	blue-grey-orange
R3	15K	brown-green-orange
R5	3.9meg	orange-white-green
R6	82K	grey-red-orange
R7	100K	brown-black-yellow
R9, R10	470 K	yellow-violet-yellow
R13	470 ohm	yellow violet-brown
R14, R15, R16, R20	33K	orange-orange-orange
R17	1 meg	brown-black-green
R18	22K	red-red-orange
R19	680 ohm	blue-grey-brown
R24	47 ohm	yellow-violet-black

All components values other than resistors are marked on the body of the component.

Supplied with this kit is a pre-printed vinyl panel marking sheet. Note that for ease of application the adhesive on this sheet is not activated until the sheet is firmly pressed against the panel. Apply the sheet by following the instructions written on it's backing paper. The white line at the top of the sheet is meant to be aligned with the back most edge of the case top. When the sheet is firmly adhered wrap the loose edges under and adhere them to the back of the panel for a finished look at the edges. Prior to mounting the panel controls and J1-J3 cut around their holes with a razor blade or sharp knife. If necessary additional sheets are available from PAIA Electronics, 6700 N. Classen Blvd., Okla. City, OK 73116, at a cost of $1.50 each Postpaid.

Before assembling parts on the circuit board thoroughly scour the board with steel wool until it has a shiny appearance. Use only rosin core solder; acid core solder is completely unacceptable.

A repair service is available if needed. Repairs are charged at a rate of $4.00/hr. plus parts and postage. Before returning a unit for repair please write, describing the symptoms of the malfunction. Some problems can be diagnosed through the mail without charge.