

## CTL Modular One Restoration Tasks

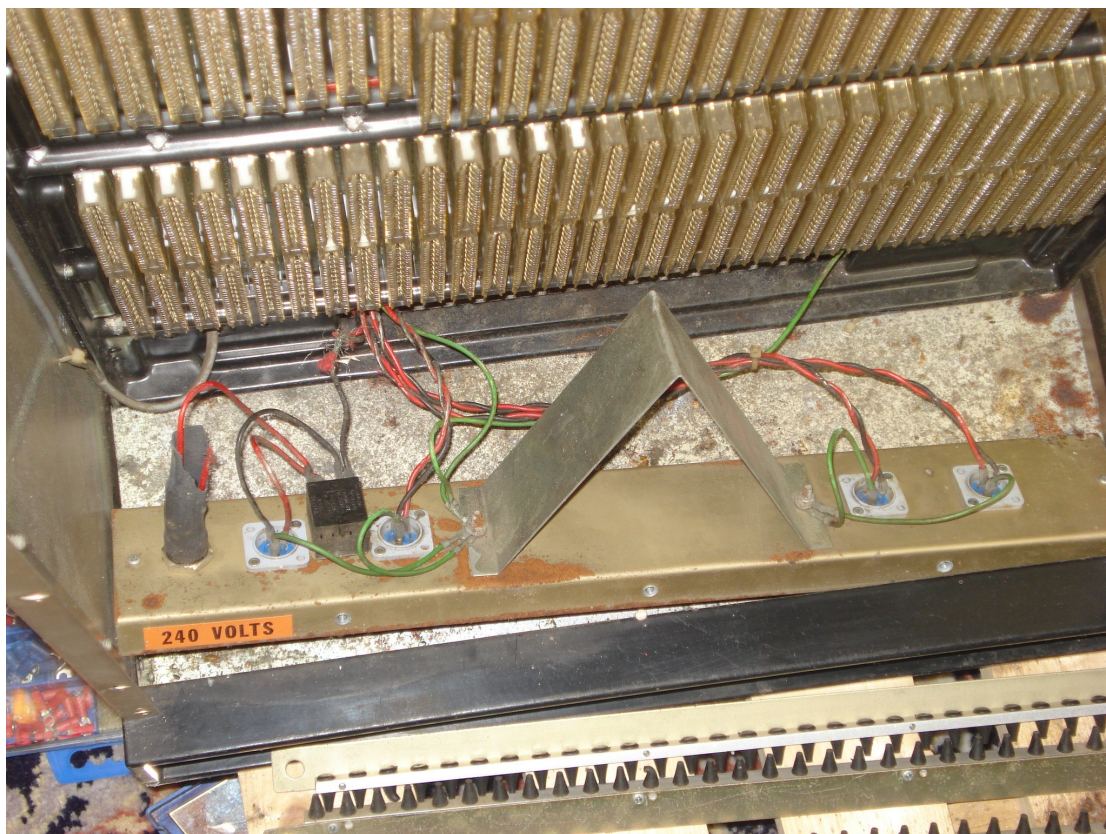
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### 1. Modular One

As a result of a detailed inspection the following issues were identified.

1. The mains power wiring in the base had been damaged by mice and would need replacing.
2. The main air filter had crumbled and fallen inside the machine.
3. The large Electrolytic capacitors in the power supply constituted a potential hazard as they had not been used for twenty years and could fail dramatically if they had deteriorated.

Task	Status
Check the manuals for a wiring diagram of the power tray in the base of the computer that was damaged by the mice.	None found
Produce a Wiring diagram from the existing power tray.	Complete
Rewire the power wiring in the base of the computer that was damaged by the mice.	Complete



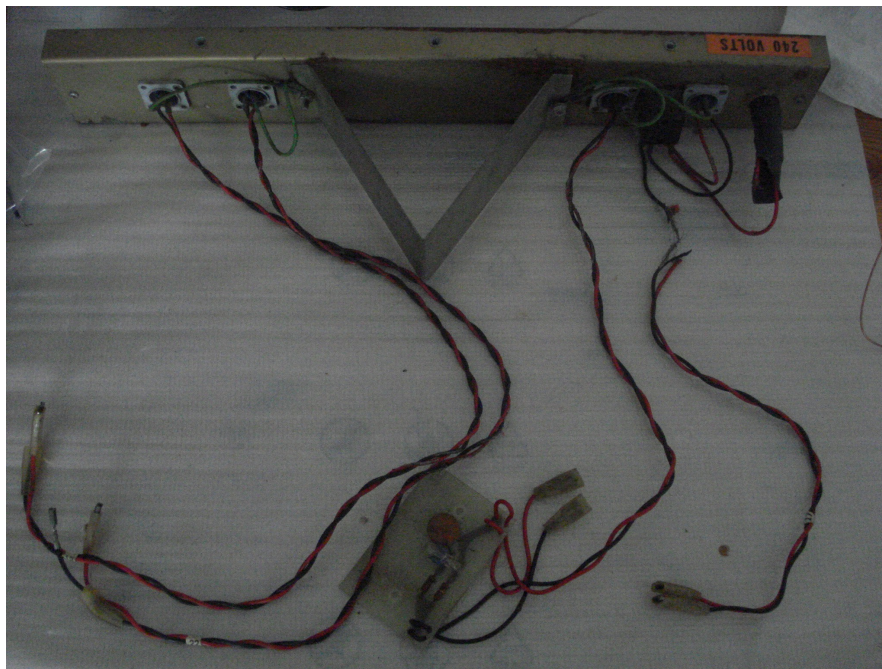
The lower power panel removed for rewiring.



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The full back plane with all the processor boards and power wiring removed.

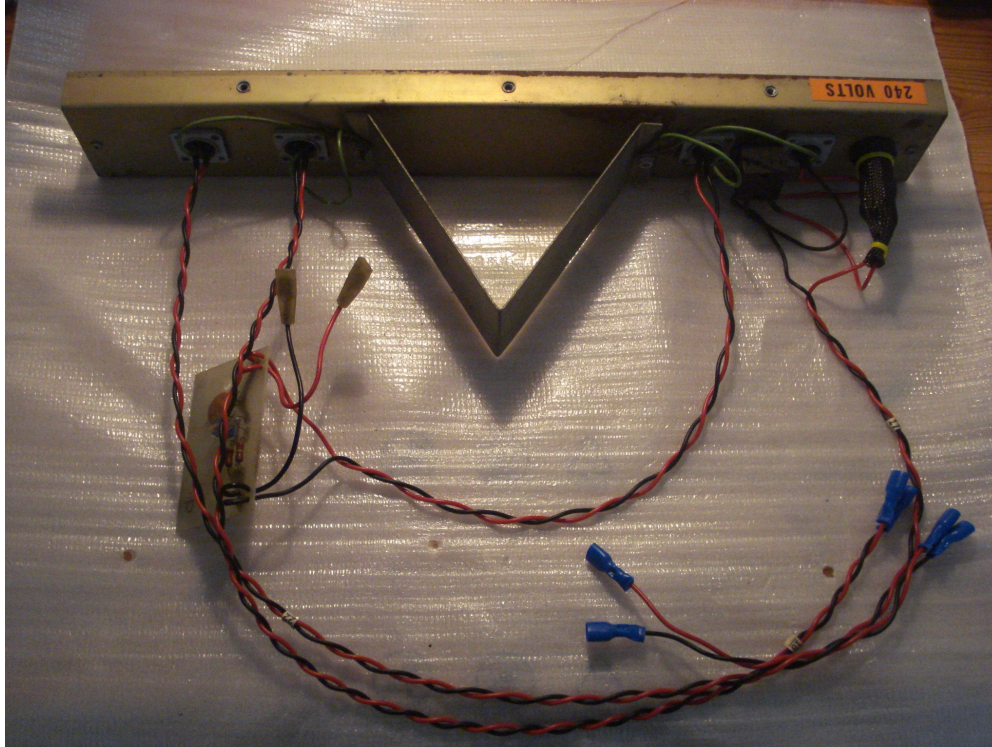


The power panel on the bench ready for re-wiring. The Modular one could be supplied with mains power locally through a mains cable or remotely via an auxiliary cable. The circuit board attached to the harness is fitted with a neon lamp which



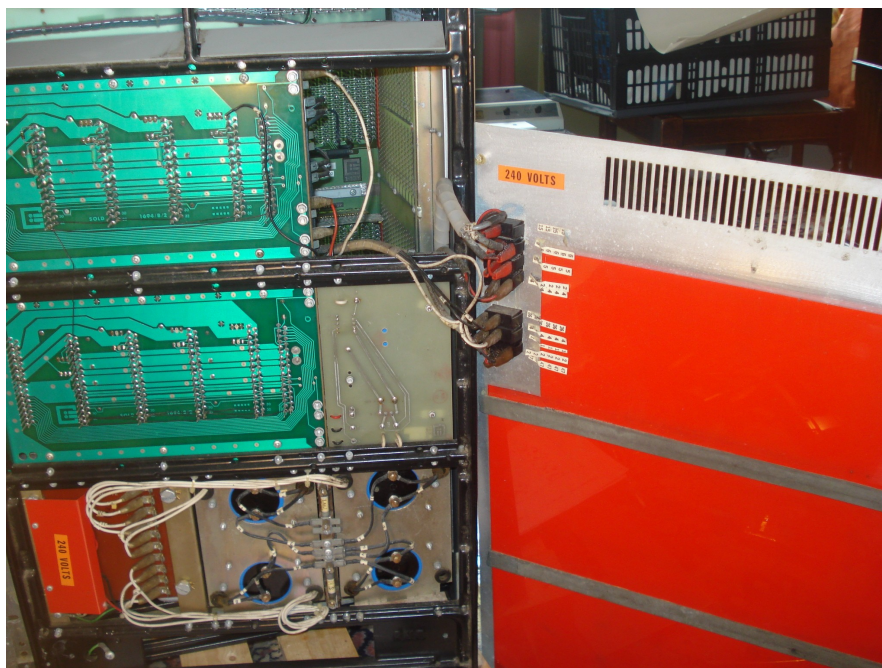
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indicates that the computer is being powered remotely, presumably to alert a Technician that is accessing the machine that the machine is live even though its mains cable may have been unplugged.



The rewired Power panel.

Task	Status
Ascertain if the large capacitors in the power supply will still be viable.	Complete, obtained support from the manufacturer.
Remove and test the Electrolytic capacitors in the power supply	Complete. All OK after reforming





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The power door with the cover removed.



The Power door with the capacitors removed.



The capacitors on the bench for reforming.



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The 40 volt capacitor connected to the Bench power supply. An additional fixed power supply was added to raise the voltage to 70 volts for the 75 volt capacitors.

The initial leakage current was measured;

Capacitor	Initial Leakage current at 31.5 volts	
	Initial value	Falling to;
21000 $\mu$ F 40 Volts	0.3 mA	
10000 $\mu$ F 75 Volts #1	1.5 mA	
10000 $\mu$ F 75 Volts #2	5.0 mA	1.3 mA
10000 $\mu$ F 75 Volts #3	4.3 mA	1.0 mA
10000 $\mu$ F 75 Volts #4	100 mA	

After soak testing the total leakage current for the four 10000  $\mu$ F caps wired in parallel fell to 0.21 mA

The capacitance values were obtained by measuring the discharge time through a known resistance to 0.63 of the initial supply voltage.

Capacitor	Measured Capacitance		% over tolerance
21000 $\mu$ F 40 Volts	25862.67606	$\mu$ F	23.15560027
10000 $\mu$ F 75 Volts #1	11393.30986	$\mu$ F	13.93309859
10000 $\mu$ F 75 Volts #2	11720.59859	$\mu$ F	17.20598592
10000 $\mu$ F 75 Volts #3	11606.16197	$\mu$ F	16.06161972
10000 $\mu$ F 75 Volts #4	12404.92958	$\mu$ F	24.04929577

The nominal tolerance is +/- 20% for these capacitors.

Task	Status
Replace the main air filter in the cabinet which had disintegrated.	Complete, a dual density filter was obtained and fitted.
Remove all of the processor and memory boards from the computer and test the new wiring, Remote input power.	Complete, The remote power relay energises and the remote neon is lit.



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Task	Status
Test the new wiring, Local power, the rear power switch is on and the front panel power switch is off	Complete. The red neon on the inner lower front panel is lit.
Test the Main power supply; The rear power switch is on and the front panel power switch is on. The operational switch is off.	Complete, The front panel neon flashes. This is correct as the Operational switch is set to the off position. The cooling Fan runs. The following DC voltages are measured on the power door; +5, +15, +20, -65 volts. -5 volts is measured on the Modular one interface edge connector. + 20 volts is measured on the connector to the memory matrix cards.
Test the Main power supply; The rear power switch is on and the front panel power switch is on. The operational switch is on.	Complete, The front panel neon is on continuously.
Install all CPU and memory boards and power on the machine.	Complete 13-07-2013, but not much to see as expected. -5 volts is present on the interface connector and boards are warming up. Connected the teletype
Identify the boot sequence for the machine	Complete, It is in the manual for the 1.14 processor. The required paper tapes are available.



## 2. Teletype Net 3

This Teletype was labelled “NET 3” when it was used at the National Physical Laboratory.



This device has four prime functions; Keyboard, Printer, Paper Tape punch and Paper Tape Reader. The paper tape reader is at the left front and mechanically senses the holes in the tape. The punch is on the left of the machine, there are four clear buttons arranged in a square that are used to control it. The blank paper tape reel would sit in the slot at the top left of this picture.

The Teletype was cleaned internally and the motor turned by hand to ensure that the major mechanisms were not stuck. The Teletype was powered up and run with the cover set alongside. When the Start button was pressed the drive motor ran, although at other times it stalled and had to be freed by hand.

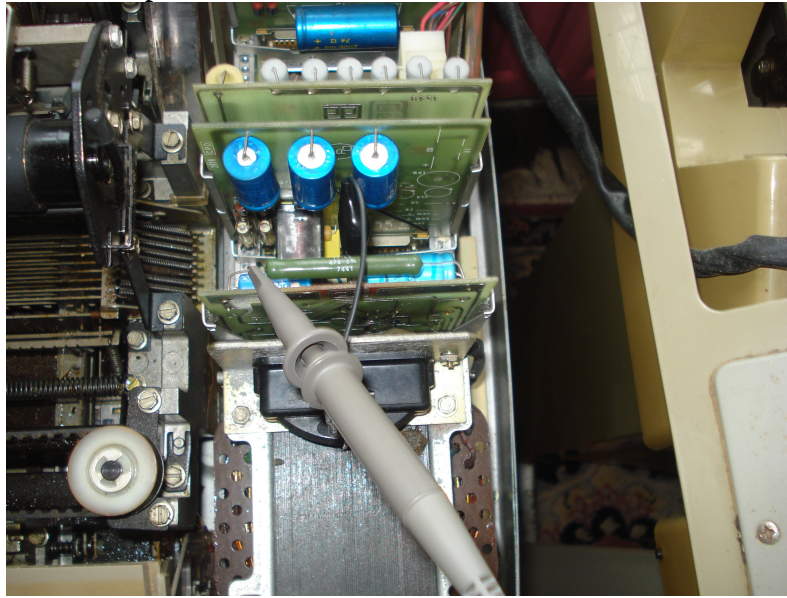
Task	Status
Lubricate as per the TTY manual	Complete
Obtain a new paper roll and ribbon.	<i>Current items are just about serviceable for the time being</i>
Test TT keyboard off-line	Initially it failed, The Universal bar was stuck, now fixed.
Test Printer off-line	Initially failed see list of faults
Printer: The typing mechanism only prints the top line of characters on the Print wheel.	Fixed, two code bars (5&7) were not moving.
Printer: The Carriage return does not work.	Fixed, the function code bar was stuck.



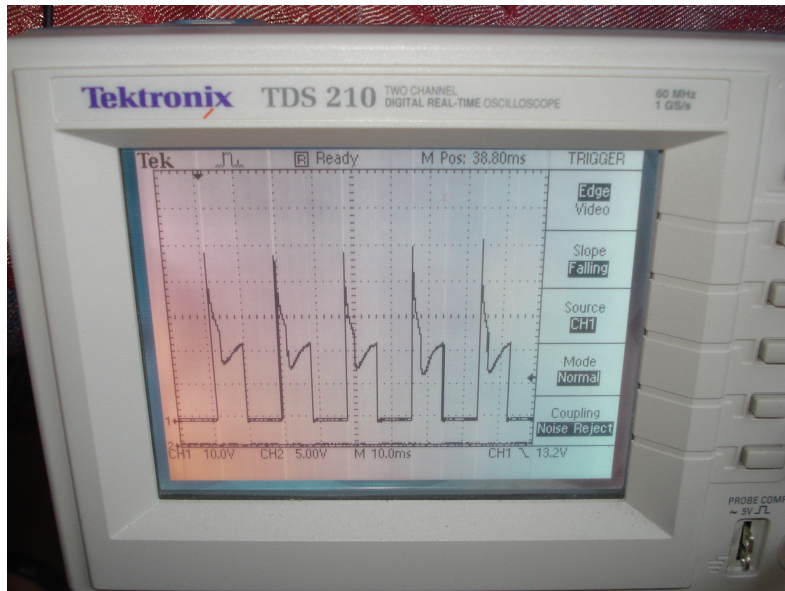
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Task	Status
Printer: Carriage index mechanism is intermittent.	The Carriage Return mechanism was holding the indexer off of the ratchet wheel. A minor adjustment was required.

An Oscilloscope was used to determine if the cause of the missing bits was electrical or mechanical. The scope was connected to the Selector solenoid drive circuit.



Scope connected to the Selector drive circuit.

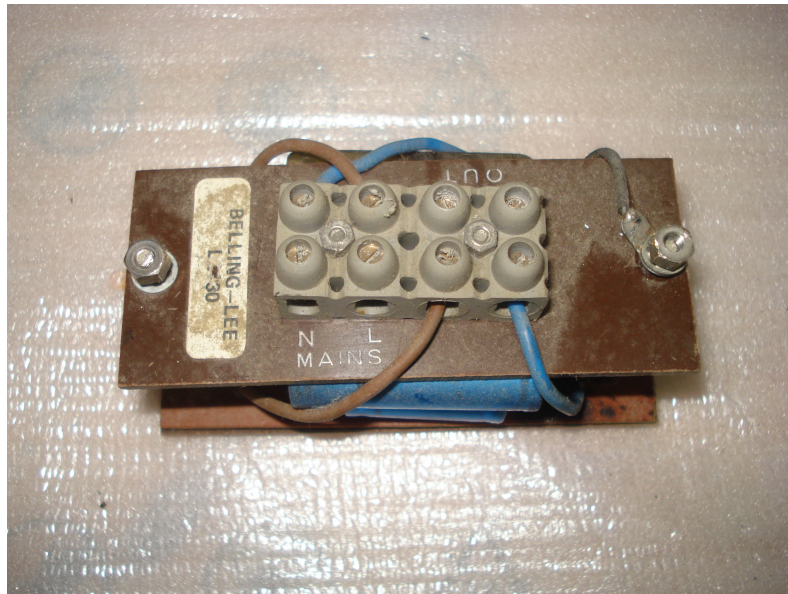


Character 'U' (0x55) displayed on the scope a positive voltage indicates that a bit is off. It could be seen by typing a range of characters that all the data bits were arriving at the solenoid. Therefore the problem must be mechanical and in the Typing mechanism.

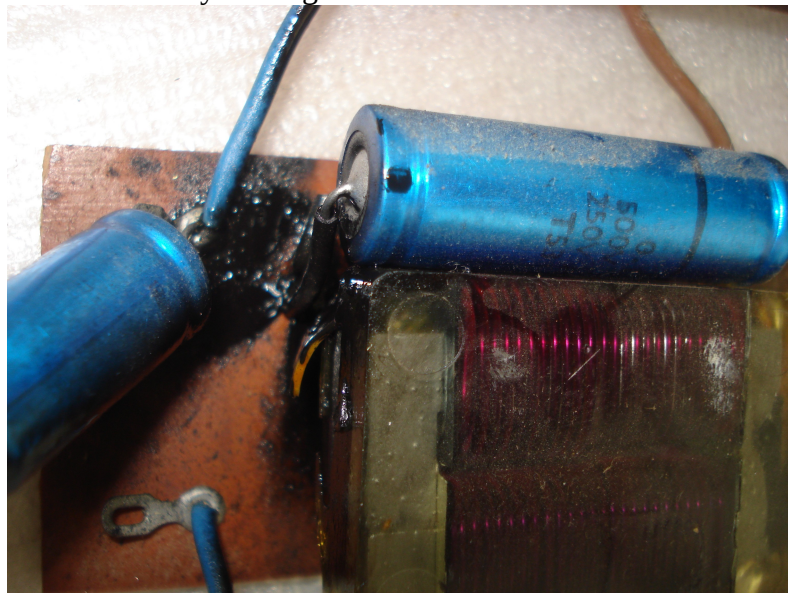


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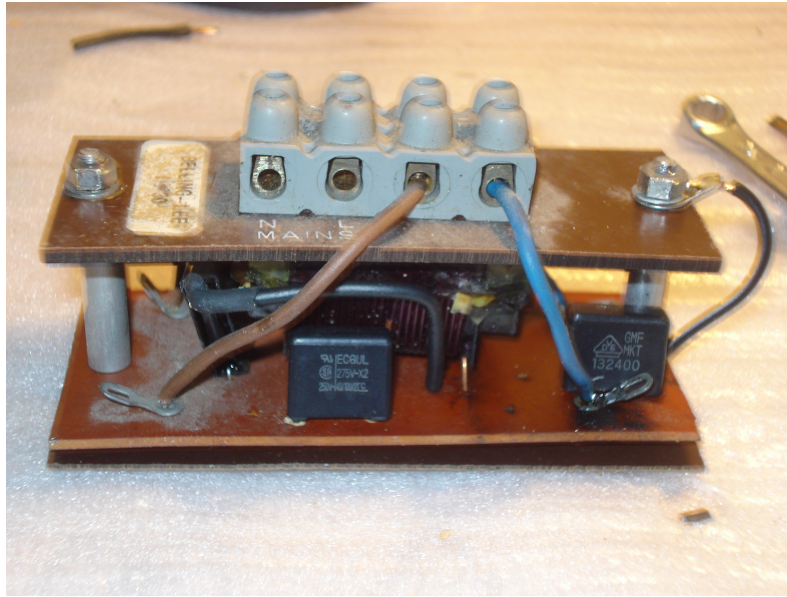
Task	Status
Test TT Tape reader off-line	Two bits missing due to the problem with the code bars (above) now fixed.
Test TT tape Punch off-line	Two bits missing due to the problem with the code bars (above) now fixed.
A capacitor in the Mains filter in the base of the Teletype stand failed. It had been working for a couple of weeks over many power cycles.	Replacement capacitors obtained and fitted. The Teletype is now fully working.



The Mains filter, probably added to the Teletype by CTL as it is not a Teletype standard part and is made by Belling-Lee a UK manufacturer.



Black goo produced by the capacitor when it popped.



The repaired mains filter, all of the capacitors have been replaced with modern X2 rated capacitors used in RFI filters.

### **3. Paper Tape Reader 1.32**

1.32 is the CTL Device number for the High Speed Paper Tape Reader.



4101 Photoelectric paper tape reader. GNT Automatic A/S Denmark.

The Paper Tape Reader was powered up. The drive motor was running continuously (according to the circuit diagram in the manual this is normal). After a while smoke was emitted from the front left of the machine. On inspection this appeared to be

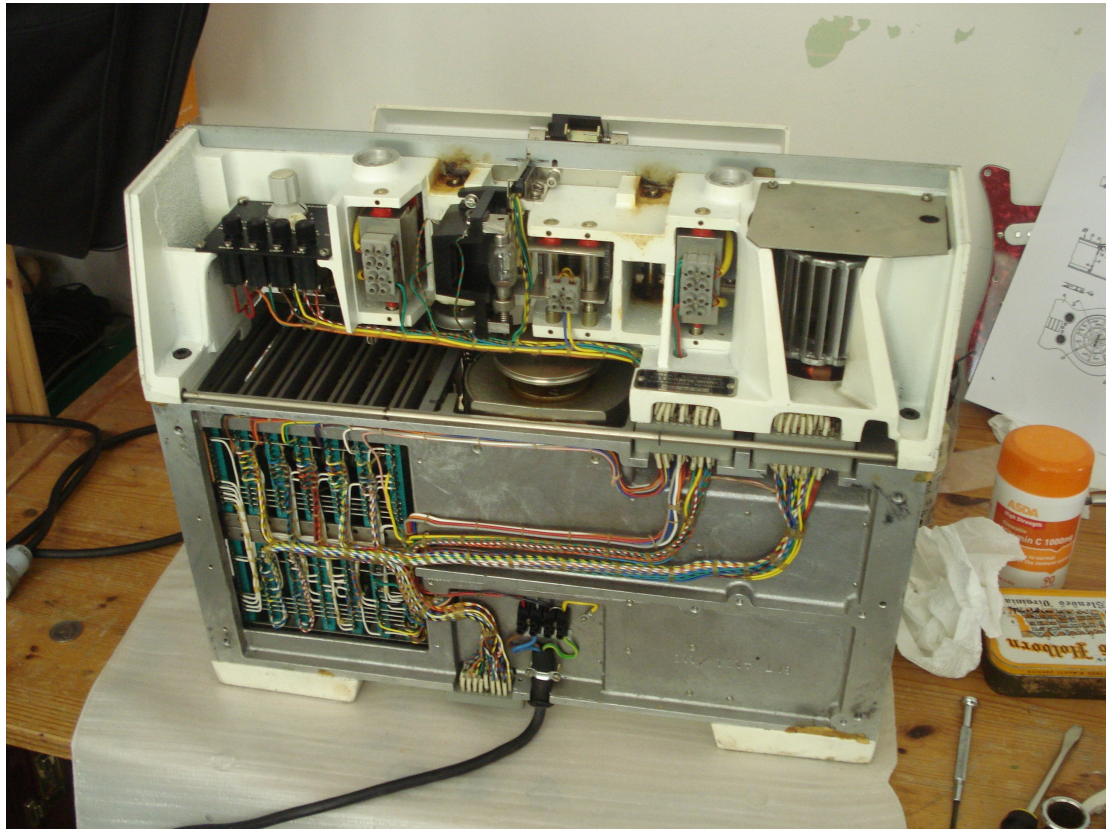


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coming from the suppressor fitted to the mains switch. A capacitor on the power card was leaking an oily substance. The power card was removed and cleaned.

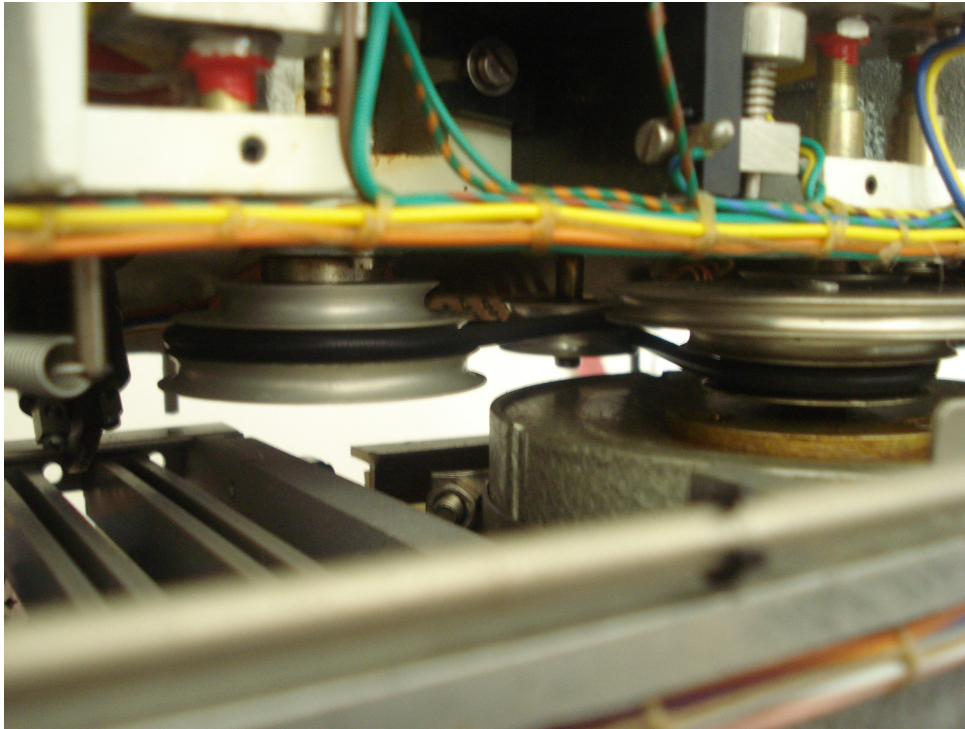
Task	Status
Obtain and fit a replacement Suppressor	Complete

Initially it appeared that replacing the suppressor would be difficult because of access to the front panel. However, the machine is designed so that the front unbolts and unplugs from the main chassis. In addition it is necessary only to remove the drive belt to separate the two parts.

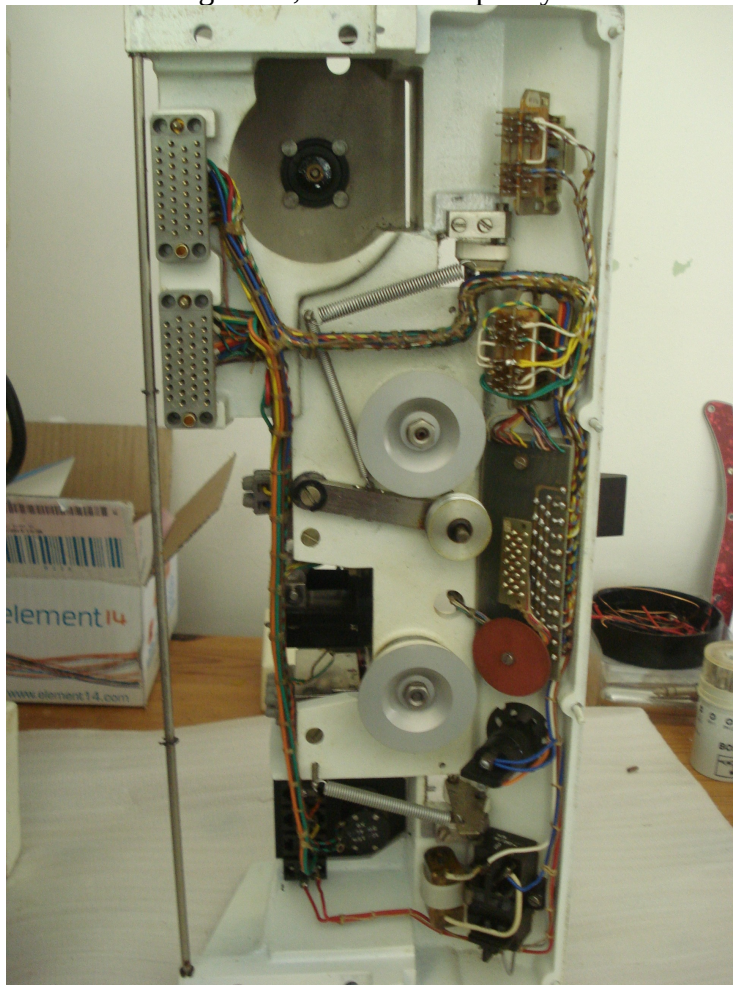


The PTR with the front cover and bottom cover removed. The Electrical connectors between the front and the main sections are on the right below the fan.

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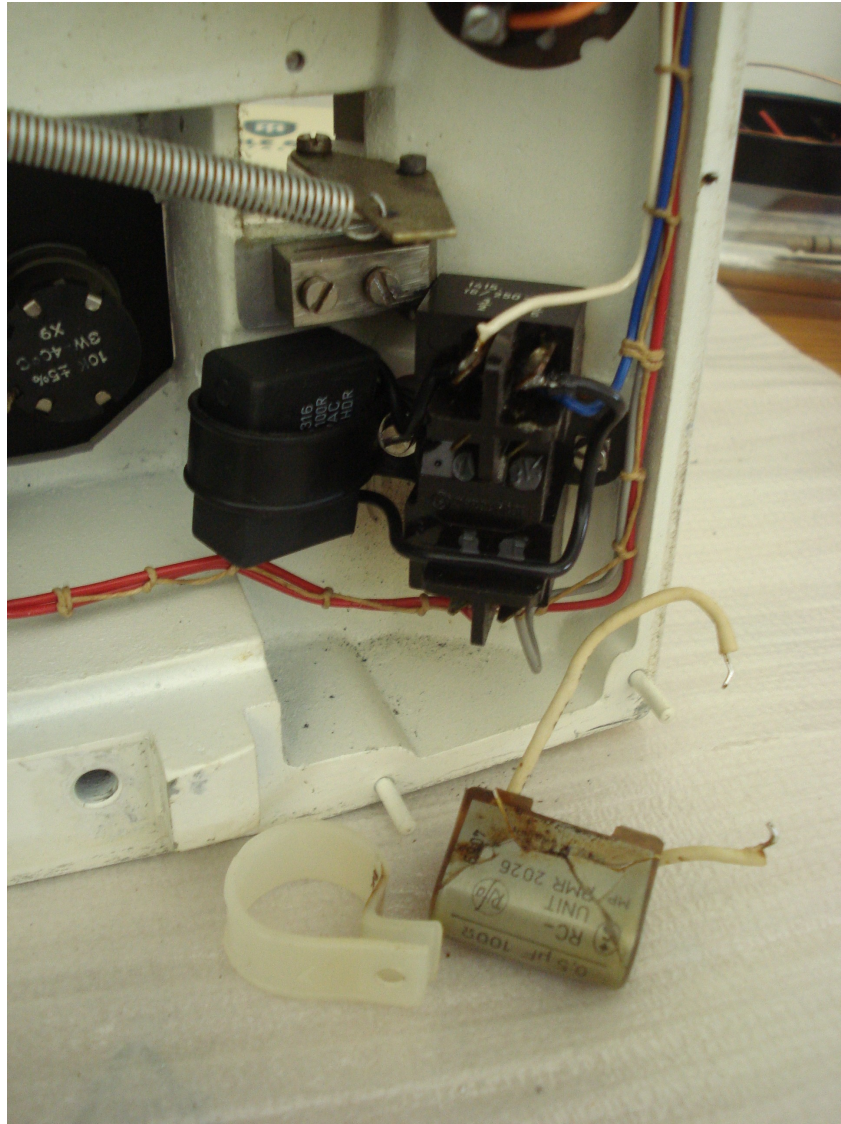


The tape belt drive arrangement; note that the pulleys allow for three speeds.



The front section separated from the main chassis. The faulty suppressor is clipped next to the power switch (bottom right).



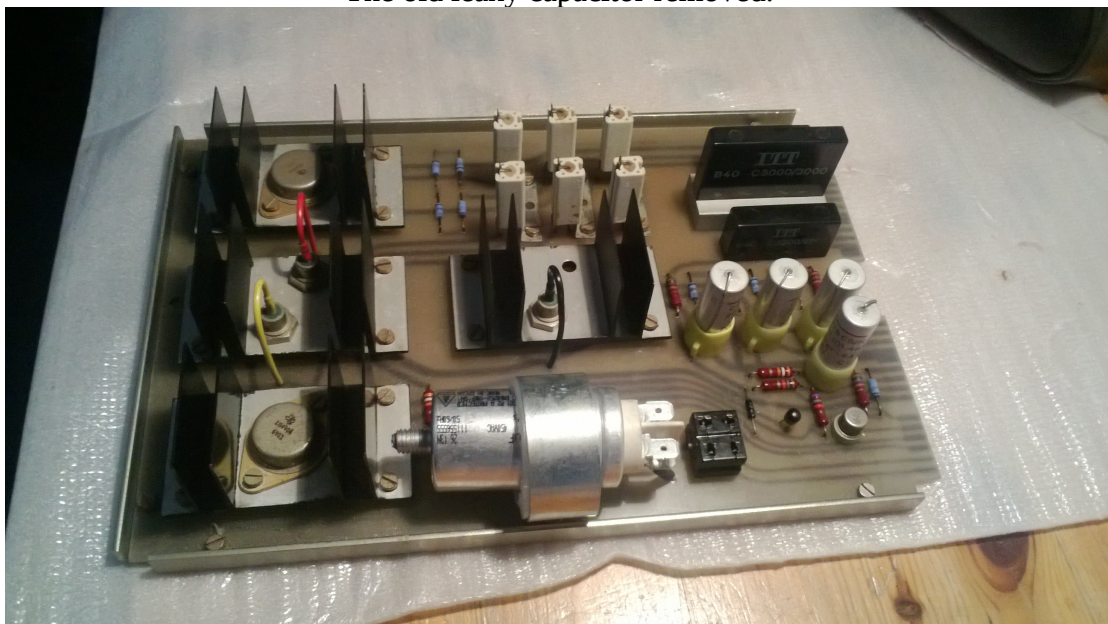


The old cracked suppressor and clip have been removed and the new suppressor and clip are fitted to the switch.

Task	Status
Obtain and fit a replacement Motor Run Capacitor	The replacement capacitor has been fitted and the motor runs.



The old leaky capacitor removed.

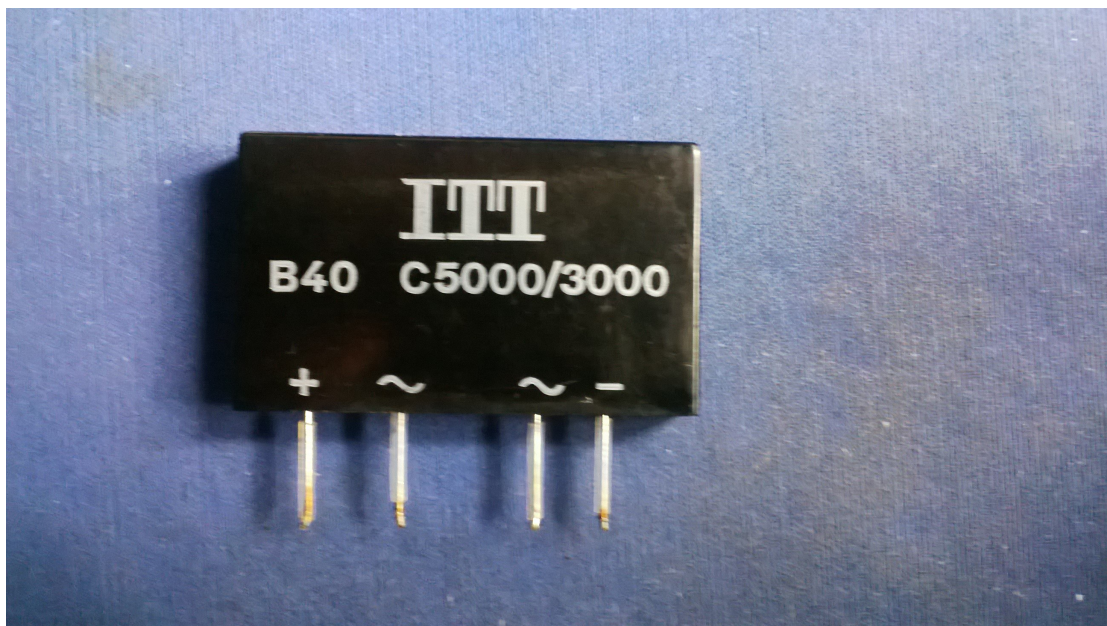


The new capacitor fitted.



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Task	Status
Power up and Test	Failed: The tape feed was not working. The electromagnets that engage the pinch rollers onto the paper tape were not being energised. On investigation the rectifier in the power supply was only delivering 0.5 volts.
Obtain a replacement Bridge rectifier D1. Type: ITT B40 C5000/3000 part number: 4101/211-41	This part is obsolete, but I have found one in France. Awaiting delivery by 28-09-2013.
Run a test tape through and monitor the output signals.	A test tape was pulled through by hand and the sensor head appears to be working as the indicator lights are operating for every data bit.



The faulty rectifier.

Task	Status
Replace the Bridge rectifier. D1	
Power up and Test	
Run a test tape through and monitor the output signals.	