

TubeHead Plan Set

If you love vacuum tubes, this project has got your name on it. The TubeHead is a low-cost, two-channel vacuum tube pre-amplifier with a twist. The twist is that this circuit is designed to be adjustable from crisp solid-state transparency to an exaggerated caricature of tube amp warmth. In between these extremes, you'll find tonal coloring options than you've never had before and sounds that mimic every tube amp you ever heard. This circuit is so versatile that you may use it in place of compressors, limiters and sustainers even though, technically, it is none of these.

DESIGN ANALYSIS (See schematic Fig 2, pg 3.)

Power from the 12 VAC transformer is positive half-wave rectified by D1 and filtered by C1, C2 and R1 for a +15V supply rail. A -15V supply is provided by D2, C3, C4 and R3.

Most tube circuits operate at high voltages, frequently hundreds of Volts, and components for these voltages can be expensive and difficult to find. But we get a little break here because the trick that we use to make a tube really SOUND LIKE a tube is to "starve" it with low plate voltage.

Even the 45 Volts used in the TubeHead is higher than you typically find in solid state circuitry. Rather than use an exotic multiwinding power transformer, the tube's plate supply is produced by a voltage multiplier. As shown in the schematic, fig 8; C7, R4 and R5 together with three of the six inverters in IC1 form a 60 kHz., 15V p-p square wave oscillator. The remaining three buffers in IC1 are wired in parallel to provide greater output current to drive the network of diodes (D4-D8) and capacitors (C5, C6, C8-C10) that multiply the 15V square wave up to 45VDC.

You will quickly notice that the two channel Tubehead clearly consists of two identical preamp/tube/final amp sections. We'll talk about the channel built around V1 and IC2, but everything said about this section applies to the V2, IC3 section as well.

The signal path begins with an adjustable gain stage built around one of the two low noise OpAmps in a 5532 (IC2:A). Input signals are capacitively coupled by C17 and appear across R26. When the DRIVE control R15 is fully CCW the ratio of R12 to R21 sets the minimum voltage gain to 1/2 (a 2:1 attenuation). At the CW end, the ratio of R15 to R7 (more or less) sets the maximum voltage gain to 25. Capacitor C14 rolls off the high frequency response at a corner frequency of about 30 kHz. An OpAmp wired as a comparator (IC4:A) turns on LED D9 when the output of the gain stage approaches its clipping point.

The output of the gain stage is coupled by R19 and C18 to R27, the grid resistor of the first tube stage. Two tube stages are used to optimize the symmetry of the output waveform. A single tube stage would compress the tops of waveforms, but leave the bottoms unchanged. With two stages, the first can squeeze the top of the signal, invert it and send it to the second stage to squeeze what was originally the bottom.

Both tube stages are contained within V2, a 12AX7 Dual Triode. The output of the first tube stage appears across the plate load resistor R10 and is coupled by R14 and C15 to the SYMMETRY trimmer R23, which sets the amount of signal applied to the grid of the second stage. The output of the second stage appears across plate load resistor R11.

A final output buffer stage built around OpAmp IC2:B converts the relatively high impedance output of the tubes to a more reasonable lower impedance consistent with contemporary audio processing gear. It's operation is very similar to that of the circuitry around IC2:A.

IC2:B also provides for mixing the dry signal (pre-tube) with post-tube processed signal using the BLEND pot R20. At the CW end of the rotation of the BLEND pot, the final amplifier is fed exclusively with the output of the tube. At the CCW end, it's fed by the buffered input signal from the first gain stage. At intermediate settings of R20 a mix of the dry signal and the tube output drive the final buffer. The relative values of R37 and R61 compensate for the addition gain of the tubes so that overall level is fairly constant as BLEND is varied from "pre" to "post".

TubeHead kit from PAiA

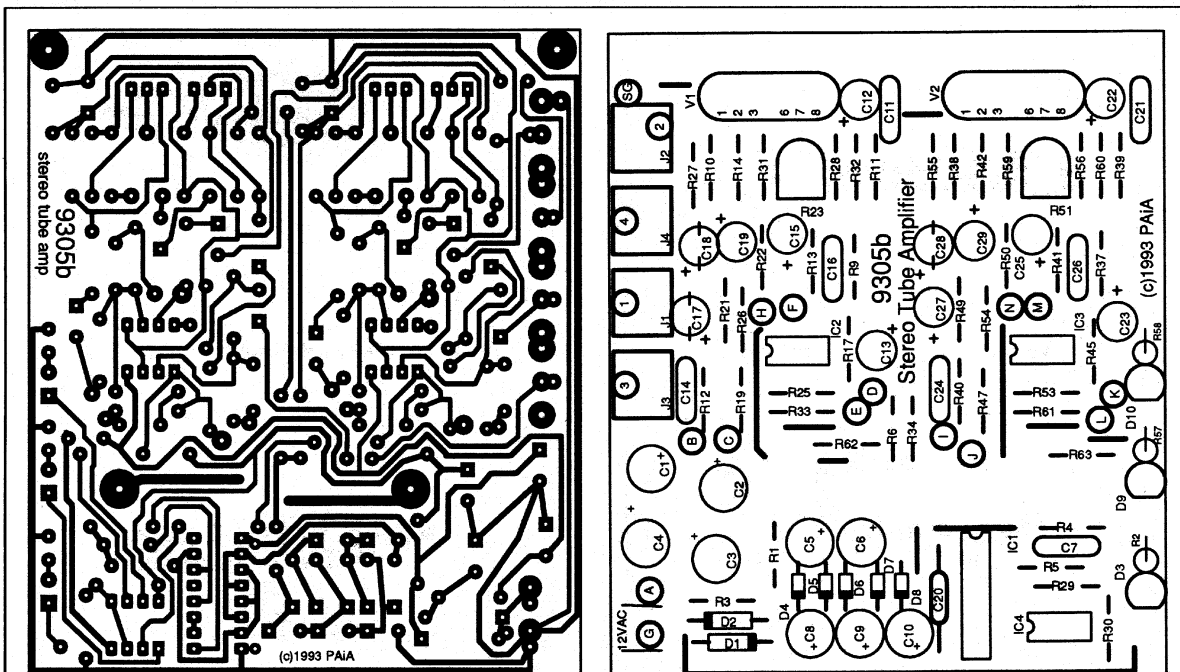
The TubeHead is particularly useful with Microphones and Synths as well as Samplers, DAT, CDs and other digital sound sources. It's a natural complement to our Dual Phantom Powered Pre-amp (#9215K) for condenser microphones.

The PAiA kit comes with two Sovtek 12AX7 vacuum tubes, shielded porcelain sockets and all electronic and mechanical parts, including the fully enclosed rack case, as listed in the "Parts Required" list. The well illustrated, step-by-step Assembly and Using Manual written by John Simonton may be ordered separately for evaluation.

<http://www.paia.com/tubestuff.asp>

I-9305..TubeHead Assembly/Using manual..... \$15.00

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The full size bottom foil and parts legending shown above is (c) 1994 by PAiA. You may reproduce this circuit board for your personal, non-commercial use only.

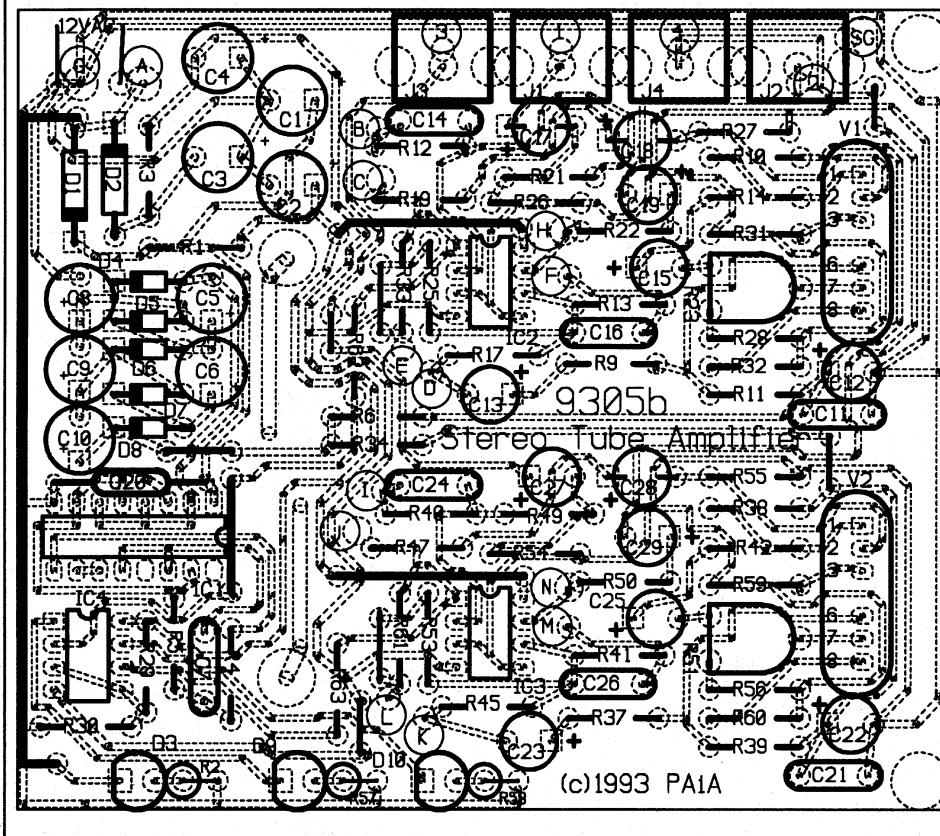


Fig 1. This view of the circuit board with phantom traces will be useful if you need to trace out the circuit.

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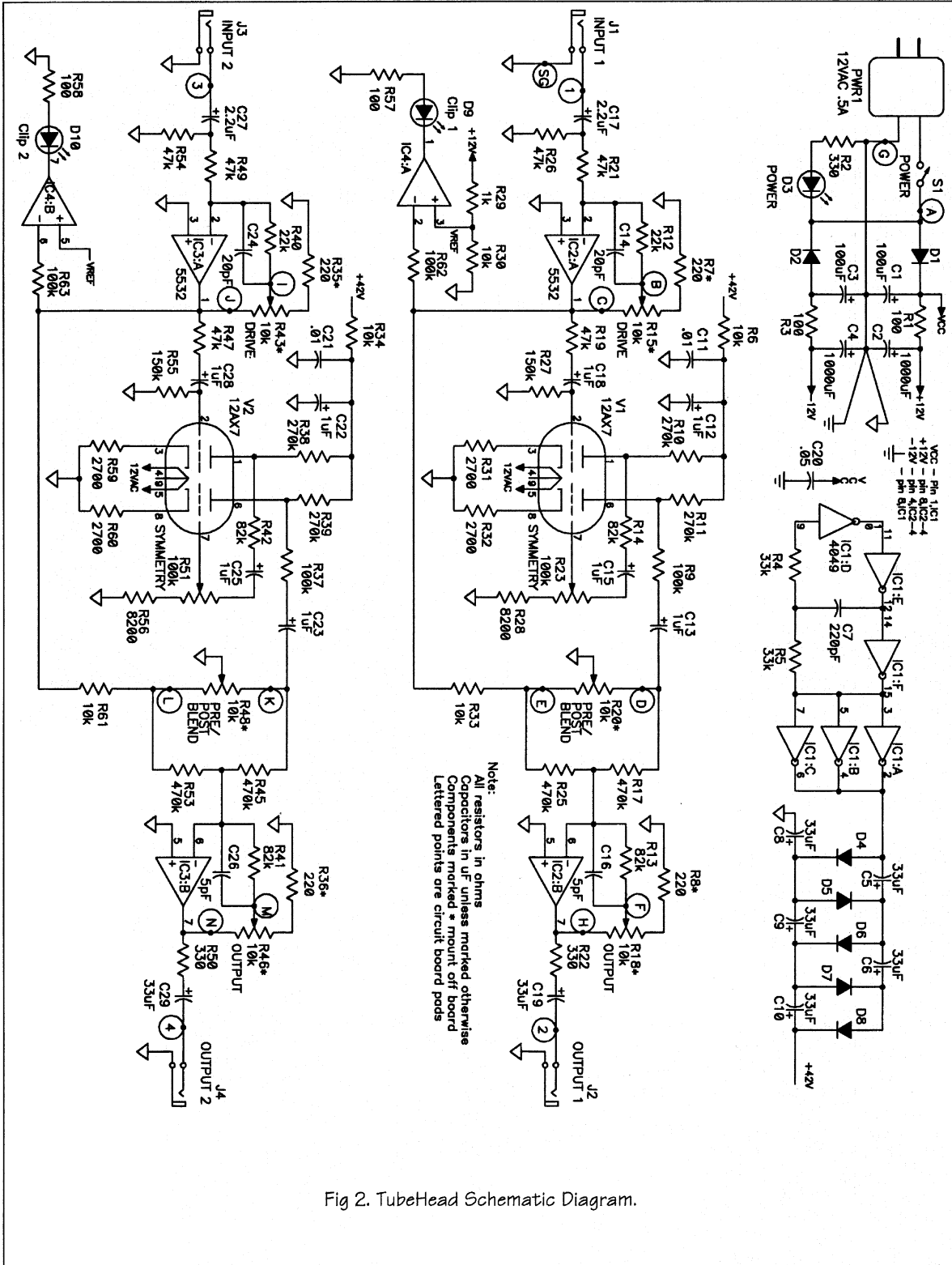


Fig 2. TubeHead Schematic Diagram.

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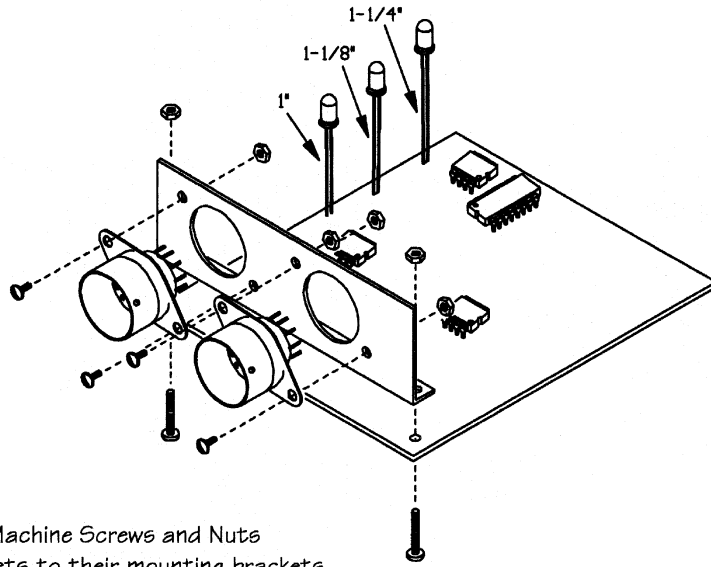


Fig 3. Four #4 X 1/4" Machine Screws and Nuts attach the tube sockets to their mounting brackets. After wires from the tube sockets to the circuit board are in place, the bracket is temporarily screwed to the circuit board with the same #4 X 1/2" screws and nuts which will later hold the assembly in the case.

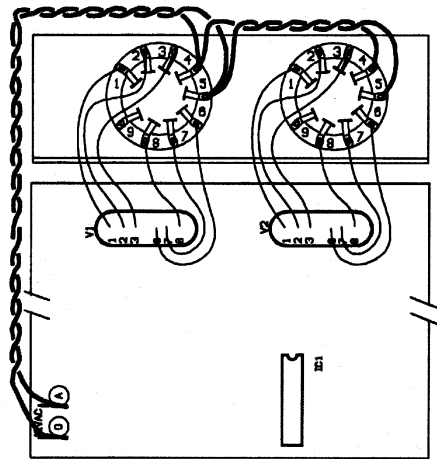


Fig 4. The wires that carry power to the tube filaments are twisted together to reduce magnetic fields. The insulated sleeving used on the other wires is not shown here.

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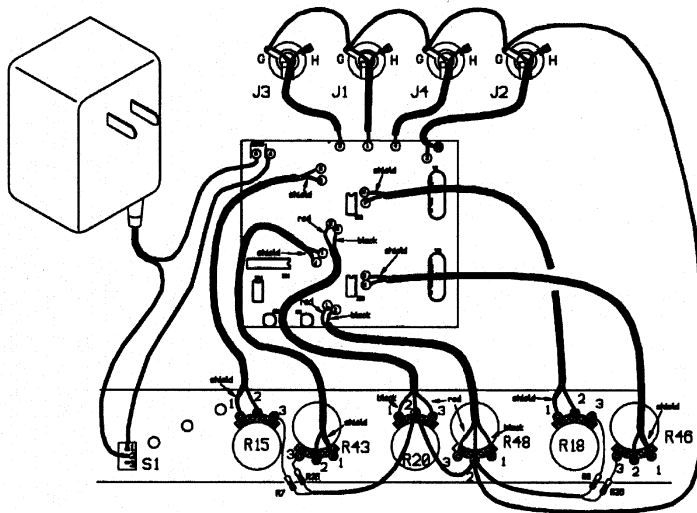


Fig 5. Single strand insulated wire, co-ax and twin-ax connect the TubeHead circuit board to controls and Jacks. Wire lengths have been exaggerated for clarity.

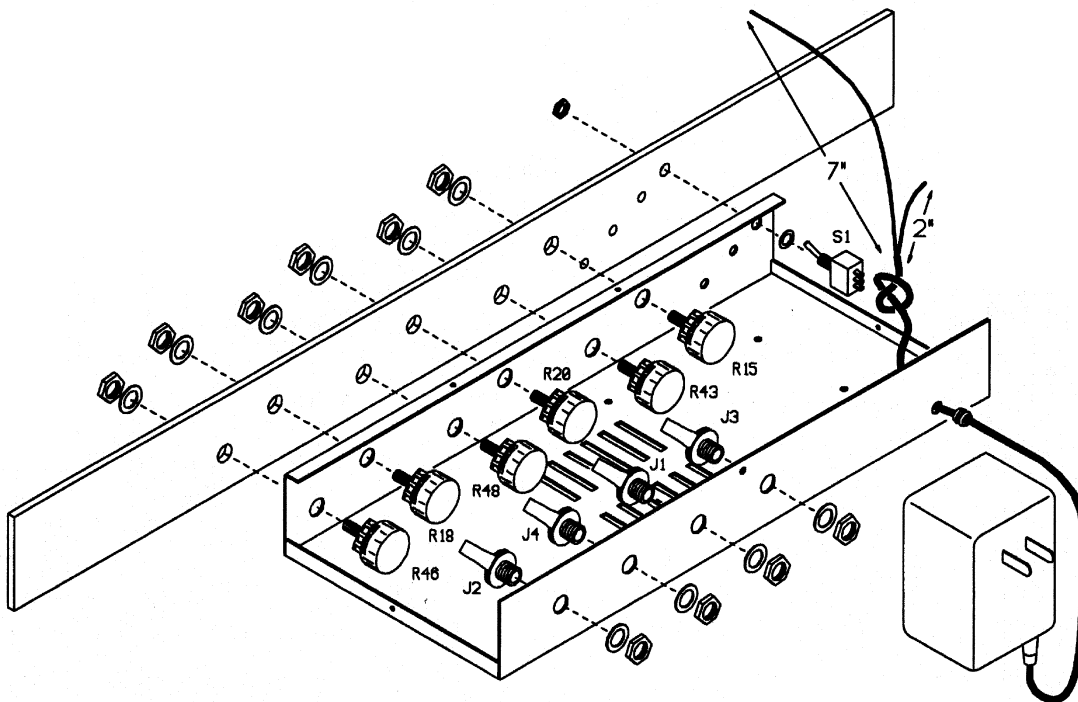
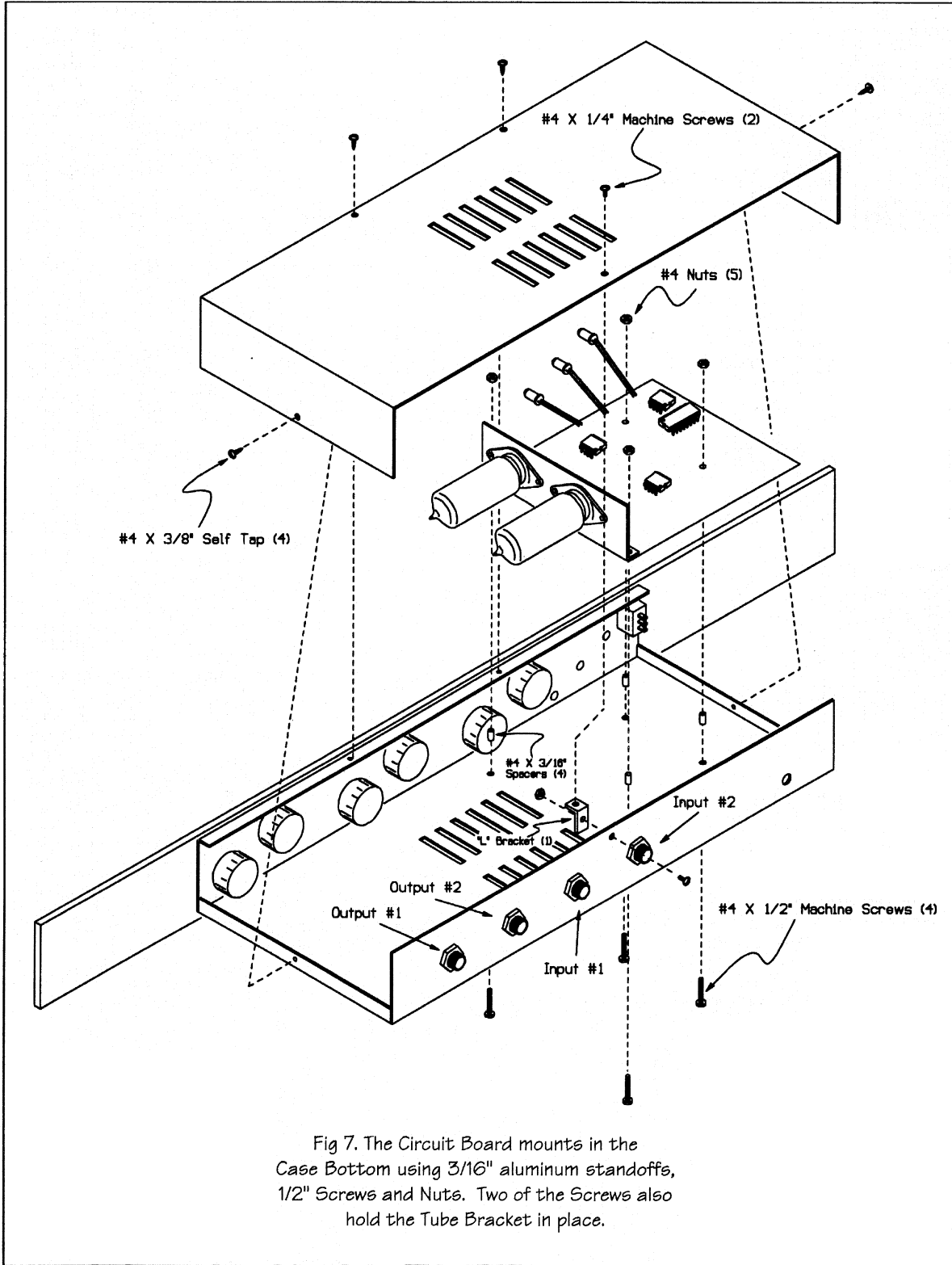
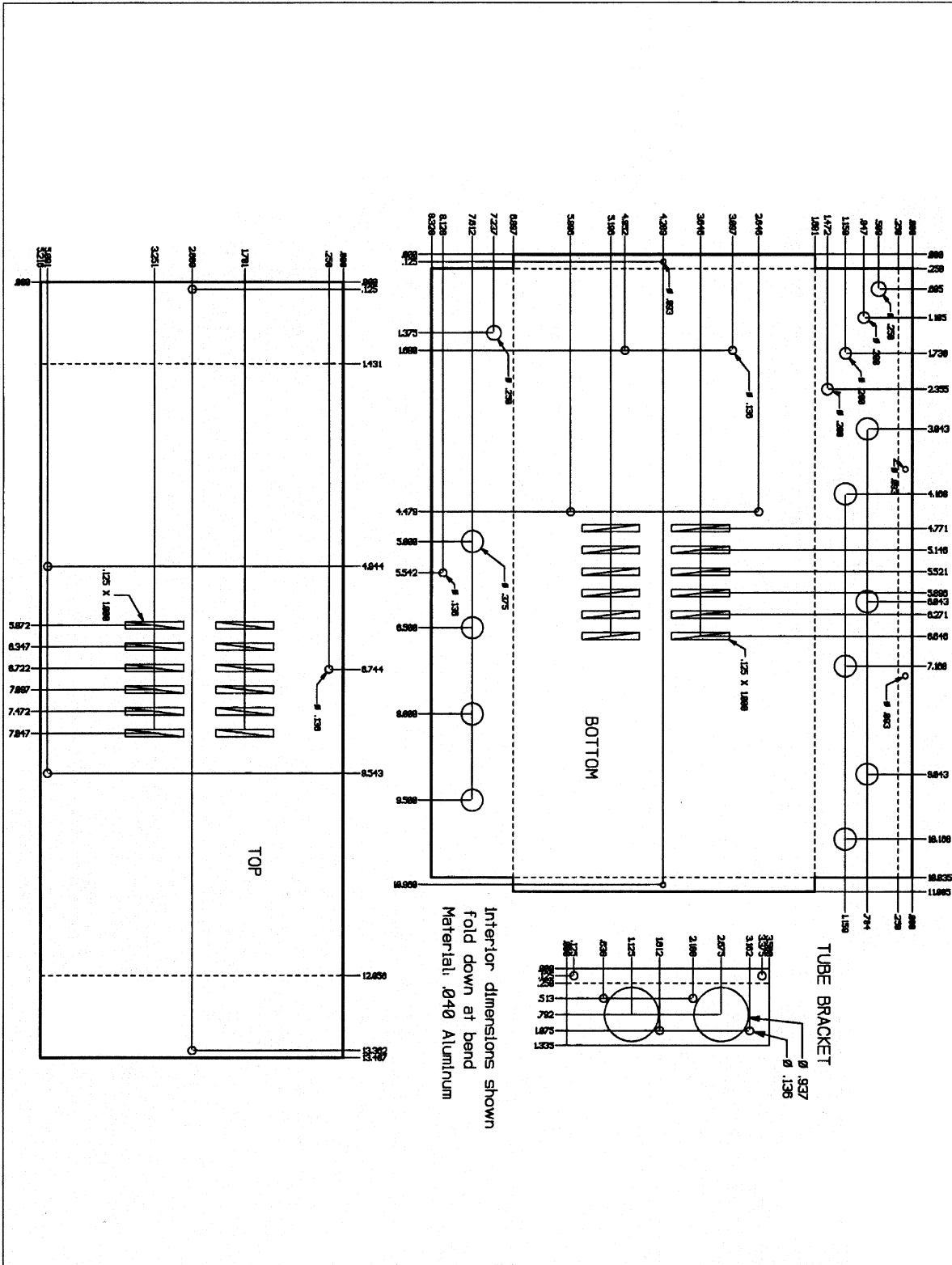


Fig 6. The only hardware that attaches the case to the rack panel is the threaded bushings of the pots and power switch. Wiring which is already connected when the Case and Panel are joined is not shown for clarity.

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TubeHead Parts Required

- 2 .01 Ceramic Disk Capacitor
- 1 .05 " " " "
- 2 20pF " " " "
- 1 220pF " " " "
- 2 5pF " " " "

- 2 100uF / 25V Electrolytic Capacitor
- 2 1000 / 16V " " " "
- 8 1uF / 50V " " " "
- 2 2.2uF/25V " " " "
- 7 33uF / 25V " " " "

- 5 1N4148 Signal Diodes
- 2 1N4001 Power Diodes
- 3 Red LED
- 1 4049 CMOS Hex Inverting Buffer
- 3 5532 Dual Low-Noise OpAmp
- 4 1/4" O.C. Phone jack
- 2 100k Horizontal Trimmer Pot
- 6 10k Panel Mount Potentiometer

- 4 100 ohm all fixed resistors are
- 4 100k 1/4W, 5%, values in ohms
- 5 10k
- 2 150k
- 1 1k
- 4 220
- 2 22k
- 4 2700
- 4 270k
- 3 330
- 2 33k
- 4 470k
- 6 47k
- 2 8200
- 4 82k

- 1 SPST Toggle Switch
- 1 12V 500mA AC Transformer
- 2 12AX7
- 2 9 Pin Tube Sockets
- 6 Set Screw Knobs
- 1 9305 Circuit Board
- 1 Tube Mounting Bracket
- 2 4-40 X 1/2" Machine Screws
- 4 4-40 X 1/4" Machine Screws
- 6 #4 machine nuts

- 48" #22 stranded wire
- 52" RG-174/U co-ax
- 14" Twin-axial cable
- 42" Bare Wire
- 18" Small Insulated Sleeving

TubeHead Rack Case Parts Required

- 1 Rack panel
- 1 case top
- 1 case bottom
- 4 3/16" spacers
- 2 4-40 X 1/2" Machine Screws
- 2 4-40 X 1/4" Machine Screws
- 3 #4 X 1/4" machine nuts
- 1 "L" Bracket
- 4 #4 X 1/4" Self Tap screws
- 1 1/4" Rubber Grommet

