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Spark Eroder

A Simple Self-Acting Spark Erosion Machine by Derek Lynas

1. Introduction

This machine has been designed with the requirements of the Model Engineer in mind, requiring minimum financial outlay, straightforward construction and little electrical knowledge. Its main use is envisaged to be the removal of broken drills or taps, but it can also be used to create holes of any shape in any conductive material, including hardened steels. Its mode of operation differs from typical industrial machines and many previous designs based on similar principles which have been published in model engineering magazines. As is normal in industrial use, the work is submerged in a bath of paraffin so that the sparking between tool and work takes place without the presence of air, so avoiding oxidation (burning). The paraffin also aids dispersal of erosion debris. Fire risk appears to be minimal, but precautions should be taken such as having a fire extinguisher available. In operation the tool is connected to a capacitor charged to about 60 volts so that an arc discharge occurs when it contacts the workpiece. The recharge current passes through a solenoid coil, which applies a lift force to the tool raising it from the workpiece and extinguishing the arc. Whilst the current continues, recharging the capacitor, the lift force holds the tool plunger against an upper stop until the current ceases when the discharge capacitor is fully recharged. The tool plunger then falls under gravity until the tool contacts the workpiece again, and the cycle repeats.

2. Construction

Drawings of the prototype are available. Most dimensions are not critical and can be changed to suit materials and thread sizes that happen to be available. It is important to ensure that the tool plunger slides freely in the bearing block, and that the armature does not contact the bore of the solenoid, causing friction. The solenoid and tool assembly must be mounted so that it can be held at an adjustable height above the work, whilst being electrically isolated from the work. The drawings show this being achieved by interposing sheet plastic material between the tool/solenoid assembly and its stand and sleeving the securing screws with insulating material.

The drawings show an anti-rotation stop fitted to prevent rotation of the tool as it oscillates vertically. This is unnecessary if it is only intended to make circular holes or remove taps, etc. The electrical components are available from suppliers such as RS Components and should not cost more than about £25 total. The circuit diagram shows a switched charge resistor & discharge capacitor used for optimisation during development. Experience has shown these to be unnecessary. The 7 ohm resistor should be capable of dissipating 10 watts, so is likely to be a wire wound type. Note that the discharge current from the discharge capacitor through the tool/workpiece is quite large, so wire cross-section should be at least 4 sq. mm.in this part of the circuit and terminals should be adequately sized. The cable to the tool must, of course, be flexible.

3. Operation

Tools are normally made from copper, but brass is also suitable. Hollow (tubular) tools are ideal as they minimise the amount of metal to be removed. Set the height of the solenoid/tool assembly initially so that the tool rests on the work with about 3 mm lift available before hitting the upper stop, then switch on. Repetition rate should be about 20 per second. If deep drilling is needed it will be necessary to lower the solenoid/tool periodically to maintain the lift height which affects the repetition rate.