Development of an Integrated Drilling, Chamfering and Deburring Tool

Peter Stringer
Agenda

• General project overview

• Outline of project goals

• What has taken place
  – Summary of literature review
  – Patent search

• Upcoming work
General Project Overview

- Project Summary

- Investigation of a new drill head design
  - Incorporating a Deburring/Chamfering tool for removal of exit side burrs
  - For use drilling holes in the range of 2-10mm
  - Drill head must expand on the exit side of the workpiece once the hole has been drilled, and retract to fit back through the hole

General Project Overview

• Funded by Enterprise Ireland for 12 months.

• Proof of concept.
  – is sufficiently robust
  – is seen to address a viable market and
  – is not encumbered by intellectual property considerations.
General Project Overview
- Extra Challenges due to

- Many solutions exist for larger diameter holes
  - Possible to access exit side through the hole

- Smaller size increases complexity greatly
  - No access through hole
  - Less possible space to incorporate device
  - Possible lack of rigidity if mechanical system incorporated
General Project Overview
- Why remove burrs?

- Burrs can cause Mechanisms to jam
- Lead to increased wear
- Damage electrical connections
- Cause personal injuries
- Lead to problems while connecting components
General Project Overview
- What does burr removal cost?

• Estimates of between 10% and 30% of the total cost of a part

• In 1977 estimated cost of deburring $100 million in Canada alone
General Project Overview - Expected Conclusion

• Working Prototype

• Integrated into CNC machine

• Market potential surveyed

• Protection of intellectual properties
What has been done

- Literature review
- Patent Search
- Start getting information from industry
  - Methods in common use
  - Cost of deburring specifically for deburring
Literature Review

• 2 books on
  – Deburring in general
  – Burrs from drilling

• 44 relevant papers on
  – Deburring
  – Drilling
  – Burrs produced by drilling
  – Methods for deburring
  – Classification of burrs
  – One paper on integrated deburring and drilling
Literature Review
Main researchers and locations

- Gillespie, L.K. – Bendix corporation
- Dornfeld, D.A. – CODEF, Berkeley, California
- Korea University
- Japanese Society for Precision Engineering
Literature Review
How is a burr formed?

- Uniform Burr
  - Initial fracture at the chisel edge (drill tip),
    - Plastic deformation zone at chisel edge, no cutting takes place here, material near chisel edge is thinned by plastic deformation and removed by cutting
  - Second fracture occurs at end of cutting edge
    - Plastic zone expands to edge of drill
  - Drill cap and burr are formed

Literature Review

How is a burr formed?

- Uniform Burr

Literature Review
How is a burr formed?

• Transient Burr

  - Initial and Second fracture occur at the same time, later than with the Uniform burr.

  - As the drill advances further the strain at the chisel edge exceeds the fracture strain of the remaining material forming the crown burr shape

Literature Review
How is a burr formed?

- Transient Burr

Literature Review
How is a burr formed?

• Crown Burr
  - Occurs when there are high feed rates, which lead to large thrust forces
  - Plastic deformation occurs earlier in the drilling process
    • Larger layer plastically deformed
  - Strain hardening occurs at the centre region of exit surface
    • Region becomes brittle
    • Fracture occurs

Literature Review
How is a burr formed?

• Crown Burr

Deburring and Drilling in a single process.
Literature Review Paper on Drilling and Deburring

• Capable of removing uniform burrs

• Drill must go fully through the work piece
  – Possible problem with clearance on exit side
Methods of Burr minimisation

- Changing drill tip design
- Tool coatings
- Most significant factor is tool sharpness
Patent Search

- Patent search carried out using the European Patent Office website:

- A number of related patents were found
- For a twist drill with a cutter recessed into the spiral portion of the drill auger
- For removing burrs on both sides of the hole as the drill passes through the hole.
- Blade forced out by the spring.
• Patent No: EP 1446252 A1 (EZ-Burr Tool Co.)
  – For a deburring tool
  – Removes burrs on both sides of the hole
  – Blade forced out by the spring.
EZ Burr Tool Company

EZburr.mov
EZ-Burr tool

- Available in sizes from 9.5 to 31 mm

- Spade drill – problem removing chips when drilling deep holes

- Potential problem with damage to surface of drilled hole due to principle of operation
Summary of existing solutions

- Do not cater for smaller diameters
- Possible risk to integrity of surface of drilled hole
- Some can’t remove all burr types
Upcoming Work

• Attempting to make contact with industry
  – Establish current cost of deburring in industry
  – Establish budget for tool

• Investigating possible methods of actuation

• Conceptual design

• Ongoing Patent Search
Thanks for Listening

Peter Stringer