

T-300
SERIES
HAMMOND ORGAN
WITH
RHYTHM RAIL



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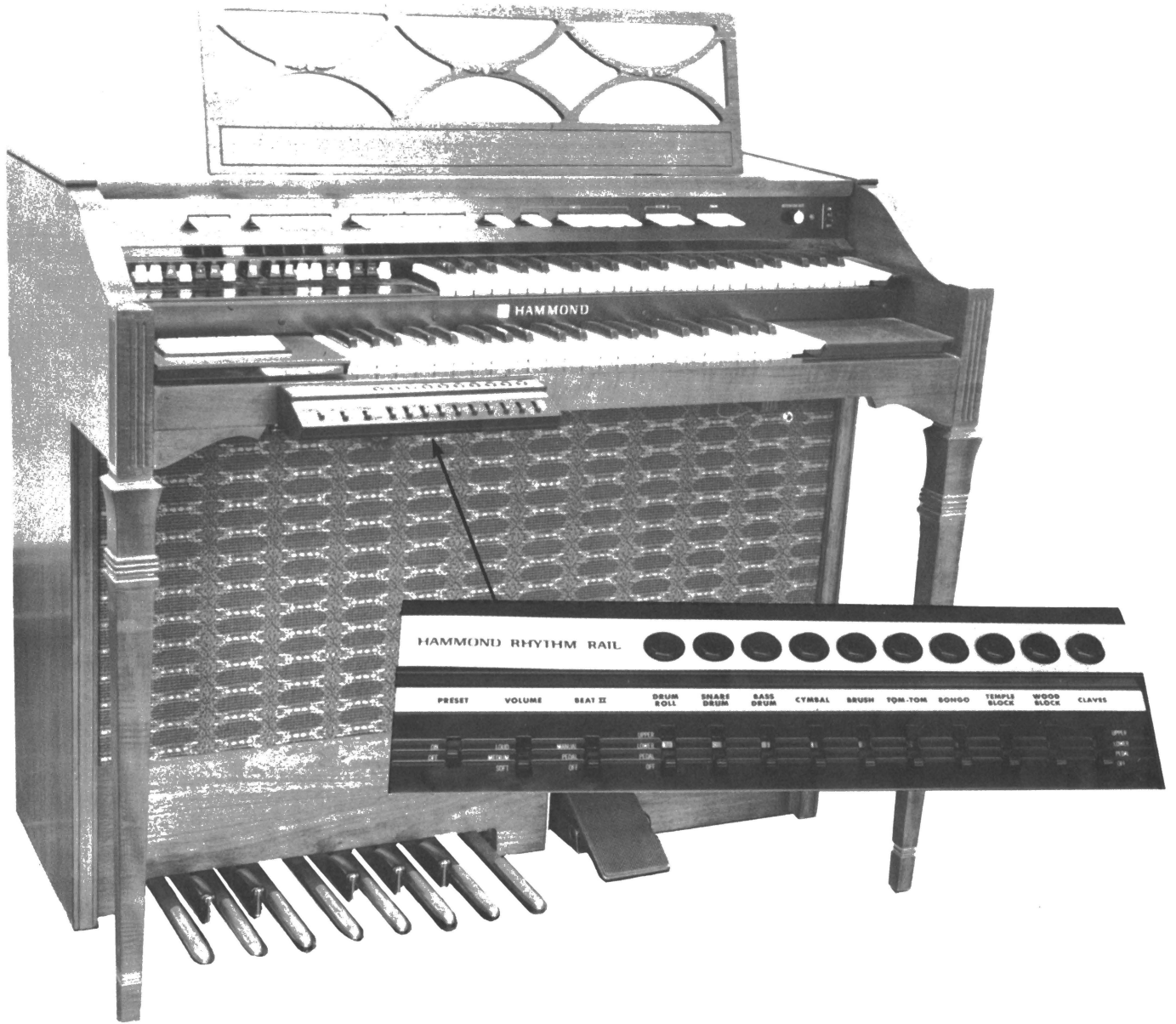


FIGURE 1 - TYPICAL T-300 WITH RHYTHM RAIL

GENERAL DESCRIPTION T-300

The T-300 series Hammond Organ is essentially a T-200 series instrument with the Rhythm Rail and its associated circuitry added. The Brush and Cymbal tabs have been omitted. These effects are included in the Rhythm Rail. For service information not included herein, refer to the T-100, T-200 series manual.

The Rhythm Rail is mounted on the front rail of the console in a left-of-center position. Fastenings are provided which permit the unit to swing down and lock under the lower manual for shipment or concealment when not in use.

The electronic portions of the Rhythm unit are mounted within the console, and consist of the power supply (127-000007), rhythm unit detector (124-000024), and rhythm unit voice boards (124-000023).

Ten voices appear on the Rhythm Rail. They are from left to right:

- | | |
|---------------|-----------------|
| 1. Drum Roll | 6. Tom Tom |
| 2. Snare Drum | 7. Bongo |
| 3. Bass Drum | 8. Temple Block |
| 4. Cymbal | 9. Wood Block |
| 5. Brush | 10. Claves. |

The ten (10) voices are playable from their respective push buttons at any time. They can also be programmed into the upper manual, lower manual, or pedals, by means of a 4-position slider switch associated with each voice and a "Preset" switch at the extreme left of the Rhythm Rail. Moving the "Preset" switch to the "Off" position cancels the programming.

A variation in programming is provided by the BEAT II feature.

When the BEAT II switch is in the Manual position, and Preset switch is on, voices selected for the upper manual are triggered by the first depressed key of the lower manual. Subsequently depressed keys of the lower manual trigger the voice (s) selected for the lower manual.

When the BEAT II switch is in the Pedal position and Preset switch is On, voices selected for upper manual, except Drum Roll, are triggered by release of a Bass pedal, while Drum Roll and voices selected for Pedal are triggered by depressing a Bass pedal.

A three position slider switch regulates the loudness of the Rhythm Rail voices relative to the organ. The expression pedal also affects the Rhythm Rail.

THEORY OF CIRCUIT OPERATION (Refer to Figure 4)

1. POWER SUPPLY CIRCUIT - power supply components are located in the power supply chassis assembly (127-7 thru -9). All necessary DC supply voltages for the rhythm unit are supplied by this chassis. The voltages are 30 V DC, 15 V DC, and 5.5 V DC.

120 V AC 50/60 Hz is supplied to the power transformer from an external source. The secondary AC voltage is 40 V AC, which is then rectified by the full wave bridge of diodes D100, D101, D102 and D103. This DC voltage is then filtered by the combination of R101, R103, C100A, C101 and applied across the

30 V DC Zener diode D104. The 30 V DC is the supply voltage for the amplifier stages Q207, Q208 and Q209 on voice PWB & Q420 on detector (124-24) & the reference voltage for the 15 V DC & the 5.5 V DC supplies. The 30 V DC is supplied to the voltage divider of R107 & R108 and fed to the voltage regulators Q100 & Q102, the output of which is the 15 V DC which is used to supply all other circuits on the rhythm device.

The 30 V DC is also supplied to the voltage divider R106 & R105, and fed to the emitter follower Q101, the emitter output of which is 5.5 V DC and is the bias supply for the threshold detector circuits Q416 & Q414. Q101 is used as a voltage regulator and in conjunction with C100B provides the filtering for the 5.5 V DC.

2. PUSH BUTTON CIRCUIT OPERATION - One side of each push button (except drum roll) is connected thru R501, 2.2 K ohm resistor to the 15 V DC supply in the switch assembly. The 15 V DC is available to the push button at all times and, if these are depressed at any time, that particular voice will be seen at the output. If any of the push buttons of the Snare Drum, Bass Drum, Tom-Tom, Bongo, Temple Block, Wood Block and Claves is depressed, that button applies 15 V DC to the base input of a phase shift oscillator.

As an example, if the Temple Block push button is depressed, 15 V DC is applied to the junction of R247 and capacitor C228. This signal is differentiated by C228 and the resulting pulse is fed thru D202 and R282 to the base of Q202 turning it on. This signal is fed back to the base, inverted by the phase shift network C206, C207, C208, R227 and R226 and will be regenerative for a period of time determined by R247, C228 and R269. The decay-time of the collector output depends upon the values of C216, R282 & R256. The output is coupled through capacitor C209, resistor R305 & capacitor C251 to the base of amplifier stage Q207 and after amplification by Q207 & Q208, it is connected to the volume control contained in the switch assembly. Snare Drum, Bass Drum, Wood Block, Claves, Bongo and Tom-Tom are similar in operation. The frequencies of the oscillators are determined by the values of the components in the phase shift network.

3. When the Snare Drum push button is depressed, 15 V DC is also supplied through an 8.2 K resistor, R406 to the junction of R433 & C417, located on the detector board assembly. This pulse, dependent on the charge time of C417, applies base bias to gated amplifier stage Q408 which allows white noise coupled through C411 from noise source Q428 to appear on the collector of Q408 and is fed through C400, R478, C433 and C405 to the base of hiss amplifier Q420, is amplified and routed to switch assembly volume control, top of resistor divider network R505, R506 & R507. This signal is then routed through expression pedal matching network R271, R218, C234, C239 and through C233 to the base of amplifier Q209, is amplified and would then be routed to an appropriate input point on a completed console. When the Cymbal push button is depressed, +15 V DC is supplied to junction of R447 and C431 through D408 and R479 and to the base of Cymbal Gate transistor, Q410. This base bias turns "ON" Q410 and allows white noise from Q428 to appear on the collector, tuned by C412 and L401, and is routed through C404 and output level control R490 through R448 and once again to hiss amplifier, Q420.

When the Brush push button is depressed, +15 V DC is supplied to the junction of R434 and C413, and this supplies bias through D406 to the base of Q406,

turning "ON" the one shot multi-vibrator stage, Q406 and Q407 for one complete cycle. The Brush Gate transistor Q409 is turned "ON" for a period determined by C430 and R474 of the multi-vibrator stage. This applies positive bias through R465, D407, R477 to base of Q409, turning on Q409 and allowing white noise to appear on collector of Q409, tuned by C408 and L400 and this signal is then routed through C403 and output level control R491 and R458 to hiss amplifier Q420. When the Drum Roll push button is depressed, the base of Q423 (located on detector board assembly) is grounded through 100K resistor R443. This turns "ON" PNP transistor Q423 and supplies + 15 V DC through D402, R411 to Q404 of the multi-vibrator stage Q404 and Q405. The multi-vibrator then oscillates at the rate of approximately 17 times per second. The collector of Q405 is connected through R464 to the base of Q424. Q424 inverts the repetitive signal and on the collector of Q424 is a repetitive pulse (square wave) which goes from 0 to + 15 V at the rate of the multi-vibrator. This repetitive signal is routed through D400, R487, D401, R482 to base of Q408. This turns "ON" the Snare Drum hiss gate at the repetitive rate. The repetitive signal is also routed to the base of Snare Drum thump oscillator, located on the voice board, thru D206 and R278. This turns on the oscillator Q206 at the repetitive rate. Thus the pressing on the Drum Roll push button turns on the Snare Drum hiss gate and Thump oscillator at the repetitive rate of the multi-vibrator output which gives the "Drum Roll" signals at the output amplifiers Q420 & Q208.

3. UPPER MANUAL KEYING CIRCUITS (DETECTOR P. W. B.) - In a console assembly the emitter of Q418 PNP transistor is connected to the manual buss line supply voltage while the base is connected through resistor R454 to the buss itself. On each manual key contact is wired a 200K resistor of which one side is connected to ground. With no keys depressed, switching transistor, Q418 is in the "OFF" condition, since the base voltage is the same as the emitter voltage. When a key is depressed, a 220K resistor is connected from the buss side of the isolation resistor to ground, effectively lowering the buss voltage approximately 20%. This lowers the base voltage on Q418 and transistor Q418 switches to the "ON" condition thus making the voltage on collector equal to the buss supply voltage. This voltage is routed to the junction of R439 and R481 and to the base of NPN Q419 which, with no key depressed, had been in the "OFF" condition. Now with a key depressed, the base of Q419 is made slightly positive with respect to the emitter and transistor Q419 switches to the "ON" condition. In the "ON" condition, the collector of Q419 is at ground potential. The collector signal is routed to the Drum Roll switch (switch assembly) upper manual position. The wiper of the Drum Roll slide switch is connected to the preset switch, and then to resistor R443 and to the base of transistor switching circuit Q423. If the "Preset" switch is in the "ON" position and Drum Roll Slide switch is in the "UPPER" position, depressing an upper manual key, which causes the collector of Q419 to change from +15 V DC to ground potential (upper roll trigger pulse) and this change now being routed through the switches will cause the multi-vibrator stage to turn "ON" and the Drum Roll circuitry will then function as previously outlined (Drum Roll push button).

In addition, the upper manual buss line is connected through C426 to the base of Q417 which is a pulse amplifier stage. Resistor R468 provides base bias to the stage so that with no keys depressed, the collector is at approximately 4.5 V DC. C426 and R432 is a differentiating network that puts a pulse on the base of Q417. This pulse is amplified by Q417 and instantaneously the collector of Q417 rises from 4.5 V DC to 11 V DC. This change is routed through R467 to the base of Q416, which at emitter voltage of 5.5 V and base bias of 4.5 was "OFF", and with 11 V DC now turns "ON" Q416, whose collector had been 15 V DC now changes to 5.5 V DC. This change is then coupled through C423 & R453 to the

base of Q427, a PNP which had been biased "OFF" through resistor R452 & R453. The change in base bias turns "ON" Q427 and the collector has an instantaneous output of + 15 V DC for about 2-milliseconds duration. This signal is routed through the BEAT II switch, then through the Preset Switch, and then to the common "UPPER" manual slide switch buss. Thus, if any of the wipers of voices other than Drum Roll slide switches are placed in the "UPPER" manual position, these voices would be triggered by the instantaneous + 15 V DC pulse in a similar manner as discussed previously in Section 2 (Push Button Operation). This trigger pulse is defined as the Upper Manual Legato Trigger Pulse.

4. LOWER MANUAL KEYING - Lower manual Drum Roll keying is accomplished in the identical manner as upper manual keying (3.) using the circuitry associated with Q411 and Q412. The lower manual Drum Roll Trigger Pulse (15 V DC to 0 V DC) is routed from the collector of Q412 to the Drum Roll slide switch lower manual position, and, if the wiper is placed in the lower manual position, and Preset switch on; upon depressing a key (220K to ground) switching transistor, Q423 will switch to the "ON" condition and the roll oscillator will operate as described in Section 3.

The collector signal of transistor, Q412 is also routed through C427 & R455 to the base of PNP transistor, Q425. Prior to depressing a manual key, Q425 is biased to the "OFF" condition by R450 & R455. When a key is depressed, Q412 turns "ON" and the bias on the base of Q425 momentarily decreased to zero volts through the path of R455, R450 & C427 & Q412. This turns "ON" PNP Q425 & on its collector appears a 0 to +15 V DC square pulse whose time period is dependent upon C427, R450 & R455. This instantaneous pulse is defined as the Lower Manual Touch Response Pulse, and it is routed to the manual BEAT II slide switch, the function of which is explained later in this section.

Lower manual legato keying pulse is obtained in the identical manner as described in 3. by the circuitry associated with Q413, Q414 & Q426. The collector signal of Q426 is routed through the preset switch and to the lower manual common buss connector at the slide switch assembly. Thus, whenever any voice-wiper of a slide switch is in the lower manual position depressing a lower manual key causes the collector of Q426 to have an instantaneous 0 to +15 V DC pulse which triggers the appropriate voice in a similar manner as described in 2.

5. MANUAL BEAT II CIRCUITS THEORY OF OPERATION - With BEAT II switch in the "OFF" position, lower manual legato keying is accomplished as described in 4., however, as noted previously, depressing a lower manual key also produces an instantaneous lower manual touch response pulse on collector of Q425 which is routed to the BEAT II switch. In the "OFF" and "PEDAL" position of this switch, the signal is not used and thus is left as an open circuit in the switch. When the switch is placed into the Manual position, this signal is routed to two different circuits. It is routed through the preset switch to the Upper Manual slide switch common buss and, if a voice wiper (except Drum Roll) were placed in the upper position and a key depressed, that voice would be triggered by the Lower Manual Touch Response Pulse produced at the collector of Q425. At the same time, the touch response pulse is routed through D410 & R470 to the base of inhibit transistor stage Q415. With 5.5 V DC on its emitter and 4.5 V DC on the base of Q414, Q415 is in the "OFF" condition. The touch response pulse turns "ON" Q415 and keeps the base bias voltage low enough on Q414 so that it cannot be turned "ON" by Q413. Thus depressing the first

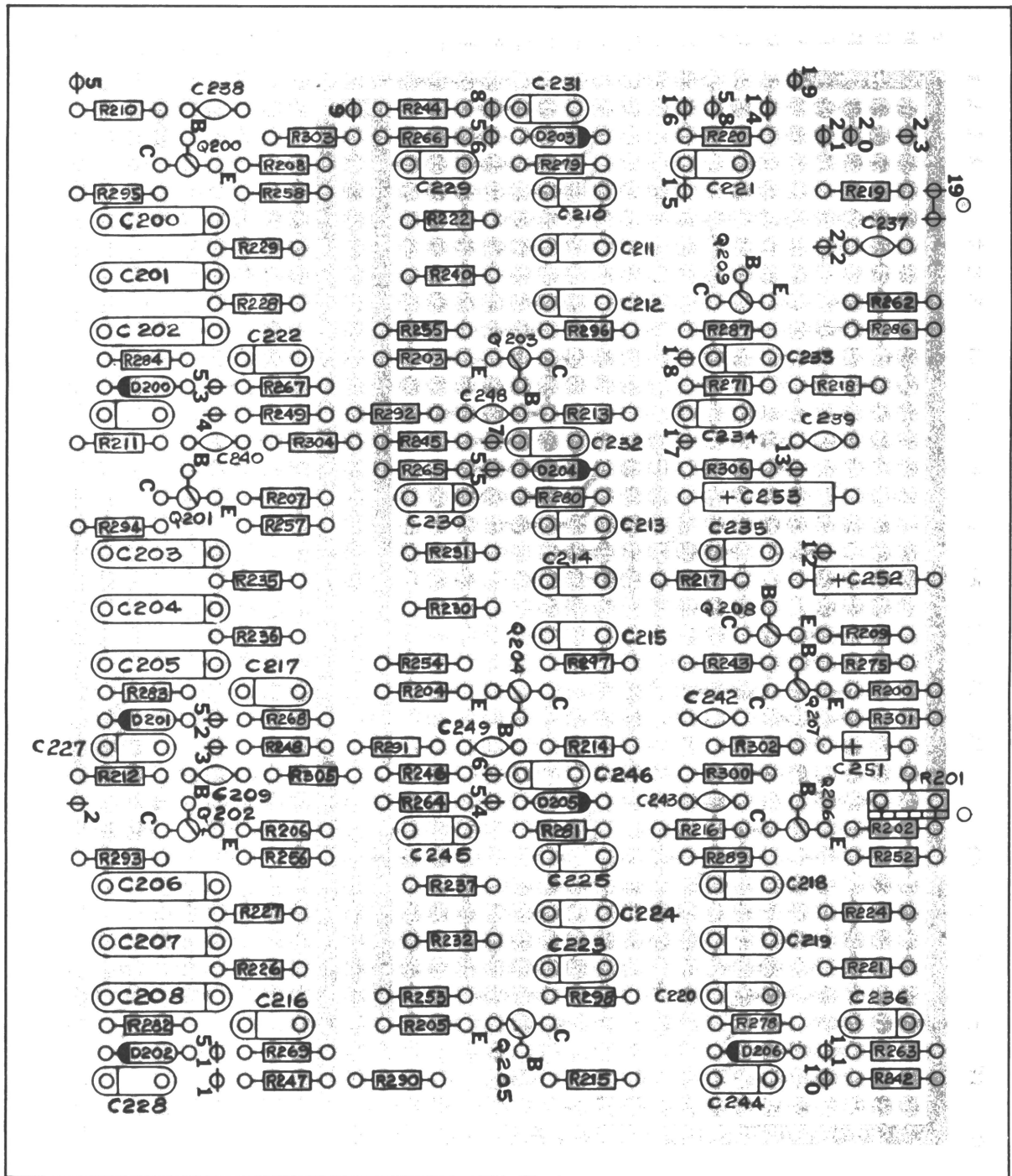
lower manual key would trigger a voice programmed for the upper manual and "inhibit" the lower manual legato pulse output at Q426 and not allow a lower manual voice to be triggered by this first closure. Since the base of Q425 is AC coupled and if the first key depressed is held down, no other lower manual touch response pulses are produced by Q425, and Q415 returns to the "OFF" condition. If other lower manual keys are then depressed (one must be down) the voice programmed for the lower manual will then be triggered normally as noted previously in 4.

6. PEDAL KEYING CIRCUITS THEORY OF OPERATION - In the T-100, T-200, and T-300 series instruments, the pedal keying signal used to trigger the pedal circuits in the rhythm unit is a DC voltage change of from +15 V DC to 0 V DC as a pedal is depressed. Point "A" is connected to "D" and point "C" to "G" for a positive going pulse (0 to 6 V DC) and the input is connected to point "F". The signal is fed through R459 to the base of Q402 which is in the "OFF" condition with no pedal pressed and its collector is at 15 V DC. When a pedal is pressed, the positive signal applied to the base turns "ON" Q402 and the collector +15 V DC is reduced to V DC. This collector signal (Point "G") is routed to the Drum Roll slide switch and, if the wiper were in the PEDAL position, the Drum Roll multi-vibrator stage will be turned on as described in Section 2. previously.

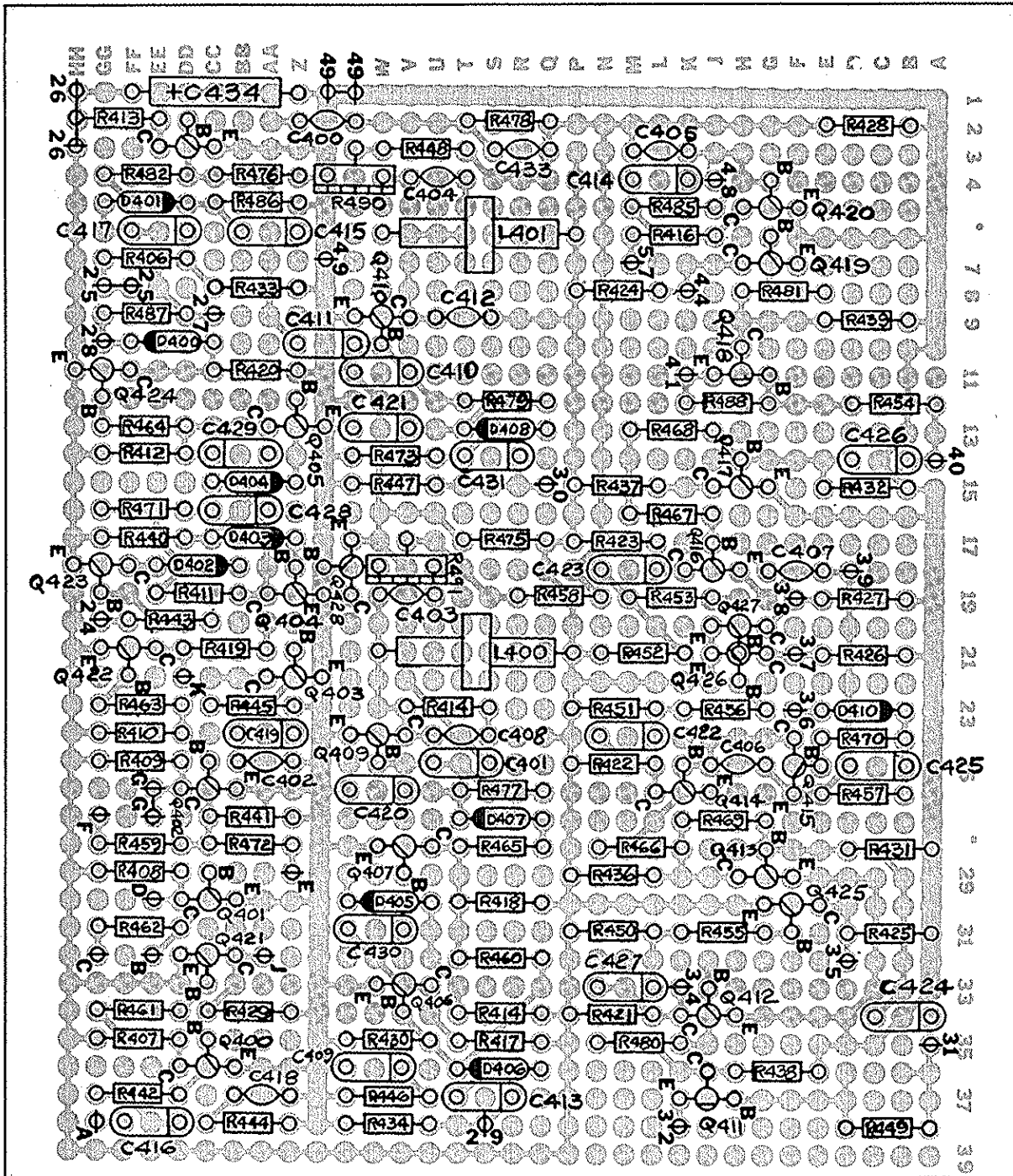
The collector signal of Q402 is also routed through C419 to the base of Q403 and through R462 to the base of Q401. Q401 which was kept in the "ON" condition by Q402 switches to the "OFF" condition and the collector rises to +15 V DC. This signal on the collector of Q401 is then routed through C416 & R442 to the base of Q400. Q400 which is normally "OFF", is turned "ON" and its collector voltage decreases to zero volts. The collector signal of Q400 is then fed to base of PNP Q421 turning it "ON" and its collector switches to 15 V DC. This 15 V DC pulse on the collector of Q421 is designated as the Pedal-Down Pulse and is routed through the preset switch to the pedal common buss in the slide switch assembly. If a slide switch voice were in the "Pedal" position and the preset switch "ON", the voice would be triggered and output obtained as previously described in Section 2.

For the "T" series instruments point "A" is connected to "D" and to "F" with the negative going pedal input pulse connected to point "C" and operation then being identical as described above (+15 V to 0 V DC).

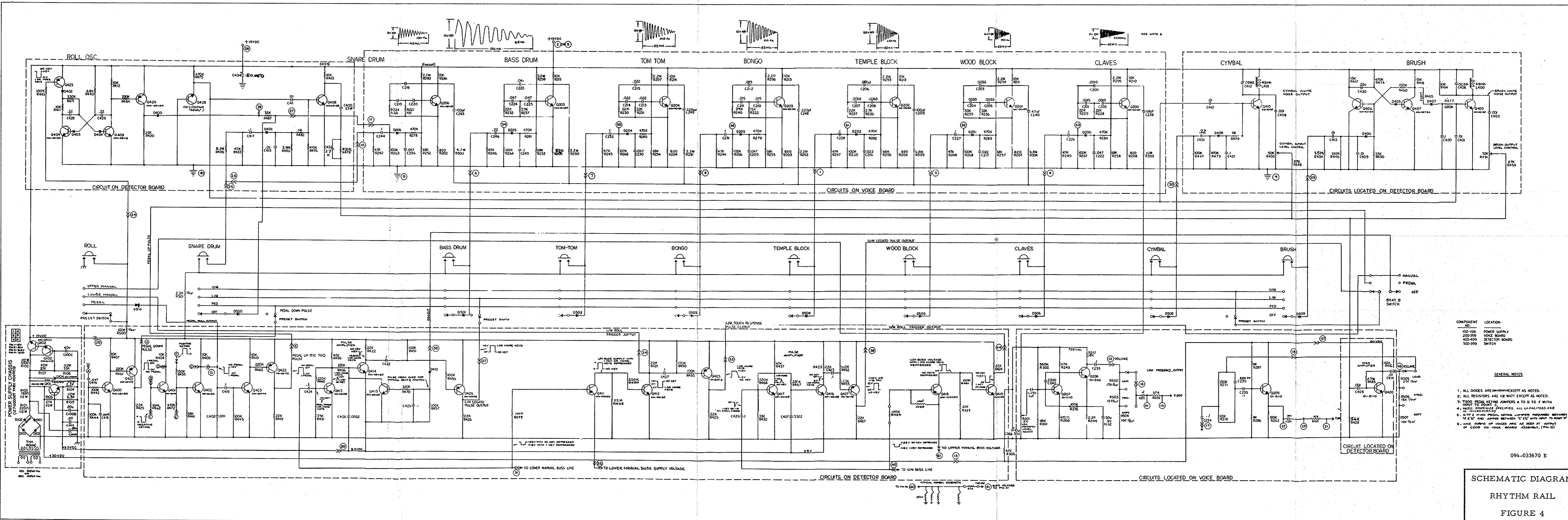
7. PEDAL BEAT II - As noted, the collector signal of Q402 is also routed through C419 to the base of Q403. The negative going signal is differentiated by C419 and Q403 remains in the "OFF" condition, however, upon release of a pedal, a positive going differentiated signal is produced by C419 which turns "ON" Q403 and instantaneously the collector switches from + 15 V DC to 0 V DC. This signal change is fed through R463 to the base of PNP Q422 which normally in the "OFF" condition is now turned "ON" and the collector changes from 0 V DC to + 15 V DC. This collector signal is designated as the Pedal-Up Pulse and is routed to BEAT II switch. When in "Pedal" position on the BEAT II switch, this signal is routed to the upper manual slide switch buss and, if a slide switch voice (other than Drum Roll) were programmed for the upper manual and another voice programmed for the "Pedal" position on a slide switch, the pedal "positioned" voice would be triggered by the signal on collector of Q421 during the depression of a pedal and the upper manual voice triggered on the release of a pedal by the signal on collector of Q422.



124-000023 VOICE BOARD
FIGURE 2



124-000024 DETECTOR BOARD
FIGURE 3

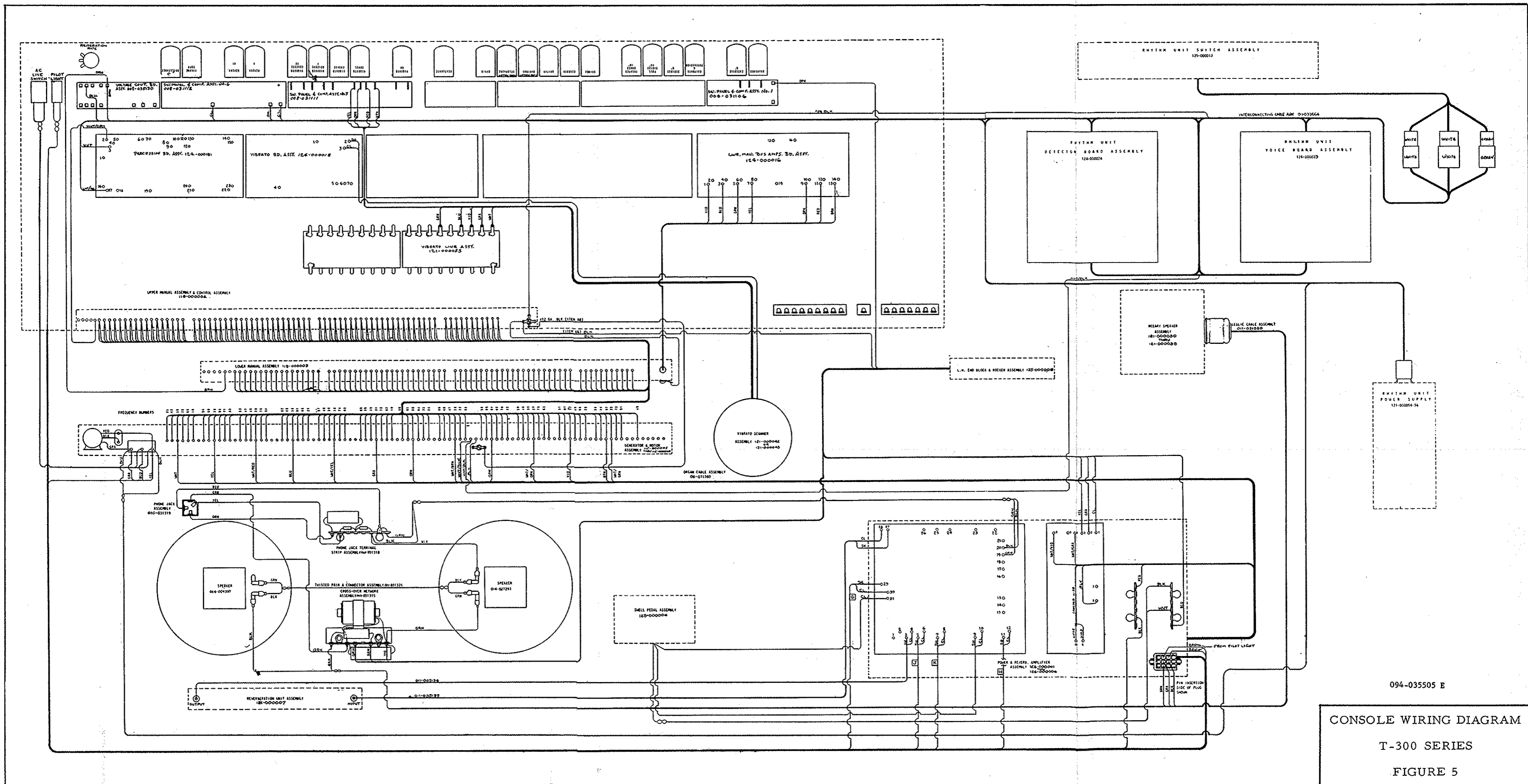


COMPONENT NO.	LOCATION
100-199	POWER SUPPLY
200-299	VOICE BOARD
400-499	DETECTOR BOARD
500-599	SWITCH

- GENERAL NOTES**
1. ALL DIODES ARE 0.1A EXCEPT AS NOTED.
 2. ALL RESISTORS ARE 1/2 WATT EXCEPT AS NOTED.
 3. TRUSS PEDAL KEYING JUMPS A TO D TO F WITH INPUT TO POINT.
 4. UNLESS OTHERWISE SPECIFIED ALL CAPACITORS ARE IN MICROFARADS.
 5. 1K77 & 1K100 PEDAL KEYING JUMPER REQUIRED BETWEEN 1K427 AND JUMPER BETWEEN 1K527 WITH INPUT TO POINT.
 6. WAVE FORMS OF VOICES ARE AS SHOWN AT OUTPUT OF Q200 ON VOICE BOARD ASSEMBLY (PH 12).

094-033670 B

SCHEMATIC DIAGRAM
RHYTHM RAIL
FIGURE 4



094-035505 E

CONSOLE WIRING DIAGRAM
T-300 SERIES
FIGURE 5