Dick Penny's EDM

1. Introduction

The motivation to embark upon this project came when I broke (not for the first time) a tap in something I was making. I could have put the hole somewhere else which would have been ugly, or re-made the piece which would have been tedious as it involved re-making the mating part as well, so I investigated alternatives. As this happened close to Christmas I put Ben Fleming's 'EDM How To' book on my wish-list for holiday reading and became hooked on the idea of making an EDM machine.

I thought these words and pictures might be of assistance to those embarking on the same exercise. There are some pictures at the end and a short video clip to prove it worked !

The original design idea was to use the chassis and cover from a redundant PC to house the spark generator and control electronics. However a friend was clearing out his garage and came across an old 12/24v DC – 240v AC inverter which was housed in a rather interesting box, so I used that instead.

The chassis in the process of being re-worked is shown above. It probably dates from the 1960's by the look of the components that were contained in it, and was reputed to be of US military origin (there is a Canadian emblem that appeared when the paint was sanded off). The material cut and behaved like Aluminium, but strangely it was slightly magnetic, and I persuaded a colleague to analyse the metal. It is 30% Cadmium (I didn't sand and grind much more, and it is now coated in paint again !)

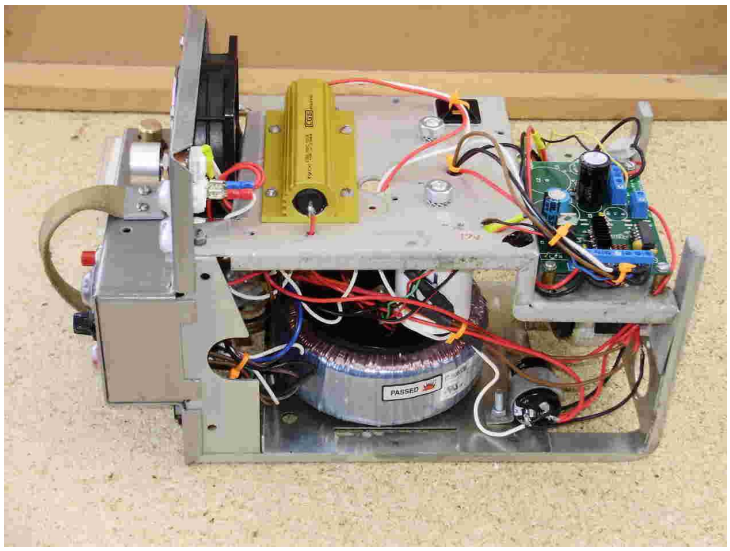
I would be interested in any ideas as to where it came from.

2. Electronics

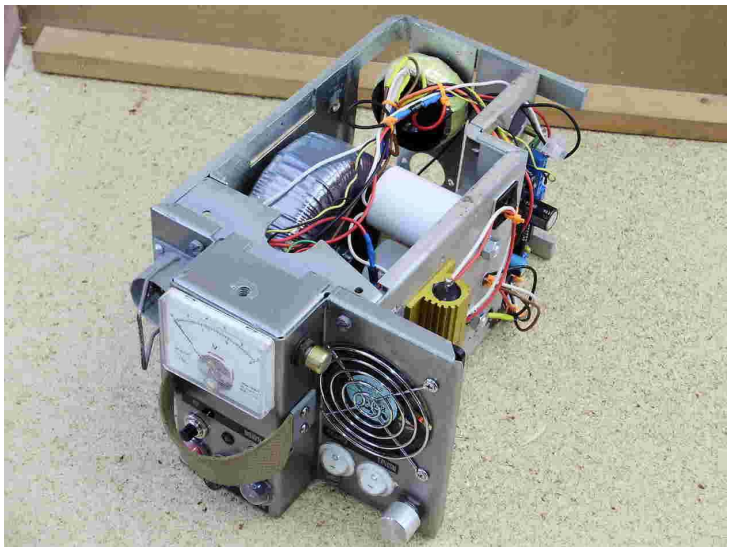
For people building an EDM in the UK, the following parts list may be useful

Farnell Order Code	**# Rqd**	**Description**
3851825	2	C1, 2 20uf 250v AC Polycarbonate capacitor
9696300	1	C3 150uf 200v DC capacitor
1198665	1	C4 1000uf 160v DC capacitor
8126593	1	C5 1000uf 35v capacitor
1457590	5 *	C6 6.8uf 35v capacitor
1216440	5 *	C7, 8, 9, C9a (motor upgrade) 100nf 50v capacitor
1281820	1	C10 22uf capacitor (pcb upgrade)
4084810	1	D1 6A 100v bridge rectifier
1017647	1	D2 2A 400V bridge rectifier
9556125	2	D4, 5 3A 100v diode
1619326	1	R1+2 150W 10R resistor
1265082	5 *	R3, 6, 7, 8, 14 33k resistor
1265072	5 *	R4, 9, 11a, 15, 16, 1k resistor
8557470	1	R5 50k potentiometer
1265085	5 *	R10 100k resistor
1265077	5 *	R12 4.7k resistor
1634659	1	SW1 AC on/off. Red illuminated
1634647	2	SW2, 3 cutting power selection switches
1634645	1	SW3 servo on/off
1634666	4	Splash proof switch covers
1086634	1	SW5 electrode up (black)
1086635	1	SW6 electrode down (red)
9532501	1	T1 2x30v 300VA torroid transformer
1675045	1	T3 2x12v 15VA torroid transformer
9756132	1	U1 12v regulator
1470411	1	U2 SN75441ONE controller
9487670	1	U3 LM-339 comparitor
8576378	5 *	5mm LED holders
1641934	8	PCB connector block
4620896	1	DIP heat sink
1211706	2	Heat sink foil
1077295	1	14 pin socket
1077298	1	16 pin socket
Upload to		**Note**: Items marked * are minimum order quantities
http://uk.farnell.com/		
to place an order		At the time of purchase, torroid transformers were
		the most cost effective and best size option.
		This may change depending on primary supplier

Maplin Order Code		
		These items should also be available from Farnell, but
		were purchased from Maplin for convenience
QY83E	1	D3 red/green 5mm LED
JM71N	1	R11 (mod) 10k miniature pot
UF97F	1	R13 100k trimmer
	2	Heat shrink tubing selection pack
Misc items		
		Panel meter 100 µA 10kΩ per volt
		12v cooling fan salvaged from PC power supply
		Knobs for potentiometers (turned from stock material);
		Wiring (also salvaged from PC power supply)
		Fuse holder; 2 amp **slow blow fuse**, cable ties
		push-on crimp connectors, motor and servo connector
		Redundant PC chassis and casing (see intro text)



Showing PCB, 150W power resistor immediately behind the cooling fan, and the 300VA 60 volt torroid transformer below. The 12 volt cooling fan blows outwards. It connects to TB 1 and 2 and sucks air through ventilation holes cut in the outer case adjacent to the power resistor and to the pcb.

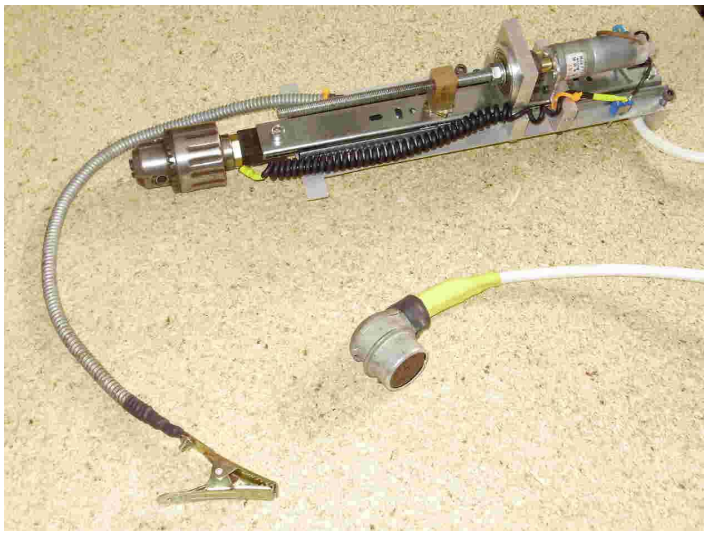


Illustrating the smaller 15VA 12 volt transformer. Capacitors C1 and C2 are too large to fit on the PCB and are mounted on the chassis.

The complete assembly. Window adjusting potentiometer is to the right of the meter, reference potentiometer lower right. 240V AC power connects via the chassis connector socket on the lower left, combined electrode and servo motor output is from the top left hand connector socket.

3. Servo

Servo motor	http://www.virtualvillage.co.uk/12v-dc-60-rpm-high-torque-gear-box-motor-001480-63.html
Ball bearing drawer slide	B&Q Hardware store
Bearing	40mm OD sealed ball race
	M8 threaded rod
	Salvaged drill chuck



There is a switch at the top which isolates the electrode to allow precise positioning using the servo motor without running the risk of sparking or shocks.

The small gearbox motor from www.virtualvillage.com works well. Modest price, only draws 100 mA when running and 500 mA turning against the ball clutch.

The ball clutch is a modification of the drawings and pictures from Rich Carlstedt shown on the EDMHomeBuilders site. Constructed from 19 mm hex brass as the outer housing and connected to the 8 mm threaded rod, held by the bearing. The housing is drilled for 3 x 5mm ball bearings and encased in heatshrink tubing which acts as the spring. Inside is a 15 mm dia. round brass rotor with dimples for the ball bearings drilled through from the outer housing, and connected to the motor shaft.

3. Dielectric Bath, Filter and Pump

Workpiece tank		Small plastic storage box. B&Q
Reservoir		Cooling system from lathe (Axminster Tool Centre) with
		upgraded (used) pump.
Filter		From commercial vehicle salvage yard. Uses AC72
		paper filter element
Vice		3" machine vice (Machine Mart – Clarkes)
Hoses		8mm braided air hose; 3/4" suction/delivery hose (Machine Mart – Clarkes); washing machine inlet hose
		Misc 15mm compression fittings and valves
Paraffin/kerosene		10 litres

Space is at a premium as the servo is fixed to the milling head of a combined lathe/mill, and the work piece is positioned using the lathe cross slide.

The spark generator and control box is positioned alongside, and the dielectric reservoir and pump on the floor.

A manifold directs the flow of dielectric fluid to fill, or flush, and allows the fluid to drain back to the reservoir at the end of a burn. Filling and emptying of the dielectric bath only takes about 20 sec. A large bore overflow pipe carries fluid back to the reservoir during the burn.

The small volume in the bath means it becomes dirty very quickly, but there is a good flow of clean flushing fluid.

The servo is bolted to the milling head. Rough height position is made using the coarse feed from the milling head.

A drill press vice is bolted to 2 pieces of angle iron fixed to clips on the side of the dielectric tank which attach to a piece of 22 mm plywood bolted to the cross slide.

Pipe attachments to the tank are reinforced with angle iron plates.

Reservoir and lathe coolant pump on the floor.

The original coolant pump from this lathe was replaced by a heavy duty pump being disposed of by a local engineering company.

Filter housing bolted to an Aluminium plate fixed to the tank lid uses an AC72 filter element.

5. Results

Stainless steel shaft with M6 tap broken in the left hand hole taken out in around 10 mins with a Copper electrode. Hole edge had been damaged from previous attempts to remove the tap, but deeper in the tap was removed leaving the tap size hole intact.

Second item is a stainless rod with a 5 mm deep 6 mm hex hole burned in using a piece of hex brass rod as the electrode. Burn was stable using full power (all capacitors switched in), but the brass eroded twice as fast as the stainless !

0.75 mm hole in a 10 mm dia. 1.5 mm wall thickness stainless steel tube, made in 5 mins using a solid carbide drill as the electrode on coarse cut setting. Not a very stable burn as there was a small oscillation with each spark. Four holes were made before the drill eroded away.

Video shows a burn using the brass hex electrode.