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DEBURRING: AN ANNOTATED BIBLIOGRAPHY

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KANSAS CITY DIVISION

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Index Terms

DEBURRING: AN ANNOTATED BIBLIOGRAPHY

Burrs

Burr Properties

Burr Prevention

Deburring

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Abstract

An annotated summary of 1143 articles and publications on burrs, burr prevention and deburring.

Eighteen deburring processes are listed.

Entries cited include English, Russian, French, Japanese and German language articles. Entries are indexed by deburring process, author, and language. Indexes also indicate which references discuss Equipment and Tooling, How to Use a Process, Economics, and Burr Properties. Research studies are identified as are the materials deburred.

When Eli Whitney originated the concept of mass production he generated the problem of mass deburring. Today burr removal costs U. S. industry an estimated two billion dollars a year. Despite this high price industry in general treats deburring as a necessary evil and relies on "art" and tradition rather than science to eliminate it.

The following bibliography represents one of several initial attempts to make burr removal as reliable and predictable a science as metal cutting is. The information contained in the references cited will provide the reader with an understanding of burr formation, properties, the mechanics of each deburring process, and a general comparison between the capabilities of each process.

The references listed in this bibliography describe one or more of the eighteen principle deburring or deflashing processes, the equipment or tooling used, how to use a process, the economics involved, the formation of burrs, or measures taken to prevent burrs. As such this paper covers both burrs and deburring. Many of the deburring processes are also frequently used to improve surface finish, clean, and descale. Only those articles which are directly related to deburring or which present significant related data are included in this paper, however. While many articles discuss more than just deburring, the annotated comments in this bibliography essentially describe only the deburring aspects of each article.

The references shown were unearthed in a search of the following documents. The words in parentheses indicate the topics searched in each index.

Engineering Index, 1930 - Aug. 1973 (burrs, deburring, metals finishing,
metal finishing)

Applied Science and Technology Index (Industrial Arts Index before 1960), 1941-1972, (burrs, deburring, metal finishing, tumbling barrels, steel finishing.)

Metals Abstracts (ASM Review of Metal Literature from 1944-1967), 1944-

Aug. 1973, (tumbling, deburring, burrs, cleaning, coating and finishing)

Metal Finishing Abstracts, Vol. 1-13, (burrs, deburring, electropolishing, vibratory finishing, mechanical treatments, barrel polishing and deburring)

British Technology Index, 1962 - June 1973 (deburring)

Government Reports Index (U.S.), 1971-1972 (burrs, deburring)

Nuclear Science Abstracts, 1970-1972 (burrs, deburring)

Scientific Technical and Aerospace Reports, 1970-1972, (burrs, deburring)

International Aerospace Abstracts, 1970-1972, (burrs, deburring)

Bibliographie Der Deutschenzeitschriften Literatur (Bibliographie der Fremdsprachigen Zeitschriften Literatur, 1949-1964; Internationale Bibliographie der Zeitschriften-Literatur 1965-1972) 1940-1972 (Entgraten, Grat, Entgrater, Auswicken, Entkletten, Entklettung)

Bulletin Signalétique (Sections 740 (Metaux-Metallurgie), and 890 Sciences de l'Ingénieur) 1969-1973 (ébarbage, finition, traitements superficiels)

Standard U. S. abbreviations are used throughout this bibliography. The following is believed to be a complete listing of these abbreviations.

ASME - American Society of Mechanical Engineers

ASTE - American Society of Tool Engineers (Now SME)

ASTME - American Society of Tool & Manufacturing Engineers (Now SME)

B.S. - Bulletin Signalétique

NTIS - National Technical Information Service

R. Zh. Mash. - Referativnyi Zhurnal-Tekhnologiya Mashinostroyeniya

SAE - Society of Automotive Engineers

SME - Society of Manufacturing Engineers

Most of the foreign language articles have not been annotated because a translation was not available. Similarly few of these entries are included in the indexes at the end of the bibliography.

Copies of ninety-five percent of the English language articles listed in this bibliography can be obtained from the library listed below. Probably fifty percent of the Russian, German, French and Japanese articles are also available from the same source. Repositories of the remaining citations can be identified by the librarians at Linda Hall Library. NTIS reports can be ordered from the address listed below.

Linda Hall Library
5100 Cherry
Kansas City, Missouri 64141

National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151

The author is indebted to the librarians and staff of Linda Hall Library for their assistance in retrieving the hundreds of magazines which were reviewed. Their courteous and friendly assistance in deciphering some of the requests is gratefully appreciated. The author would also like to express his appreciation to Ms. Marguerite N. Judge and the staff of Products Finishing for furnishing a list of articles published in Products Finishing.

While a conscientious effort was made to include all entries related to burrs and deburring some significant articles may have been inadvertently overlooked. The author would appreciate notification of any additional publications on the subject of burrs and deburring.

FORMAT OF BIBLIOGRAPHY

The entries in this bibliography are divided into 19 deburring categories, two categories on burrs and one category entitled "unclassified." Within each of

these categories, entries are listed by year of publication, subsequent sub-divisions are alphabetically by author, then title. Articles of anonymous authors are listed before any of known authors. Patents are described if no other published information was available.

The deburring entries listed in the table of contents are for the most fairly widely accepted and known deburring processes. Barrel tumbling (D) was also once known as barreling, rattling, and tubbing. Harperizing and spindle finishing have also been called gyro finishing. The terms electropolish, deburring and electrochemical deburring are used interchangeably by some authors although there is a distinct difference in equipment, tooling and side effects produced. The reader is urged to review articles listed in these last two categories carefully to prevent confusion. Liquid hone deburring involves forcing water and abrasive over burr laden edges. It is a gentle process which does not rely on blasting or impact pressures. The "burr properties" category includes all references which describe such burr properties as length, thickness, shape, or hardness. "Burr Prevention" lists articles which describe how to prevent burrs. In general most of these articles actually describe methods of minimizing burrs. The "unclassified" category lists articles which were not reviewed. As such it was not possible to discern which category the article described.

Each article is indexed by several classifications in addition to those listed above. These indexes, located at the end of this publication indicate which articles describe equipment and tooling, present formal research results, describe how to use a process, list the workpiece material, present data, or include some economic analysis. Indexes by author and language are also included.

TABLE OF CONTENTS

Deburring Processes	Page
A. Hand (manual)	1
B. Chlorine gas (hot gas).....	2
C. Abrasive Jet (blast deburring).....	3
D. Loose Abrasive Processes.....	10
E. Thermal Shock (thermal).....	85
F. Extrude Hone.....	87
G. Power Brushing.....	89
H. Sanding.....	97
I. Electrochemical (EC, ECD).....	98
J. Electropolish (ELD).....	105
K. Ultrasonic.....	114
L. Chemical Vibratory.....	117
M. Electrochemical Vibratory.....	118
N. Water Jet.....	119
O. Chemical.....	120
P. Liquid Hone.....	121
Q. Flame.....	122
R. Multiple Processes.....	123
S. Mechanical Methods (Scraping, Machining).....	129
Burr	
T. Burr Formation and Properties.....	137
U. Burr Prevention.....	143
Miscellaneous	
V. Unclassified.....	150
W. Late Entries.....	154
Indexes	
Equipment and Tooling.....	155
Research.....	155
How to Use Process.....	155
Materials Deburred	155
Articles Presenting Data.....	157
Articles Discussing Economics.....	157
References Discussing Burr Formation.....	157
References Discussing Burr Prevention.....	157
References Discussing Specific Processes.....	158
Foreign Language Articles.....	160
Author Index.....	161

MANUAL DEBURRING

1965

- A1. *Miller, Bernard S., "Control Deburring Quality," Metalworking, Nov. 1965, pp. 40-42, 56-58.

Hamilton Standard uses three pronged attack to reduce deburring costs. They found better deburring processes, developed time standards for deburring, and value analyzed actual deburring requirements. Deburring costs accounted for 25% of their labor costs. Under use of vibratory deburring and ECD cut costs as did the use of foot-controlled speed lathes.

1973

- A2. Narins, Robert, "Precision Deburring - The Full Story," Tooling and Production, April 1973, pp. 43-45.

Basic discussion of approaches typically used in a complete deburring shop. Deburring is often done by hand under 20x microscopes. Pointers on hand deburring are given.

CHLORINE GAS DEBURRING

1962

- B1. *Deburring of Machined Parts, Armour Research Foundation Report ARF 2839-9 (Final Report) July 1962.

This research study presents data on chlorine gas deburring and its effect on part dimensions. Drilling, sawing, and abrasive cutoff burrs were studied. Electropolish deburring tests are also given.

1963

- B2. "New Field Opened by Chlorine Deburring," Steel, Vol. 153, Nov. 4, 1963, pp. 115-116.

Summary of chlorine gas deburring.

1964

- B3. "Hot Chlorine Gas Deburrers, Machines," Materials in Design Engineering, Vol. 59, January, 1964, pp. 111-113.

Describes chlorine gas deburring and machining.

- B4. "How We'll Manufacture Tomorrow," Steel, Vol. 154, April 13, 1964, pp. 80-89.

Includes 1 page description of chlorine gas deburring.

1965

- B5. "Thermo-Chemical Deburring," Metalworking Production, Vol. 109 (No. 18), May 5, 1965, p. 68.

ABRASIVE JET DEBURRING

1941

- C1. "Abrasive Blast Cleaner Reduces Burr Removal Costs," Iron Age, Vol. 147, No. 50, April 17, 1941.

1945

- C2. Adams, J. B., "Sandblasting Removes Sharp Angles From Aluminum Alloy Spar Caps," American Machinist, Vol. 89, August 16, 1945, pp. 111-112.

Adjustable nozzles radius edges of parts.

1949

- C3. "Vapor Blasting Precision Parts," Steel, Vol. 124, June 13, 1949, p. 104.

Steel fuel injection pump components are deburred by a wet abrasive stream.

- C4. Farrell, J. F., "Abrasive Blasting Applications," Die Castings, Vol. 7, Sept. 1949, p. 45-46, 48-50.

Blasting deburrs and fineshes die castings.

1952

- C5. "Applications of Vapour Blasting," Machinery (London), Vol. 81 (2068), July 3, 1952, p. 26.

- C6. "Deburring in a Nutshell," Mill & Factory, Vol. 51, Oct. 1952, p. 98.

Crushed walnut shells are used to blast burrs from die cast parts.

1953

- C7. "Abrasive Blasting Removes Flash From Die Cast Toys," Precision Metal Molding, Vol. 11, Oct. 1953, p. 71-72.

- C8. Patton, W. G., "Gun Barrels Deburred and Cleaned by Liquid Honing," Iron Age, Vol. 172, August 27, 1953, pp. 102-103.

Liquid honing is used to deburr gun barrels for 90 mm tank cannons.

1954

- C9. Anderson, E. F., "Automatic, Bulk Flash Removal on Die Castings," Precision Metal Molding, Vol. 12, Aug. 1954, p. 65-67, 82.

Blasting machine saves deflashing costs.

1955

- C10. Anderson, Eugene F., "Automatic Deflashing of Thermoset Mouldings by Soft Grit Pellets," Plastic Technology, April 1955.

1956

- C11. "Deburring Beechcraft Machine Parts," Wheelabrator Digest, No. 2, 1956.
C12. Pedrosa, F., "\$200,000 in Annual Savings," Grinding & Finishing, Vol. 1, No. 9, Jan. 1956, pp. 17-18.

1957

- C13. *Bahgn, W. Reece, William D. Stampeli, and Ben C. Brosheer, "Deburring Improved, Cost Reduced by Blasting with Crushed Walnut Shell Pellets," American Machinist, Vol. 101, April 22, 1957, pp. 126-128.

Machined cast iron, steel, and diecast aluminum parts are blasted with crushed walnut pellets to remove burrs. Chrysler chose mechanical blasting pneumatic blasting because it provides higher velocities and volume. Cycle is automatic requiring less than one minute per part.

- C14. Furgeson, Ray, and John R. Eggum, "Vapor Blasting Deburrs and Blends Machined Surfaces," Machinery, Vol. 63, July 1957, pp. 180-183.

Wing panels are liquid honed to remove burrs and blend surfaces.

1959

- C15. "Job Shop Automates Deburring and Turning," Automation, Vol. 6, July 1959, p. 77.

Pump vanes are deburred by blasting with apricot pits in an automated setup.

- C16. "Wet Blasting Method Speeds Finishing," Industrial Finishing, Vol. 11 (128): p. 54, 1959.

Wet blasting equipment of American Wheelabrator can maintain 0.0001 inch tolerances while removing fine burrs.

- C17. Bernards, A., "New Process for the Interior Sand Blasting of Tubes," Metall-Reinigung und Vorbehandlung, Vol. 8 (No. 6), 1959, pp. 90-91.

To sand blast small tube i.d., tubes are attached to vacu-blast unit such that tube becomes the nozzle.

1960

- C18. "Blast Unit Cuts Cost in Deburring Diecastings," Foundry, Vol. 88, Nov. 1960, p. 196.

Gasoline engine die castings are deburred with steel shot.

- C19. "Shotblasting Offers Benefits Over a Wider Field," Australasian Manufacturer, Vol. 45, June 25, 1960, p. 76-8.

Shotblasting deflashes plastic parts.

1961

- C20. "Save \$30,000 a Year Deburring Die Castings," Precision Metal Molding, 1961, Vol. 19, No. 1, p. 51-2.

Reed plates and engine bases are deburred by abrasive blasting.

1962

- C21. "Instruments, Electronics and Automation Exhibition," Machinery, Vol. 100, May 23, 1962, pp. 1189-1190; SEE ALSO Summary in Machinery, Vol. 108, March 16, 1966, p. 584.

A blasting machine is shown for deburring plastics.

- C22. McMullen, Helen L., "Wet Blasting -- Versatility for Finishing," Grinding & Finishing, Vol. 8, No. 12, Dec. 1962, p. 26-28.

Illustrates blast deburring and other blasting operations.

1963

- C23. "Entgratung von Kunststoffteilen im Strahlver Fahren," Kunststoffe, Vol. 10, 1963, pp. 93-94.

- C24. "Use of Abrasive Grain in Pressure Blasting," Grinding & Finishing, Vol. 9, Sept. 1963, p. 41-44.

Comparison of Al_2O_3 and SiC with other blasting materials as to service life, hardness, density, reactivity and free Si content. Factors influencing the surface finish of blasted work pieces, including abrasive type, grit size, distance of nozzle from work, blasting pressure and angle. Types of equipment available and applications of the process.

1964

- C25. "Abrasive Jet Deburr Tiny Parts," Metal Progress, Vol. 85, May 1964, pp. 9-10.

Michigan Dynamics, Detroit uses S. S. White Equipment to deburr complex intersecting holes in stainless steel filter end caps. Deburring time was reduced from 20 to 5 minutes.

- C26. "Blast Deburring. 'High Production Handwork'," Grinding and Polishing, 1964, Vol. 10, No. 10, p. 38-40.

A review of equipment for blast deburring.

- C27. McKee, Richard L., "Blast Deburring: High-Production Hand Work," Grinding & Finishing, Vol. 10, No. 9, Sept. 1964, p. 38-40, 58.

General review of abrasive blast deburring.

- C28. Watson, F. D., "Mechanical Rubber Deflashing," Rubber Age, April 1964.

1965

- C29. Arnold, O. M., and D. M. Evans, W. L. Johnson and R. G. Millhiser, "New Method for Deburring Machined Pressure Die Casting Products," Giesserei Praxis, No. 24, Dec. 25, 1965, pp. 523-529.

New machine utilizes abrasive blasting and a wet spray cleaning to deburr and finish aluminum die castings.

1966

- C30. "Deflashing Plastic Mouldings," Products Finishing, Vol. 19, No. 3, March 1966, p. 53.

Deflashing turntable unit removes flash as parts come off press.

1967

- C31. *Beletskii, D. G., and V. N. Zhemchugov, "Osnovnye Parametry Bezezhetskionnoi gidroabrazivnostruinoi obrabotki," Vestnik Mashinostroeniya, n5, May 1967, pp. 53-56.

Formula is derived expressing metal removal rate as function of liquid abrasive jet pressure, inclination angle, nozzle diameter, abrasive concentration, and grain size.

- C32. Ingulli, Charles N., "Abrasive Jet Machining," Tool and Manufacturing Engineer, Vol. 59, No. 5, Nov. 1967, pp. 28-33.

- C33. Kurz, William W., "Shot Peening—Abrasive Blast Finishing Its Form and Uses," Modern Machine Shop, August, 1967, pp. 120-128.

Aluminum oxide in 100 to 320 mesh sizes are used for deburring as are glass beads. Plastic beads are used to remove delicate mold flash from plastic parts.

- C34. *Spencer, Lester F., "Abrasive Blasting—Wet and Dry," Metal Finishing, June, 1967, pp. 97-100, 104.

A good basic discussion of blasting applications and problems. Tables of SAE grit sizes are given.

1968

- C35. "Deflash, Deburr and Surface Improvement - Simultaneously," Precision Metal, Vol. 26, Jan. 1968, pp. 91-92.

Die cast parts for air cooled engines are blasted to deburr and smooth edges.

- C36. "Fastest in the West," Tooling and Production, Vol. 34, No. 2, May, 1968, pp. 74-75.

S. S. White deburring of miniature parts is described.

- C37. "Wet Abrasive Finishing," Machinery Lloyd, Vol. 40, Sept. 1968, pp. 22-23.

Describes a wet blast finishing produced by Centri-Spray Corp., Livonia, Michigan. Removing small burrs on an automated line is part of its function

- C38. Kulischenko, Walter, "Airbrasive Jet Machining Techniques and Related AJM Equipment," ASTME Paper MR68-524, 1968.

Uses of S. S. White equipment for deburring and cleaning both metal and plastics.

1969

- C39. "New Abrasive Jet Deburrs, Cleans or Cuts--Gently," Purchasing Week, April 7, 1969, pp. 64-65.

Applications for S. S. White Equipment.

- C40. Borch, Einar A., "Metal Abrasives -- All Purpose Variable in Blast Cleaning," Abrasive Engineering, Vol. 15, No. 11, Nov. 1969, pp. 20-22.

- C41. Schroeder, E. G., "Air Abrasive Blasting Finds New Job," Modern Metals, Vol. 25, Feb. 1969, pp. 52-58.

General discussion of blasting applications.

1970

- C42. "Bounce Offers Blind Deburring Plus," Tooling and Production, Sept. 1970, p. 60.

Glass bead blasting machine is described.

- C43. "How Glass-Bead Blasting Cleans Parts, Descales Dies," Precision Metal, Vol. 28, No. 7, July 1970, pp. 89-90.

- C44. *Smeltzer, C. E., M. E. Gulden, and W. A. Compton, "Mechanisms of Metal Removal by Impacting Dust Particles," Transactions of the ASME, Sept. 1970, pp. 639-654.

A comprehensive study of metal removal as a function of blasting variables. Materials studied include 410 stainless steel, 17-4 Ph stainless steel and titanium.

1971

- C45. Balcar, Gerald, and Earl Hanley, "Economics of Glass Bead Shot Peening," Abrasive Engineering, April 1971, pp. 16-19.

A general article about the economics of glass beads.

- C46. *Jones, John R., and Michael N. Gardos, "An Investigation of Abrasive Blasting," Lubrication Engineering, Vol. 27, Nov. 1971, pp. 393-400.

Authors investigate effects of wet and dry blasting on workpiece dimensions, finish and weight change. Workpieces included 17-4 ph stainless steel and 440 C steel. Effects of time and pressure are shown.

- C47. *Spencer, Lester F., "Abrasive Blasting," Metal Finishing Guidebook and Directory, 1971, pp. 140-149.

An excellent summary of blasting variables, and side effects produced by blasting.

1972

- C48. "Can't Cut Hard Material?: Blast it Away," Iron Age, April 13, 1972, pp. 63-64.

Summary of S. S. White applications.

- C49. *Plaster, H. J., Blast Cleaning and Allied Processes, Volumes I and II, Garden City Press Limited, Letchworth, Hertfordshire (England), 1972.

This extensively detailed book covers the equipment, media, techniques, and uses of all blasting processes. Volume I also contains Chapters on high pressure deburring and plastic deflashing. Volume II describes centrifugal blasting and rubber deflashing.

- C50. Wrigley, Al, "GM Div. Puts New Plastic Deburring Material to Test," Metalworking News, Feb. 7, 1972, p. 16.

Plastic cylinders are used to deburr transmission components.

1973

- C51. "A Little Shpritz--For Cleaner Fits," Tooling & Production, Vol. 38, No. 12, March, 1973, pp. 46-48.

S. S. White unit is used for deburring precision parts.

LOOSE ABRASIVE PROCESSES

(Barrel Tumbling, Harperizing, Spindle
Finishing, Vibratory Deburring)

1943

- D1. "Ford Tumbles Aircraft Engine Parts," American Machinist, Vol. 87, No. 26, Dec. 23, '43, pp. 90-92.

Used to conserve labor and increase quality. The work compartment is filled 2/3 full with stone, pumice and water. Barrel speed is 500 r.p.m. Parts are fixtured.

1944

- D2. "Burring by Tumbling," Iron Age, Vol. 154, Dec. 14, 1944, pp. 160-161.

Barrel tumbling is used to deburr and radius aircraft parts. After 3-4 hours surface finishes of 6-8 are produced and radii of 0.008 to 0.010 inch are maintained.

- D3. Mitchell, R. W., "Barrel Finishing," Metal Industry (London), Vol. 65, No. 14, Oct. 6, 1944, pp. 211-213; No. 15, Oct. 13, 1944, pp. 231-232.

A general summary of barrel tumbling.

- D4. Mitchell, R. W., "Barrel Finishing of Metal Parts," Metals & Alloys, Vol. 19, June '44, pp. 1396-1401.

Review of barrel deburring.

- D5. Sizelove, Robert, "Deburring Metal Parts in Bulk," Metal Finishing, Vol. 34, No. 1, Jan. '44, pp. 16-17.

Five approaches to barrel deburring.

1945

- D6. "Controlled Barrel Burnishing Action Imparts Precise Finish to Metal Parts," American Machinist, Vol. 89, Oct. 25, '45, pp. 114-117.

Barrel tumbling deburrs and polishes.

- D7. *Hyler, John E., "Burrs and Burring," Mill and Factory, Vol. 36, Jan. 1945, pp. 106-109, 252, 258, 260, 264, 268, 270.

A good summary of deburring equipment used by one manufacturer of small, high production equipment.

- D8. MacNair, R., "Barrel Finishing," Metal Industry, Vol 66, Feb. 16, '45, pp. 98-100; (8) Feb. 23, '45, pp. 114-116; (9) March 2, '45, pp. 134-135.

Summary of barrel finishing applications.

- D9. Ransohoff, N., "Cleaning and De-Whiskering Nails," Wire & Wire Products, Vol. 20, Oct. '45, pp. 733-734, 810.

Barrel tumbling is used to remove burrs on nails.

- D10. *Stedman, Gerald Eldridge, "More Precise Work Done Faster," Mill & Factory, Vol. 36, Jan. '45, pp. 117-119, 242, 244.

Hydraulic componenets are deburred with buffing wheels, walnut shells, and tumbling.

1946

- D11. "Tumbling, Burring and Cleaning Equipment," American Machinist, Vol. 90 (No. 2), Jan. 17, 1946, pp. 162-5.

- D12. Allen, A. H., "Roto-Finish Process," Steel, Vol. 118, June 24, 1946, pp. 98-104.

Article describes barrel finishing equipment, uses, and suggested floor plans.

- D13. *Beaver, H. Leroy, "Barrel Finishing of Metal Products," Products Finishing, Vol. 11, Oct. 1946, pp. 82-90; Nov. 1946, pp. 4 -56; Dec. 1946, pp. 64-74; Jan. 1947, pp. 62-72; Feb. 1947, p. 74-84; March 1947, pp. 80-92; Apr. 1947, pp. 62-76; May 1947, pp. 46-56; June 1947, pp. 74-84; July 1947, pp. 74-86; Aug. 1947, pp. 28-38; Sept. 1947, pp. 38-50.

This excellent series began in 1937 and covers every possible aspect of barrel finishing. Including effects on subsequent operations such as plating.

- D14. Lord, R. M., "Precision Tumbling of Metal Parts," Materials & Methods, Vol. 24, Nov. '46, p. 1227, 1229.

Barrel deburring of gears.

- D15. Lord, R. M., "Precision Tumbling of Metal Parts Reduced Production Costs," Grits and Grinds, Vol. 37 (No. 6), June 1946, pp. 1-5.

General summary of barrel tumbling.

- D16. Scotten, Frank M., "Mechanization Slashes Costs on Deburring and Polishing," Production Engineering & Management, Vol. 18, Oct. '46, p. 51-54.

Barrel tumbling reduces deburring costs.

1947

- D17. *Beaver, H. Leroy, "Barrel Finishing of Metal Products," Products Finishing, Vol. 12, Oct. 1947, pp. 36-50; Nov. 1947, pp. 76-88; Dec. 1947, pp. 28-40; Jan. 1948, pp. 76-84; Feb. 1948, pp. 70-82; Mar. 1948, pp. 50-62; Apr. 1948, pp. 58-68; May 1948, pp. 58-68; June 1948, pp. 78-86; July 1948, pp. 60-68; Aug. 1948, pp. 56-68.

This series deals primarily with the history of barrel finishing equipment and media.

- D18. Castle, C. H., "Roto Finishing Method for Processing Metals," Machine & Tool Blue Book, Vol. 43 (no. 12), Dec. 1947, pp. 158-160, 162, 164, 166 & 168.

Very brief description of roto finish barrel equipment and how to use it.

- D19. Chase, Herbert, "Manufacturing Economies Result From Barrel Finishing," Materials & Methods, Vol. 25, June 1947, pp. 84-88.

Applications of barrel finishing.

- D20. Chase, H. "Modern Tumbling Techniques Cut Finishing Costs," Iron Age, Vol. 159 (18), May 1, 1947, pp. 62-66; See also Materials and Methods, Vol. 25 (6), June 1947, pp. 84-88.

Review of barrel tumbling and its use by the Shakespeare Co.
Some dollar savings are described.

- D21. Laughner, Vallory H., "Abrasive Tumbling Reduces Finishing Cost," Machinery, Vol. 54, Dec. 1947, p. 139-146.

New applications for barrel tumbling.

- D22. Lord, R. M., "Precision Tumbling of Metal Parts," Grits and Grinds, Vol. 38, (No. 10), Oct. 1947, pp. 1-9.

Summary of barrel finishing techniques.

- D23. Lord, R. M., "Precision Tumbling Metal Parts," Steel, Vol. 121, Dec. 15, 1947, pp. 93-94, 124.

Applications of barrel tumbling using special abrasives.

1948

- D24. *Beaver, H. Leroy, "Barrel Finishing of Metals Products," Products Finishing, Vol. 13, Oct. 1948, pp. 40-52; Dec. 1948, pp. 38-50; Feb. 1949, pp. 52-64; Apr. 1949, pp. 50-68.

This continuing series covers effects on electroplating, history of barrels used, and finishing stainless steel.

- D25. Castle, C. Heamon, "Precision Tumbling Processes Improve Finishing Efficiency," Steel, Vol. 123, Oct. 25, 1948, pp. 68-70, 94, 98.

How to save money using barrel tumbling.

- D26. Chase, Herbert, "Barrel Finishing for Mass Production," Metal Finishing, Vol. 46, April 1948, p. 56-60.

Use at Endicott, N. Y., plant of IBM for some 8500 different parts ranging from gray-iron castings about $2\frac{1}{2}$ x 4 x 14 in. overall and weighing about 6 lbs., to tiny parts weighing a small fraction of an ounce. Zinc die castings, steel forgings, scores of screw-machine products, hundreds of stampings in steel, brass, and aluminum, and a wide assortment of other products are regularly subjected to surface treatment in barrels of many sizes and types.

- D27. Schulze, Arthur P., "Roto-Finish Spurs Finishing Economies," Tool Engineer, Vol. 20, April 1948, p. 35-37.

Barrel finishing is described.

- D28. Simmons, A. L., "Pitting of Steel Parts During Barrel Tumbling," Metal Progress, Vol. 54, Sept. 1948, p. 349.

A PH range of 10.4 to 11.4 prevents pitting. Soda ash is used to provide this alkaline solution.

- D29. Wingate, Joseph, "Barrel Finishing of Aircraft Parts," Metal Finishing, Vol. 46, Oct. 1948, p. 67-74.

Finishes of 2 RMS can be achieved by barrel finishing.

1949

- D30. "Finishing of Wire Forms and Small Stampings," Products Finishing, Vol. 13, Sept. 1949, pp. 27-36.

Describes in detail how small stampings and wire forms are deburred using barrel tumbling.

- D31. *"Thin Stampings Deburred Without Bending," Steel, Vol. 125, July 25, 194, p. 75.

Self tumbling prevents interlocking and bending on soft steel stacker plate. The 4 inch by 6 inch by 1/32 inch plates are tumbled with a fine abrasive in lots of 2000. Inclined barrels are used for small stampings, horizontal barrels for large stampings.

- D32. Beaver, H. LeRoy, "Barrel Finishing of Metal Products. Part 27. The Creation of a Barrel Finishing Laboratory," Products Finishing, Vol. 13, Feb. 1949, p. 52, 54, 58, 60, 62, 64.

Proposes that such a laboratory be created under sponsorship of one or several technical societies. Points out benefits to be derived.

- D33. Charleson, J. E., "Barrel Tumbling Practice on Yale Hardware," Metal Finishing, Vol. 47, Nov. 1949, pp. 51-52.

Cast iron parts are deburred in 10 minutes, steel and bronze parts require up to 8 hours.

- D34. Chase, Herbert, "Finishing Automotive Die Cast Parts," Iron Age, Vol. 164, Nov. 3, 1949, p. 89-91.

Barrel tumbling and blasting remove burrs and flash from zinc dies cast parts.

- D35. Lord, R. M., and M. M. Maynes, "Fast, Low Cost Barrel Finishing," Grits and Grinds, Vol. 38, 1949, pp. 1-5.

Tumbling increases fatigue life. Selection of media for barrel tumbling.

- D36. Weiss, Hans, "Some Aspects of Deburring and Polishing in Barrels," Electroplating and Metal Finishing, Vol. 2, May 1949, p. 349-353; discussion, p. 353-354.

- D37. Weiss, Hans, "Some Aspects of De-Burring and Polishing in Barrels," Journal of Electrodepositors' Technical Society, Vol. 24, 1949, p. 171-180. (Preprint)

Discussion of barrel finishing.

- D38. Weiss, H., "Some Aspects of De-Burring and Polishing in Barrels," Metal Finishing, Vol. 47, July 1949, pp. 54-55.

General description of part motion within barrels.

1950

- D39. Anderson, Robert H., "Wet Tumbling Lowers Deburring Costs," Iron Age, Vol. 166, Nov. 30, 1950, p. 69-71.

Equipment and procedures of Bendix Aviation Corp. Over 1,000,000 Zn, Al, Mg, and steel parts are deburred and burnished each week. Parts from 1 oz. to 15 lb. are wet tumbled in Roto-Finish barrels. Cost is less, and uniformity higher than with hand burring. (L10, Zn, Al, Mg, ST)

- D40. *Bregman, Adolph, "Tumbling For Low-Cost Finishing," Metal Progress, (London), Vol. 57, May 1950, pp. 625-628, 680-694.

A rather complete summary of barrel finishing and its use.

- D41. Chase, Herbert, "Tumbling Nylon Cams," Modern Plastics, Vol. 27, March 1950.

Flash is removed from molded nylon parts by dry tumbling for eight hours.

- D42. Engel, E., "Barrel Tumbling of Parts Prior to Finishing," Tool Engineer, Vol. 24, N2, Feb. 1950, pp. 40-42.

Optimum work loads and media quantities are given as are suggestions for selection of media. Stainless steel wears 0.0003 in a cutting operation and about 0.00015 in a burnish operation.

- D43. Mable, L., "Barrel Finishing," Electroplating, Vol. 3(13), Sept. 1950, pp. 479-487.

Detailed article on how to use barrel tumbling.

1951

- D44. "Abrasive Tumbling - Precision Finishing Method," Steel, Vol. 128, (6), Feb. 5, 1951, pp. 81-84, 86, 89.

General discussion of tumbling using roto finish equipment.

- D45. "Mechanical Deburring at Whirlpool Corporation," Products Finishing, Vol. 15, No. 10, July 1951, pp. 101-103.

General summary of Whirlpool's use of barrel tumbling.

- D46. Blount, Ezra A., "Barrel Deburring and Plating of Steel Stampings," Products Finishing, Vol. 15, May 1951, p. 28-30, 32.

Describes the barrel deburring of steel parts in a two compartment barrel.

- D47. Chase, Herbert, "Deburring Precision Parts by Wet Tumbling Method," Automotive Industries, Vol. 105, Nov. 1, 1951, p. 51-53, 83, 86.

A general discussion of tumbling as used by Warner Gear Co.

- D48. Chase, Herbert, "Gears and Stampings De-Burred by Wet Tumble Grinding," Magazine of Tooling and Production, Vol. 17, Nov. 1951, p. 48-49, 88, 90, 92.

Barrel Finishing Procedure, equipment and applications.

- D49. Chase, Herbert, "How Chevrolet Deburr Powerglide Parts," American Machinist, Vol. 95, April 16, 1951, pp. 138-139.

General discussion of Chevrolet's use of barrel tumbling to deburr transmission parts.

- D50. Gray, Allen G., "Advances in Mechanical Finishing Open Up New Possibilities," Products Finishing, Vol. 16, Oct. 1951, pp. 68-92.

A complete summary of barrel finishing as it existed in 1951.

- D51. Kohler, A. S., "Barrel Tumbling - Present Practices in American Metal Finishing Industry," Metal Industry, Vol. 78, (No. 5), Feb. 2, 1951, pp. 88-89; (No. 9), Mar. 2, 1951, pp. 169-172.

A general summary of the barrel finishing process.

- D52. *Veit, Peter L., "Practical Barrel Finishing - Part I," Metal Finishing, Vol. 49, Sept. 1951, pp. 71-77, 88; "Part II," Oct. 1951, pp. 70-73; "Part III," Nov. 1951, pp. 65-73, 76.

Excellent summary of media selection and abrasive compounds, treatment of metals.

1952

- D53. "Developments in Barrel Finishing," Machinery, Vol. 81, Aug. 28, 1952, p. 354.

General editorial on the applications for barrel finishing. Radii larger than 0.020 inch are not readily producible by barrel tumbling.

- D54. "Stationary Fixture Machine For Barrel Finishing," Metal Finishing, Vol. 50, March 1952, pp. 88-89.

Description of barrel tumbling unit designed for use with fixtures cylindrical parts.

- D55. "Washer-Tumbler Speeds Cleaning, Deburring," Steel, Vol. 130, April 7, 1952, p. 117.

Screw machine parts are tumbled in special machine in kerosene. This machine provides both deburring and cleaning.

- D56. Brandt, William E., "New Trends in the Chemistry of Barrel Finishing," Products Finishing, Vol. 1, Jan. 1952, pp. 24-30.

Summary of changes to more neutral compounds and the differences produced by organic and non-organic compounds.

- D57. Colegate, G. T., "The Mechanical Surface Finishing of Metals," Sheet Metal Industries, October, 1952, p. 948; January, 1953, pp. 5-16, 26.

A summary of barrel finishing equipment and procedures.

- D58. Furbish, Charles O., "Savings by the Barrel," General Electric Review, Vol. 55, Mar. 1952, pp. 40-43.

This general summary of barrel finishing at General Electric contains three fine sketches illustrating the different action. Produced by rough tumbling, rolling, and burnishing.

- D59. Gray, Allen G., "Abrasive Tumbling Offers Finishing Economies," Products Finishing, Vol. 17, Nov. 1952, pp. 66-88.

Use of barrel tumbling at G.E. The effect of load height on radius produced is shown.

- D60. Hubbard, Floyd, "Seven Barrels Bright Hone or Deburr 110 Different Parts," Finish, Vol. 9, Feb. 1952, p. 27-29, 64.

Barrel deburring of wide variety of machining burrs in steel, aluminum, brass, zinc, and stainless steel.

- D61. Kaharl, D. J., "Barrel Finishing Precision Parts for Jet Propulsion Units," Machinery, Vol. 81, Nov. 21, 1952, pp. 1067-1073.

A summary of Pratt & Whitney's use of barrel tumbling.

- D62. Kaharl, Dudley J., "Barrel Finishing Precision Turbo-Jet Parts," Machinery (American), Vol. 58, Aug. 1952, p. 145-151.

Pratt & Whitney barrel finishes steel, brass, aluminum, magnesium, and stainless steel.

1953

- D63. "Abrasives for Tumbling," American Machinist, Vol. 97, June 22, 1953, p. 155.

Presents tabled data on abrasive media and additives.

- D64. Ashmead, Gordon B., "Washing Dollars out of Deburring," Metal Finishing, Vol. 51, Oct. 1953, pp. 71-73.

Description of Ryan Aeronautical Companies use of barrel tumbling. The change to barrel tumbling is expected to save \$100,000 per year.

- D65. Barbicane, T. P., "Barrel Finishing Processes for Small and Large Die Castings," Machinery, (London), Vol. 83, Oct. 30, 1953, p. 866-871.

A review of barrel tumbling covers fixturing of parts also.

- D66. Beaudet, E. C., "Finishing Costs Push Use of Tumbling," Iron Age, Vol. 172, Sept. 3, 1953, pp. 83.

Brief mention of tumbling's use on aircraft parts.

- D67. *Beaver, H. Leroy, "For Reducing Surface Area," Products Finishing, Vol. 18, Nov. 1953, pp. 46-56.

Describes the use and application for various types of media.

- D68. Depastina, Richard, "Precision Tumbling Produces Fine Finish," American Machinist, Vol. 97, July 6, 1953, p. 113-115.

'Slidabrading' deburring.

- D69. DePastina, Richard, "Slidabrading - A Faster, Cheaper Way to Precision-Finish Small Parts," Factory Management, Vol 111, No. 1, Jan. 1953, pp. 106-108.

Burrs up to 0.010 inch thick are removed by this tumbling process.

- D70. Hobday, W. J., "Brake Disks Deburred on Special Fixtures in Rotating Barrels," Automotive Industries, Vol. 108, May 1, 1953, p. 53, 102.

Equipment for deburring SAE 1035 disks.

- D71. Larson, Harry C., "Burr Removal Expedited by Wet Tumbling," Products Finishing, Vol. 18, Nov. 1953, pp. 66-69.

Machined and stamped steel parts are barrel tumbled.

- D72. *Pinke, Kurt G. O., "How To Select Compounds for Barrel Finishing Metal Parts," Precision Metal Molding, Vol. 11, April 1953, pp. 94-105, 118-120.

Excellent in-depth summary of deburring and polishing compounds used in barrel finishers.

- D73. Reed, J. G., "Barrel Finishing Applications in Metal Manufacturing Industry with Job Shop Conditions," ASME Paper 53-F-27, 1953.

Describes use of tumbling in deburring and finishing.

- D74. Stone, W., "Better Tumbling Methods Cut Parts Finishing Costs," Iron Age, Vol. 172, (13) Sept. 24, 1953, pp. 117-121; (14), Oct. 1, 1953, pp. 104-107.

Bridgeport - Lycoming uses tumbling on half of their parts.
Summary of how to select media and compounds.

1954

- D75. "Barrel Deburring Hardened Steel Gun Parts," Products Finishing, Vol. 19, No. 2, Nov. 1954, pp. 82-84.

Slowing barrel speed to insure maximum cutting action removed large burrs which were not removed at higher speeds.

- D76. "Barrelling to Fine Limits," Engineering, 177 (4605), Apr. 30, 1954, p. 573.

Describes roto-finish tumbling equipment.

- D77. "Engineering Applications of Barrel Finishing," Electroplating, Vol. 7, Sept. 1954, pp. 339-340.

General description of barrel finishing operation and use..

- D78. "Machine Adds Finishing Touches," Steel, Vol. 134, May 10, 1954, p. 140.

Spindle finishing produces radii of 0.001 inch or larger.

- D79. "The Scope of Slidabrading," Product Finishing, Vol. 7, Feb. 1954, p. 73-76.

Details of new tumbling process.

- D80. Arensten, Sixten, "An Improved Barrel Finishing Process," Métallurgie et la construction mécanique, Vol. 86, No. 9, Sept. 1954, p. 683 + 5 pages (in French).

Current state of the art of barrel finishing.

- D81. Beaver, H. Leroy, "Barrel Finishing of Metal Products. The Use of a Slurry in Barrel Finishing," Products Finishing, Vol. 18, Jan. 1954, p. 24-26, 28, 30, 32, 34.

Describes the use of the abrasive slurry.

- D82. Chase, Herbert, "Deburring by Wet Tumbling," Metal Finishing, Vol. 52, No. 10, Oct. 1954, pp. 65-67.

Gears of SAE 8617 or 8620 steel are deburred by barrel tumbling for 4 hours.

- D83. Hopewell, L. H., "Barrel Finishing Tumbles Part Costs," Steel, Vol. 135 (16), Oct. 18, 1954, pp. 104-106.

Fairchild Camera & Instrument Corp. uses barrel tumbling to deburr aluminum, bronze and magnesium camera and instrument components.

- D84. Hyler, J. E., "Deburring by Wet Tumbling," Metal Finishing, 52 (10), Oct. 1954, pp. 65-67.

- D85. Mable, L., "Polishing of Metal by the Barrelling Process," Institute of Metal Finishing, Bulletin, Vol. 4, Winter 1954-1955, p. 289-298.

The techniques and equipment for barrel finishing.

- D86. Maynes, Malcolm M., "Precision Barrel Finishing," American Electroplaters' Society, Proceedings, Vol. 41, 1954, p. 27-32.

Techniques of barrel deburring and finishing metal parts.

1955

- D87. "Barrel Finishing," Metal Industry, Vol. 86, May 20, 1955, pp. 419-421.

General discussion of barrelling units and how to use them.

- D88. "Cushioned Cutting Action Improves Deburring Process," Steel, Vol. 117, Oct. 1, 1955, p. 124.

Soft neoprene rubber shapes are impregnated with aluminum oxide to serve as tumbling media. Media is used to provide gentle cutting action on turbing blades, drills, fine pitch gears and other steel, brass, and aluminum components.

- D89. Arensten, Sixten, "Barrel Finishing of Metal Components by the 'Advanced' Barrel Process," Metal Finishing Journal, Vol. 1, May 1955, pp. 199-206.

General description of barrelling operation and applications.

- D90. Chase, Herbert, "Wet Barrel Finish Deburring of Automatic Transmission Parts," Automotive Industries, Vol. 112, April 1, 1955, pp. 48-49, 98.

Aluminum transmission parts are deburred by barrel tumbling.

- D91. Enyedy, Ralph, Handbook of Barrel Finishing, 255 p. 1955. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

The only relatively complete book published on barrel finishing. Includes discussions on equipment, media, and special techniques.

- D92. Heger, "Barrel Deburring Process," Metal Finishing, Vol. 53, Oct. 1955, p. 75.

Abstract of paper read at Oct. 1954 meeting of German sheet research institute. General discussion of barrel tumbling.

- D93. *Hovis, H. L., "How to Deburr Small Parts," American Machinist, Vol. 99, Jan. 17, 1955, pp. 117-124.

Results of a study on the best deburring techniques for watch, instrument and fuse parts. Materials studied include steels, stainless steel, aluminum, brass, bronze, berylliumcopper, nickel silver, sterling silver and gold. Over 250 tumbling materials were evaluated. Savings made by uniform tumbling exceed one-half million dollars. Cleaning of parts, equipment design and media use are described.

- D94. *Kellard, C. J. A., "Progress in Barrel Finishing," Electroplating and Metal Finishing, March, 1955, pp. 95-98; April, 1955, pp. 149-152.

Discusses the development of barrel tumbling from 1790 to 1955. Equipment construction and general principles of the process are described. Operating variables are discussed and a bibliography of patents issued between 1879 and 1915 is given.

- D95. Kollosch, A. W., "Tiny Electronic Parts Tumbled to Precision Finishes," Products Finishing, Vol. 20, Nov. 1955, p. 82-86.

Author estimates tolerances, lists steps of correct tumbler loading, discusses general run and quality control. Photographs.

- D96. *Kurafuji, Hisao, and Natsuo Kinoshita, "Barrel Finishing (Part 2)," Journal of the Society for Precision Mechanics of Japan, Vol. 21, No. 7, June, 1955, pp. 18-22. (in Japanese).

A research study of stock losses and action in barrel finishing.

- D97. Shipley, Morris S., and William A. Biebel, "How to Get Best Results with Precision Barrel Finishing," Grinding and Finishing, Vol. 1, No. 8, Dec. 1955, pp. 26-37.

Describes how to select proper barrel finishing conditions.

- D98. Shipley, Morris S., and William A. Biebel, "Industry Cuts Costs, Ups Production with Precision Barrel Finishing," Grinding and Finishing, Vol. 1, No. 5, Sept. 1955, pp. 12-18.

General discussion of applications and limitations of precision barrel finishing.

- D99. Shipley, Morris S., and William A. Biebel, "Precision Barrel Finishing: Types and Uses of Media & Compounds," Grinding and Finishing, Vol. 1, No. 7, Nov. 1955, pp. 28-38.

General discussion of barrel finishing media and compounds.

- D100. Shipley, Morris S., and William A. Biebel, "Precision Barrel Finishing: What Equipment Do You Need?", Grinding and Finishing, Vol. 1, No. 6, Oct. 1955, pp. 20-27.

General description of tumbling machine designs and accessory equipment.

1956

- D101. "Automated Barrel Finishing Systems Hold Tight Tolerances on Automotive Parts," Products Finishing, Vol. 21, Oct. 1956, pp. 70-74, 78.

Automated barrel finishing line holds 0.0005 inch tolerance on radii of ground steel parts.

- D102. "Consistent Barrel Finishing Assured by File System; Precision Metal Molding, Vol. 14, Jan. 1956, p. 59-61

Use of a file simplifies deburring repeatability.

- D103. "Finishing: Buff Deburr Process Avoids Older Methods," Iron Age, Vol. 178, Dec. 13, 1956, pp. 154-155.

Spindle finishing machine is described.

- D104. "Polishing, De-Burring and De-Scaling," Automobile Engineer, Vol. 46, July 1956, p. 290.

Brief mention of Volkswagen use of tumbling.

- D105. "Standardized Barrel Tumbling Pays Off," Iron Age, Vol. 177, June 21, 1956, p. 115-117.

Barrel finishing of small ferrous parts. Radii of less than 0.002 inch can be maintained.

- D106. Beaver, H. Leroy, "Barrel Finishing Principles," Products Finishing, Vol. 20, June 1956, pp. 76-78.

Brief history of barrel designs.

- D107. Brandt, William E., and David W. Stitely, "How to Buy a Tumbling Barrel," Plating, Vol. 43, June 1956, p. 738-742.

Complete recommendations on what to look for when buying a barrel tumbling unit.

- D108. Brandt, William E., "Standardized Barrel Tumbling Pays Off," Iron Age, June 21, 1956.

Chrysler stocks a single chip size in an attempt to minimize inventory. Worn media is screened and saved. Blend radii below 0.002 inch are obtained. A table lists typical processing parameters for several different specimens.

- D109. Glasrud, C. J. and F. E. Smith, "Effect of Media Size and Time Cycle on Barrel Finishing Results," Products Finishing, Vol. 21, 1956, pp. 40-46.

Presents charts on metal removal rate as a function of time and media size.

- D110. Higgins, Kenneth D., "Barrels Tumble \$30,000 From Stampings Finishing Costs," Tooling and Production, Vol. 22, Oct. 1956, pp. 103-105.

Summary of savings produced on adding machine parts by barrel tumbling.

- D111. *Kincaid, Charles E., "Barrel Finishing," Metal Industry, June 1, 1956, pp. 458-460; June 8, 1956, pp. 477-478.

Results of GMC study of the four popular methods of barrel finishing. In addition to investigating fixturing, self tumbling, multiple compartment barrels, and traditional tumbling, the study included barrel speeds, compounds, types of media, and optimum loading levels. Brass and steel parts illustrate the discussion. After 4 hours, 5/8 inch brass rings had 0.015 inch radii on their edges. Self tumbling using an abrasive compound was used on punch press parts where nicks and scratches were not important. Instructions for optimum operating conditions are given.

- D112. Kincaid, Charles E., "Investigation of Barrel Finishing As a Means of Efficient Burr Removal," General Motors Engineering Journal, Vol. 3, No. 1, Jan-Feb 1956, pp. 34-39; SEE Metal Progress, Vol 69, June 1956, pp. 164-168 for summary.

General summary of barrel finishing.

- D113. Laux, Leon E., "It's Cheaper Tumbling," American Machinist, Vol. 100, July 16, 1956, pp. 124-128.

Description of deburring procedures used for aircraft components. Materials deburred include stainless steel, magnesium, steel, and aluminum. Brief summary of tumbling procedure and selecting compounds.

- D114. *Mickelson, Harold, and Gene E. Olson, "Fixtures in Barrels," Plating, Vol. 43, March 1956, pp. 363-366.

The purpose, applications, and uses of fixtures in barrel tumbling machines are described.

- D115. Nunn, William P., "Barrel Finishing--A Precision Tool," Plating, Vol. 43, Jan. 1956, p. 60-63.

How to select media and compounds for barrel tumbling.

- D116. Pedroja, Frank, "\$200,000 in Annual Savings," Grinding and Finishing, Vol. 1, Jan. 1956, pp. 17-18.

Beech Aircraft uses wet and dry blasting and barrel tumbling to reduce deburring costs.

- D117. Polucha, Albert, "Production Barrel Finishing," Metal Finishing, Vol. 54, Feb. 1956, p. 57-64.

How to process aluminum, brass, copper plastic, steel and zin parts.

- D118. Romais, J. E., "Precision Wet Barrel Finishing," Metal Industry, September 21, 1956, pp. 227-288.

Results of an \$11,000 barrel finishing installation at Douglas Aircraft is described. Cost savings are shown as is a typical job card. Job identification and effects of tumbling on zyglo inspection are mentioned. A saw dust tumbler is used to dry ferrous parts. Limitations of part cladding, fragility, and size are described.

- D119. Romais, J. E. "Same Setup Tumble-Deburrs Large and Small Parts," Iron Age, Vol. 178, Aug. 2, 1956, p. 86-87.

Castings up to 30 in. long deburr in the same equipment handling 2-in aluminum-clad parts. Comparative costs are given.

- D120. Squibb, George R., and Hall, Fred T., "Gyrofinishing," Metal Industry, October 19, 1956, pp. 333-335.

Results of a General Motors study on gyrofinishing. To observe the operation a clear plastic panel was placed over one end of the barrel. The gyrofinishing process was originally patented in the 1800's. Results of the study on aluminum, brass, stainless steel and zinc die castings are described. Diecast parts generally lose 0.005 to 0.001 inch thickness during a 1 minute gyrofinishing run.

- D121. Von der Linden, Arthur, and Steve Yacus, "Scratching the Surface," Plating, Vol. 43, Jan. 1956, p. 67-69.

Operation of and problems in barrel tumbling. Examples of fixturing are given.

- D122. *Williams, K. J., "The Embedment of Abrasive in Lapped Surfaces," Atomic Energy Research Establishment, Great Britain, 1956 (Available from NTIS under Accession No. AD 106878)

Study of irradiated silicon carbide indicates that SIC impregnates into the workpiece in lapping operations. Up to 44 micrograms per cubic centimeter is impregnated. Results show the effects of water-abrasive ratio workpiece material, lapping time and media size.

1957

- D123. "Deburring is a Precision Process," Steel, Vol. 140, Jan. 21, 1957, pp. 82-83.

Ford deburrs aircraft parts with spindle finishing and barrel tumbling machines. Larger parts are fixtured. Edge radius can be held to ± 0.002 inch or less.

- D124. "Faster Deburring," Steel, Vol. 140, April 8, 1957, p. 106.

Fixtured tumbling deburrs jet engine components.

- D125. "How General Motors Corp. Reduce Barrelling Times by Gyrofinishing," Metal Finishing Journal, Vol. 3, Sept. 1957, pp. 360-362.

The development of a spindle finishing machine for high production work is described.

- D126. "This is Barrel Finishing," Precision Metal Molding, Vol. 15, Feb. 1957, pp. 52-57.

Summary of cost per piece saved by barrel tumbling and many different parts. Operating details are also given. Brief and to the point.

- D127. "Tumbling Big Parts Speeds Finishing," Iron Age, Vol. 180, Aug. 1, 1957, pp. 118-119.

Barrel tumbling unit is 6 feet long and 4 feet in diameter. This is used to deburr and finish aircraft shroud rings.

- D128. *Black, T. W., "Fundamentals of Barrel Finishing," Tool Engineer, April, 1957, pp. 109-118.

A summary of barrel finishing media and compounds and how they should be used.

- D129. *Brandt, William E., "Precision Barrel Finishing," Automatic Machining, June, July, p. 49-53; August, p. 47-52; September, p. 51-55; October, p. 59-64; November, p. 59-64, 1957.

Factors in selecting type of barrel and size requirements are described in part 2. Part 3 discusses chemical compounds. Examples of compounds to use on stainless steel, brass, alloy steel and low carbon steel are required. Part 4 discusses burrs on small 303 stainless steel parts. Selection and use of media are described on brass, low carbon, and stainless steel,

and Stellite workpieces. A universal fixture is described. Data presented is fairly detailed. Part 5 discusses media, compounds, and techniques required to deburr plastics. Part 6 describes in detail the techniques and media for deburring screw machine parts. This is one of the most complete series of articles published on tumbling.

- D130. *Brandt, William E., "Why Not Tumble Big Parts," Iron Age, June 20, 1957.

Fixtures are used to deburr parts weighing up to 180 pounds each. Examples discussed include al. rotos, stainless steel heat exchanger, stamped 304 s.s. plates, low carbon cam shafts, bronze and zinc parts. This is one of the better articles on fixturing for loose abrasive processes.

- D131. Enyedy, Ralph F., "Planning Barrel Finishing Operations," Tool Engineer, December, 1957, pp. 105-107.

Brief summary of how to process the difficult parts.

- D132. Fitch, R. W., "Barrel Tumbling-How to Get Best Results," Products Finishing, Vol. 22, Oct. 1957, pp. 28-42.

General instructions for selecting and using barrel tumbling abrasives and compounds.

- D133. Gurnham, C. Fred, "Burr Removal by Barrel Finishing," Products Finishing, Vol. 21, No. 6, March 1957, pp. 48-64.

Describes deburring at General Motor's Allison Division. Four different loose abrasive techniques are described including fixtured barrel tumbling.

- D134. *Kaftol, Philip, "Barrel Finishing Made Simpler," Steel, Vol. 141, No. 11, Sept. 9, 1957, pp. 108-109.

Table describes which media and compound to use for various applications.

- D135. Kohler, A. S., Barrel Finishing," Metal Finishing, 55(8), Aug. 1957, pp. 58-64; (9) Sept. 1957, pp. 59-63; (10), Oct. 1957, pp. 68-73.

- D136. Schaefer, C. B., and R. G. Messenger, "Barrel Finishing with Steel Balls and Shapes," Plating, Vol. 44, Jan. 1957, pp. 40-42.

Brief discussion of use of steel media.

1958

- D137. "Barrel Finishing Saves Money," Grinding and Finishing, Vol. 4, p. 40, June, 1958.

Production rate increases over manual deburring methods are described for six parts. Materials deburred include aluminum, forged steel, and ductile iron.

- D138. "Deburring Problem Solved," Steel, Vol. 143, Oct. 6, 1958, p. 83.

Convair designs vibratory deburring machine to deburr 12 ft. long 7075-76 aluminum spars.

- D139. "High Frequency Vibrations Slash Barrel Finishing Time," Iron Age, Vol. 181, Feb. 20, 1958, pp. 86-87.

This article describes some of the first commercial applications of vibratory deburring.

- D140. "Mass Production Precision Finishing of Miniature Parts," Products Finishing, Vol. 23, Oct. 1958, pp. 74-76.

Miniature bearing races are barrel tumbled to remove small burrs. Parts are so small that 500 fit in a thimble.

- D141. *"Precision Barrelling," Automobile Engineering, 1958, Vol. 48 (13), p. 536-40.

A review of barrel finishing techniques at Rolls Royce LTD. the effect of barrelling, using various load heights and treatment times, on the radius is given for brass, copper, nickel and stainless steel. Short-life coarse grain in combination with long-life fine grain, lubricants, inhibitors and brighteners are used in the form of tablets, which are manufactured in seven grades. Fixture barrelling of cam shafts is described.

- D142. "Vibrating Barrel Finishing Reduces the Cycle," Grinding and Finishing, Vol. 3, Mar. 1958, pp. 38-39.

Vibraslide vibratory deburring machine reduces barrel tumbling time 70%. Jet blades, truss rings, fittings, and armatures are deburred.

- D143. "Vibration Speeds Finishing," Steel, Vol. 142 (No. 23), June 9, 1958, p. 110; See Also Precision Metal Molding, Vol. 16 (No. 10), Oct. 1958, pp. 69-70.

Lorco vibratory finisher works two times faster than conventional barrel tumbling. Examples of costs are given.

- D144. *Biebel, William, "How to Barrel Finish Eggs," Plating, Vol. 45, Jan. 1958, pp. 31-34.

Raw eggs were barrel tumbled to illustrate the ability of the process to handle delicate parts. Selection of media, compound, and operating conditions on zinc, aluminum, stainless steel, and copper alloys is also described.

- D145. Derigs, H., "Mechanisiertes Entgraten von Massenpressteilen," Kunststoffe, Vol. 48, 1958, No. 10, pp. 489-491. (In German)

- D146. *Hall, Fred T., "Loose Abrasive Finishing Machines," Proceedings American Electroplater's Society, 1958, pp. 37-44.

Describes spindle finishing machines and their use. Several examples of parts deburred for the aircraft industry are described. Production rates are typically 1 minute per part.

- D147. Kramer, Charles, "Tumbling Fragile Parts in Standard Equipment," Grinding and Finishing, Sept. 1958.

Describes the use of felt and corn cobs for barrel tumbling.

- D148. Mathewson, Clarence, "Which Abrasives for Barrel Tumbling," American Machinist, Vol. 102, January 13, 1958, p. 101.

Minneapolis - Honeywell evacuated barrel finishing abrasives. Their study resulted in two standardized abrasives: ceramic for deburring, cleaning, and improving surface finish, and ceramically bonded aluminum oxide for grinding. Parts studied were made from aluminum, stainless steel, hardened steel, brass and copper. Workpiece and media stock loss were measured in all tests. Granite chips proved to be unsatisfactory because they break up and the resulting small pieces lodge in holes and small grooves in the workpiece. Granite chips also tend to wear smooth after 70 hours of use. Ceramic media lost only 5% of its weight after 1500 hours of use and it continued to cut well. After 600 hours of use the aluminum oxide bonded chips lost 10% of their weight although they remained sharp. A \$6600 savings resulted from the use of manufactured abrasives rather than granite.

1959

- D149. "Barrel Finishing - New Indications of its Value," Industrial Finishing, Vol. 11, (No. 136), pp. 33-34, October, 1959.

Illustration of the types of applications where barrel finishing is advantageous.

D150. "Das Entgraten, Schleifen und Polieren von Massen und Serienteilen durch das Trowac-Vibratoren ver Fahren," Klepzigs, Vol. 67, 1959, pp. 215-217.

D151. "Deburring Pump Drive Gears," Automobile Engineer, Vol. 49, Dec. 1959, pp. 531-532.

Cast iron cam shafts and pump gears are fixtured for barrel deburring.

D152. "Developments in Barrel Polishing," Metal Finishing Journal, Vol. 5 (No. 53), pp. 196, 204, 1959; similar "Precision Barrel Finishing" Metal Industry, Vol. 94, (No. 16), pp. 305, 309.

Description of 'lacromatic' tumbling barrel. Author claims this double cone barrel produces faster deburring the horizontal octagonal barrel.

D153. "Finishing Sewing Machine Components," Industrial Finishing, Vol. 11, (No. 128), 1959, p. 28.

Barrel finishing reduces hard deburring requirements from 50 to 8 people. Sewing machine parts are tumbled at 10-15 rpm instead of the traditional 24 rpm to prevent part damage. Data is given on time of tumbling and media used. Four examples are described.

D154. "Improved Finishes Claimed for Harperizer," Industrial Finishing, Vol. 11, (No. 137), p. 29, November, 1959.

Basic discussion of the harperizer process.

D155. "Vibratory Motion gives Faster Barrelling," Industrial Finishing (London), Vol. 11 (No. 134), pp. 42, 60, 1959

Brief discussion of vibratory deburring unit by Roto Finish Co. Comparison is made with the burr removal capability of barrel tumbling.

D156. Barton, L. C., "Tumbling and Blasting With Organiz Media," Foundry Trade Journal, Vol. 106 (No. 2211), Feb. 26, 1959, pp. 237-238.

A general summary of barrel tumbling and blasting using walnut shells.

- D157. Blount, Ezra A., "Specialized Finishes and Finishing Processes for Aircraft Instruments," Products Finishing, Vol. 23, March 1959, pp. 34-44.

Includes a description of barrel tumbling and electropolish deburring at Bendix Pioneer - Central plant.

- D158. Brandt, William E., "Controlled Vibration...New Angle in Loose-Grain Finishing," Grinding and Finishing, Vol. 5, p. 30-31, July 1959.

Basic description of vibratory deburring machines and media and compound choices.

- D159. Brandt, William E., "Controlled Vibrations Speed and Simplify Parts Finishing," Iron Age, January 15, 1959.

Description of vibratory deburring. Comparisons between vibratory and barrel finishing times for brass, aluminum, and diecast parts. Vibrators work 10 to 100 times faster than tumbling barrels. Fixturing reduces time by another 50%. Surface finish can be improved 200 points. Stock removal rates of 0.026 inch can be obtained in 1 1/2 hours.

- D160. Castle, C. Heamon, "Mechanical Finishing Using Flowing Abrasive Media," Plating, Vol. 46, No. 1, 1959, pp. 31-33.

Application and operation of a spindle finishing machine are described.

- D161. Dreher, M., "Barrel Finishing," Galvanotechnik, Vol. 50, Sept. 15, 1959, p. 460-466 (in German).

Discusses effects of water level, chemical additives, revolution time and velocity.

- D162. Enyedy, Ralph F., "Barrel Finishing Delicate Parts," Electronics, Vol. 32, Feb. 27, 1959, p. 84.

Brief discussion of four electrical components which were barrel finished.

- D163. *Fishlock, D. J., "Machining in Barrels," Metal Industry, Vol. 95, (No. 3), pp. 55-57, 65; Vol. 95 (No. 4), pp. 79-81; Vol. 95 (No. 5), pp. 95-97, 1959.

Basic discussion of barrel tumbling. Media, mechanism of stock removal and abrasive compounds are described. Author claims corners can be maintained sharp within .002 inch. An example of a part finished to 2 micro inch and a .0001 is given. Part fixturing and barrel designs are described. A number of special design machines are described.

- D164. Harper, John F., "New Machine Smooths Contoured Parts," Products Finishing, Vol. 24, Oct. 1959, pp. 24-28.

Describes harperizer design.

- D165. Kellard, C. J., "Unit Cost of Barrel Finishing 'Infinitesimal'," Industrial Finishing, Vol. 11 (No. 138), 1959, pp. 31-33.

Submerged barrel eliminates the need to flush compounds from barrels. This time improvement however requires special media and burnishing compounds. Comparative run times and costs are given.

- D166. Kramer, Charles, "Barrel Finishing Plastics Parts," Plastics World, Vol. 17, Nov. 1959, pp. 22-23, 26.

Brief summary of barrel tumbling techniques required for plastic parts.

- D167. *Letner, H. R., "Stress Effects of Abrasive Tumbling," Transactions of the ASM, Vol. 51, 1959, pp. 402-420.

This in-depth paper presents 16 graphs showing the effects barrel tumbling has on residual stresses. Media composition, size, and compound effects are analyzed as are barrel geometry.

- D168. Liebman, R. C., "Old Established Roto-Finish Plant in Operation at the Blackburn Works of British Northrop Ltd.," Metal Finishing Journal, Vol. 5, (No. 49), 1959, pp. 26-27.

Brief discussion of one company's use of barrel tumbling. Materials processed include phosphor-bronze, copper, aluminum, steel, brass and cast iron. Small parts are tumbled in a small barrel inside the main barrel, to accelerate part removal from media.

- D169. Maynes, Malcom M., "Barrel Finishing for Plating," Plating, Vol. 46, (No. 1), 1959, pp. 36-40.

Basic discussion of barrel tumbling of die cast parts.

- D170. *Mosher, Donald, Frank Soper, and Thomas Loll, "Barrel Finishing: Materials and Techniques for Precision Results," Products Finishing, Vol. 24 (No. 3), pp. 60-69, Dec. 1959; Vol. 24 (No. 4), pp. 27-31, Jan. 1960.

General discussion of barrel tumbling process and media. Charts are presented indicating ratio of media and parts to use for

various situations. Charts also illustrate selection of abrasive compounds and ratio of abrasive to water.

- D171. *Mosher, D., F. Soper, and T. Loll, "Barrel Finishing With Specific Shape Abrasive Media," Tool Engineer, Vol. 42 (No. 2), Feb. 1959, pp. 81-84.

Describes how to select media size, shape, and compound for barrel finishing.

- D172. Patterson, M. M., "Vibration Deburrs Hard-to-Get-at Areas, Reduces Time," Grinding and Finishing, Vol. 5, Nov. 1959, p. 44-45.

Aluminum and cast iron parts are vibratory deburred rather than tumbled.

- D173. Stevens, L. D., "Barrel Finishing of Castings," Foundry, Vol. 87 (No. 8), Aug. 1959, pp. 65-67.

One Born-Warner plant uses barrel finishing for deburring. Examples of cost savings are shown.

- D174. *Tarasov, L. D., "Barrel Finishing What It Does to Service Life," American Machinist, Feb. 9, 1959, pp. 98-100.

Barrel tumbling raises the fatigue life of the workpiece, reduces the elastic limit, and shortens life of cutters.

- D175. Tuvek, Charles G., "Barrel Finishing Stainless Steel Hex Nuts," Products Finishing, Vol. 23, Feb. 1959, pp. 50.

Describes tumbling process for deburring punched stainless steel part.

- D176. *Tuvek, C. G., "Reduce your Tumbling Time. How to Prefinish Parts on Abrasive Belts in Preparation for Tumbling," Products Finishing, Vol. 23 (No. 7), 1959, pp. 30-34.

Pratt & Whitney use of abrasive belts for removing large burrs prior to barrel tumbling is described. A discussion of proper belt abrasive for various workpiece materials is given.

- D177. Watkins, N. L., "Barrel Finishing," Automatic Machining, Vol. 21, Nov. 1959, p. 45-48.

Small screw machine parts are barrel tumbled for deburring.

1960

D178. "Abrasive Slurry Deburrs at High Speed," Metal Working Production, Vol. 104, 1960, N. 23, pp. 83-85.

D179. "How Pesco Products Improved Deburring," Products Finishing, Vol. 24 (No. 6), March 1960, pp. 64-68.

Hydraulic, electrical, and missile components are deburred by barrel tumbling. Prior to tumbling large burrs are removed with knives or by grinding. Specifications stipulate that there shall be no raised metal on the .0001-.0005 inch tolerance parts.

D180. "Mechanical Burr Removal," Precision Metal Molding, Vol. 18 (No. 7), July 1960, pp. 85-90.

D181. "Precision Barrel Deburring of Cam Shaft Gear," Metal Working Production, Vol. 104, 1960, pp. 477-479.

D182. "Production Deburring of Bearing Races," Metalworking Production, Vol. 104, 1960, N. 38, p.82.

D183. "Rotolisieren - Eine Neuzeitliche Polier-und Entgratungstechnik," Uhr, Vol. 33, 1960, No. 2, p. 7. (in German)

D184. "Shake Deburring Rings Up Savings For Cash Register Maker," Steel, Vol. 146, May 2, 1960.

National Cash Register uses vibratory deburring.

D185. "Smoothing Off Clock Parts," Products Finishing, Vol. 24 (No. 5), Feb. 1960, p. 50.

Westclox uses barrel tumbling to deburr 80,000 clock parts a day. Previously workers used power tools.

D186. "Some Details of the Vibratory Finishing Process," Metal Finishing Journal, Vol. 6, July 1960, pp. 276-278.

Another basic summary of vibratory finishing.

D187. "Vibratory Finishers for Deburring," Products Finishing, Vol. 25, Nov. 1960, p. 84-86.

Deburring of steel stampings, aluminum die castings, and machined components. Delicate parts are cushioned.

- D188. Ashmore, Joseph, "Tumbling Thermoplastics," Modern Plastics, Vol. 37, March 1960, p. 109-112, 193.

Provides a general discussion of how to deburr and polish cellulose, methyl methacrylate, teflon, lucite, acetate, and butyrate plastics.

- D189. Burkart, Walter, H. Silman, and C. R. Draper, Mechanical Polishing, Robert Draper Ltd., Teddington, England, 1960, 255 pp.

Detailed account of manual and automatic polishing and buffing, barrel finishing and abrasive blasting of ferrous and nonferrous metals as currently practised in England, America and Germany. Particular attention is paid to the more recent developments such as automatic polishing machines, liquid polishing compositions, wet blasting processes and barrel de-burring and finishing.

- D190. Earl, Robert E., "Drum Tumbling is an Economical Process for Fine Polishing," Machine Moderne, Vol. 54, June 1960, p. 29-30 (in French).

Results of barrel tumbling.

- D191. Earl, Robert E., "Why Not 'Tumble' into Higher Profits," Machinery (N.Y.), Vol. 66, Jan. 1960, pp. 122-124.

Spindle finishing produces 0.003 edge radii and barrel finishing applications are shown in which roller bearings are polished.

- D192. Enyedy, Ralph F., "Precise Barrel Finishing," Metal Finishing, Vol. 58, July 1960, p. 85-90.

Uses of barrel finishing are described.

- D193. Enyedy, Ralph F., "Precise Barrel Finishing. Pt. 2," Metal Finishing, Vol. 58, Aug. 1960, p. 54-59.

Description of various barrels available, and the media used in them.

- D194. Enyedy, R. F., "Precise Barrel Finishing," Metal Finishing, Vol. 58 (No. 9), Sept. 1960, pp. 65-68.

- D195. Forrester, J. J., "What Precision Barrel Finishing Can Do," Products Finishing, Vol. 24 (No. 6), March 1960, pp. 54-56.

General discussion of barrel finishing. Examples of deburring, descaling and polishing are shown.

- D196. Horton, Kenneth W., and E. Noah Gould, American Machinist, Vol. 104, March 21, 1960, pp. 122-123.

Vent design to release pressure in tumbling barrels is shown.

- D197. *Kohler, A. S., "Abrasive Compounds in Barrel Finishing," Plating, Vol. 47 (No. 1), Jan. 1960, pp. 59-62.

An excellent summary of effects of abrasive compounds on surface lustre.

- D198. Magnusson, Francis, and Marty LeClair, "How C.M.W. Electroplaters Reduced Manual Handling," Products Finishing, Vol. 24, Aug. 1960, pp. 68-72.

Brief discussion of automated line for cleaning, deburring, and plating.

- D199. Patterson, M. M., "How Planning Built a Modern, Efficient Barrel Finishing Department," Grinding and Finishing, Vol. 6, Dec. 1960, p. 26-29.

Effect of tumbling parameters on finished parts.

- D200. Springford, J. L. H., "Plessey Barrel Half-Million Parts Weekly," Metalworking Production, Vol. 104, Aug. 10, 1960, p. 56-60.

- D201. Ulrich, Werner, and Hans Pimishofer, "Grinding and Polishing in Drums," Fertigungstechnik und Betrieb, Vol. 10, Dec. 1960, p. 728-731 (in German).

Deburring, polishing and grinding of die castings and forged and stamped parts of Fe, steel, Cu, Zn or Al in steel or wooden drums, using stones or metallic bodies and chemicals as grinding media. Operation experiences; limit of applicability.

- D202. Walmsley, A., "Designing for Simpler Metal Finishing Techniques," Product Engineering, Vol. 31, Mid-Sept. 1960, p. 108-111.

Design considerations which simplify barrel deburring of parts.

1961

- D203. "Barrel Finishing," Automatic Machining, Vol. 22, Jan. 1961, p. 45-47.

Applications of barrel finishing.

- D204. "Barrel Finishing Offers Efficiency and Low Cost," Design Engineering, Vol. 7, Jan. 1961, p. 28-32.

Stamped parts are barrel deburred. Efficiency of the process depends on shape of abrasive and parts, as well as load height, speed of barrel, and size and hardness of part.

- D205. "Controlled Finishing by Vibration," Automobile Engineer, Vol. 51, Jan. 1961, pp. 36-37.

Brief summary of vibratory deburring process.

- D206. "Faster, More Refined Metal Finishing," Engineering, Vol. 192, Oct. 27, 1961, p. 536.

Steel crankshafts, laminated parts and steel bolts are deburred and radiused by vibratory deburring.

- D207. "Fixture Barrelling Diecast Aluminum Plates," Electroplating and Metal Finishing, Vol. 14, June 1961, p. 213-214.

Steel balls deburr fixtured aluminum plates in barrel.

- D208. "Lacromatic Vibrator for Deburring and Polishing Metal Parts," Machinery (London), Vol. 98, Jan. 11, 1961, p. 78-79.

Describes path parts follow when deburred in lacromatic vibratory unit. Gears, stampings, and die castings are deburred.

- D209. "Machine Cuts Spar-Deburring Time 68%," American Machinist/Metalworking Manufacturing, Vol. 105, March 6, 1961, p. 79.

Boeing builds vibratory deburring unit to handle 1500 spars per month each up to 15 ft. long. A rubber bladder is inflated with water to pressurize the vibratory chamber.

- D210. "Mechanical Rubber Deflashing," Mechanical Engineering, July, 1961, p. 60.

Liquid CO₂ freezes the flash on molded rubber parts. Flash must be controlled to within 0.005 inch. Parts are peened with 0.011 inch steel shot.

- D211. "Osromatic Vibratory Finishing Machines," Machinery (London), Vol. 99, Dec. 13, 1961, p. 1398-1400.

Automatic batch type machine uses vibratory motion for deburring and cleaning.

- D212. "Precision Finishing by Vibration," Australasian Manufacturer, Vol. 46, Apr. 15, 1961, p. 76-78.

Burnishing and deburring of phosphor bronze bearing cages, zinc die castings and steel stampings, circlips and screw inserts with vibrator machine results in much faster processing time than with barrelling machine.

- D213. "Vibrafinishing for Batch and Flow Line Production," Industrial Finishing (London), Vol. 13, Nov. 1961, p. 53-54.

- D214. "Vibrating Finishing Machines," The Engineer, Vol. 212, Nov. 3, 1961, p. 755.

- D215. "Vibration Deburring Saves NAA \$100,000," Western Metalworking, Vol. 19, Dec. 1961, p. 36-37.

Deburring, burnishing, coloring and cleaning of brass, stainless steel, cast iron, Al and plastic components by a mechanical vibration deburring machine. Vibration finishing is compared with hand and barrel deburring for component uniformity and dimensional tolerances as well as for bright and honed surface finishes.

- D216. "Vibration Finishing Ends Deformation of Light Parts," Steel, Vol. 148, Feb. 27, 1961, p. 116-117.

Small spring metal parts are vibratory deburred.

- D217. "Vibratory Finishing," Electroplating and Metal Finishing, Vol. 14, Dec. 1961, p. 462-463.

Vibratory finishing also deburrs metal components.

- D218. "Vibratory Finishing," Precision Metal Molding, Vol. 19, Jan. 1961, p. 54-55.

General summary of vibratory unit operation and benefits.

- D219. "Vibratory Finishing. Improved Range of Machines for Deburring and Polishing," Metal Ind., 1961 Vol. 99, No. 17, 343-4.

Description of vibrating finishing plant of Roto-Finish Ltd., Hemel Hempstead, G.B.

- D220. Bertorelle, E., "The Evolution of Barrel Finishing," Galvano Technica, 1961, Vol. 12, No. 9, 193-4.

Brief historical review of barrel finishing.

- D221. Black, T. W., "Controlled Vibration--Key to Parts-Finishing Efficiency," Tool and Manufacturing Engineer, Vol. 46, Jan. 1961, p. 77-79.

Stainless steel and brass components are vibratory deburred.

- D222. Brandt, William E., "Discover Vibratory Finishing," Machinery, Vol. 67, Aug. 1961, p. 81-89.

Vibratory finishing with loose abrasives is used for cleaning, descaling, deburring, radius forming, coloring and burnishing of ferrous and nonferrous, cast, forged, stamped, pressed or machined metal parts. The workpieces are embedded in a mixture of fused Al_2O_3 , SiC, ceramic triangles and H_2O and are subjected to controlled vibratory vibration in specially designed equipment. Examples shown include low carbon steel, stainless steel, and die castings.

- D223. Brandt, William E., "Vibratory Finishing," Machinery (London), Vol. 99, Nov. 1, 1961, p. 1019-1025.

Carbon steel sprockets, aluminum motor frames, stainless steel turbing wheels, die cast and titanium parts are vibratory deburred.

- D224. Brandt, William E., "Vibratory Finishing Equipment," American Machinist/Metalworking Manufacturing, Vol. 105, Sept. 18, 1961, p. 118-121.

Aircraft connecting rods, stainless steel gears, delicate textile needles and brass fixtures are vibratory deburred.

- D225. Brandt, William E., "Vibratory Finishing the Key to Smoother Surfaces," Iron Age, May 18, 1961.

Vibratory finishing polishes turbing blades 21 times faster than barrel tumbling. After 2/3 of an hour, surface finishes went from 116 to 7 using fixtures. Without fixtures a 2 hour polish produced only a 19 finish. After 16 hours in barrels the best finish attained was a 47.

- D226. Brown, Michael E., "Hula-Action' Deburring Outruns Conventional Tumbling Barrel," Metalworking, Vol. 17, Nov. 1961, p. 16-18.

Vibratory deburring of aluminum and magnesium castings.

- D227. Burr, J., "Control and Techniques in Barrel Finishing," Industrial Finishing, Vol. 13, March 1961, p. 29-32.

Effects of barrel tumbling variables on finish produced.

- D228. Desemery, P. P., "New Process for Deburring and Surface Treatment," Mecanique-Electricite, 1961, Vol. 45, No. 141, 93-5, (in French).

Barrel deburring with ceramic abrasive and oil or chemical solutions is described. Saw dust is used to give fine finishes.

- D229. deVere Weston, G. D., "Vibratory Movement Speeds Finishing," Ind. Finishing London, 1961, Vol. 13, No. 153, 42 - 3, 45.

The Lacromatic Vibrator is described.

- D230. Elliott, B. W., "Rotation + Vibration Vibratory Barrel Finishing," Grinding & Finishing, Vol. 7, Dec. 1961, p. 30-32.

- D231. Fishlock, D. J., "A Look at Modern Barrelling Practice," Electroplating India, 1961, Vol. 3, No. 2, 5-19.

Summary of barrel finishing.

- D232. Hodges, F. D., "How to Use Vibratory Finishing," Iron Age, 1961, Vol. 187, No. 4, pp.72-3.

Vibratory finishing of aluminum die cast doors.

- D233. Irving, R. R., "Centrifugal Force Adds Luster to Barrel Tumbled Parts," Iron Age, Vol. 187, Feb. 2, 1961, p. 84-85.

Description of harperizing.

- D234. Khol, R., "Design for Barrel and Vibratory Finishing," Precision Metal Molding, 1961, Vol. 19, No. 7, 45-8.

Effects of part design on effectiveness of vibratory deburring.

- D235. Merwin, M., "Barrel Finishing Die Castings," Precision Metal Molding, 1961, Vol. 19, No. 2, 43-4.

A barrel finishing compound is described for Zn base die castings.

- D236. Moushey, Paul C., "Heavy Parts--Deburring by Vibration," Grinding and Finishing, Vol. 7, Mar. 1961, p. 44-46.

Castings and heavy components are vibratory deburred.

- D237. Nunn, William P., "Barrel-Finishing Guide. Pt. 1," American Machinist/Metalworking Manufacturing, Vol. 105, Oct. 30, 1961, p. 123-125.

A guide to using barrel finishing.

- D238. Olson, G., "Horizontal Barrel and Vibrating Finishing," Precision Metal Molding, 1961, Vol.19, No. 10, pp. 77-9.

Barrel finishing of instrument housings, propeller blades, grilles, window frames and door parts.

- D239. Polucha, A. A., "This Barrel Spins and Vibrates," Metalworking Production, Vol. 105., July 5, 1961, p. 83.

Rotary and vibratory motion are combined to produce a waterfall effect.

- D240. Poluchka, A. A., "Vibratory Finishing," American Machinist/Metalworking Manufacturing, Vol. 105, Apr. 17, 1961, p. 141-142.

Rotation and vibration combine to produce a spiral orbital motion which reduces deburring and polishing time on cast iron, hardened steel and other metal parts.

1962

- D241. "Abrasive Engineer's Corner," (Barrel Deburring Nylon Parts), Grinding and Finishing, March 1962, p. 13.

Brief discussion of barrel tumbling burrs on nylon components.

- D242. "Close Control with Light Finishing Machine," Industrial Finishing, Vol. 14, No. 170, Aug. 1962, p. 29-30.

Deburring, deflashing and polishing using vibration. Compares results to barrel tumbling.

- D243. "Compound Recirculation Results in Cleaner Parts," Products Finishing, 1962, Vol. 26, No. 6, 60-2, 64.

Sludge build up is limited by recirculating compound.

- D244. "De-burring and Metal Pre-Finishing Techniques," Electroplating and Metal Finishing, 1962, Vol. 15, No. 9, p. 319.

Report of the P.E.R.A. Conference, Melton Mowbray, 1962, on this subject.

- D245. "Facts Prove Advantages of Vibratory Finishing," Industrial Finishing (London), Vol. 14, No. 169, July 1962, p. 27-28, 31-33.

Steel, zinc, al, and bronze die castings are vibratory deburred. Data is given on water and power consumption and chip wear.

- D246. "Fixtures in Barrelling," Tijd. Oppervlaktetechnieken, 1962, Vol. 5, No. 10, pp. 16-7.

Barrel finishing in fixtures is described.

- D247. "Shaking Parts to a Fine Finish," Iron Age, Vol. 190, No. 20, Nov. 15, 1962, p. 121.

Stainless steel valve are vibratory deburred.

- D248. "Steel Wool Tumbling Media," Automatic Machining, Vol. 23, No. 12, Oct. 1962, p. 72.

Use of tumbling media made of steel wool fibers combined with resin binder into hard squares for the finishing and deburring of carbon steel washers.

- D249. "Vibratory de-Burr and Polish Machine," Light Metals, 1962, Vol. 25, No. 291, p. 224.

Aluminum castings are vibratory deburred.

- D250. "Vibratory Finishing," Automobile Engineer, Vol. 52, Jan. 1962, pp. 32-34.

Discussion of design of roto-finish equipment.

- D251. "Vibratory Versus Barrel Finishing," Metalworking Production, Vol. 106, No. 26, June 27, 1962, p. 48-52.

Vibratory and Barrel deburring results are compared.

- D252. Aufuldish, W., "Finishing Components for Cash Registers by Vibration Deburring," Machinery (London), Vol. 101, No. 2609, Nov. 14, 1962, p. 1110-1112.

Cash Register components are vibratory deburred. Surface finish and tolerances are examined.

- D253. Aufuldish, William, "Vibration Deburring Breaks Finishing Bottleneck," Machinery, Vol. 68, No. 12, Aug. 1962, p. 128-131.

Vibratory deburring of machined gears, levers, bearings, and plates.

- D254. Black, T. W., "Fundamentals of Vibratory Finishing," Tool and Manufacturing Engineer, Vol. 49, No. 5, Nov. 1962, p. 93-100.

Review of vibratory equipment and variables. Fixturing is also illustrated.

- D255. Bonnemaier, E., "The Trowal-Barrel Finishing Process Using Vibratory Equipment," Metall, 1962, Vol. 16, No. 1, 35-8.

Vibratory deburring of sewing and office equipment components.

- D256. Brandt, William E., "Vibratory Barrels Cut Costs 65%," Metalworking Magazine, Oct. 1962.

Eimco Corp. uses pangborn vibratory deburring units to deburr 4000 castings, forgings, and machined parts per week. A savings of 65% were realized over hand deburring methods.

- D257. Brandt, William E., "Vibratory Finishing," Australasian Manufacturer, Vol. 46, Feb. 10, 1962, p. 44-48.

Effects of time cycle, frequency and amplitude on burr removal are described.

- D258. *Brandt, William E., "Vibratory Finishing--A Precision Process," Precision Metal Molding, Vol. 20, June 1962, pp. 56-58.

Summary of surface finishes produced by barrel finishing, vibratory finishing, and fixtured vibratory deburring.

- D259. Castle, C. Hegman, "Metal Surface Preparation and Cleaning. Pt. C. Barrel Finishing Methods--Finishing Large Precision Type Parts," Chapter 3 from "Electroplating Engineering Handbook". 2nd Edition. Reinhold Publishing Corp., New York 22, 1962, p. 99-107.

Large parts are barrel finished one at a time in compartments of relatively small size or on fixtures in large compartments.

- D260. Denny, C., "A Basis for Evaluation: Barrel or Vibratory Finishing?," Trans. 1962 National Die Castings Congress, 25th - 28th Sept., Detroit, Mich. Soc. Die Castings Engrs., B-31.

Barrel and vibratory finishing are compared using case histories.

- D261. Dreher, Manfred, "Cleaning and Deburring of Zinc Pressure Die Castings and Aluminum and Brass Gravity Die and Sand Castings in Barrels, Manfred Dreher, Galvanotechnik, Vol. 53, No. 9, Sept. 1962, p. 441-444 (in German).

- D262. Funabashi, W., "Barrel Finishing Compounds," Rept. Govt. Ind. Res. Inst. Najoya, 1962, Vol. 11, No. 3, 146-51; No. 4, 210-6.

Brightening in barrel finishing using soap base compounds, e.g. 2% soln Na laurate, myristate, palmitate, stearate, oleate and toilet soap, soya bean oil and linseed oil soap was investigated. The brightness varied with the soap. Na stearate, toilet soap, soya bean oil soap or Na oleate with NaOH gave the best results, Particularly 1.6% Na stearate with 0.4 Na oleate. In experiments with metallic and abrasive media (SiO_2 , fused Al_2O_3 , emery, SiC , synthetic Al_2O_3 powder, Fe and Cr oxides) SiO_2 , fused Al_2O_3 energy and synthetic Al_2O_3 powder increased the polishing effect, Fe and Cr oxides gave the best surface finish.

- D263. *Goldman, Hubert M., "Metal Surface Preparation and Cleaning. Pt. C. Barrel Finishing Methods--Bulk Finishing Small Parts," Chapter 3 from Electroplating Engineering Handbook. 2nd Edition. Reinhold Publishing Corp., New York 22, 1962, p. 83-99.

Complete review of barrel finishing equipment and processes.

- D264. Hagelucken, B., "Vibrators, Operations and Application," Galvanotechnik u. Oberflächenschutz, 1962, Vol. 3, No. 6, 133-45. (In German)

A review of vibratory barrel finishing equipment and applications.

- D265. Heger, G., and H. Nann, "Experiences in the Use of Vibratory Barrel Polishing," Galvanotechnik u. Oberflächenschutz, 1962, Vol. 3, 23-7, 29, (in German).

A brief review of vibratory finishing equipment and processes.

- D266. Hendey, J. C., "Barrel Deburring and Polishing," Metal Finishing Journal, Vol. 8, Apr. 1962, p. 119-134.

How to Use barrel deburring.

- D267. Iredale, R., "Ball Mill Solves a Barrel Finishing Problem," Metalworking Production, Vol. 106, No. 45, Nov. 7, 1962, p. 67-68.

Barrel finishing deburrs metal components.

- D268. Keller, H. L., "Polishing and buffing," Schleif-u. Poliertechnik, 1962, Vol. 2, No. 10, 516-8; No. 11, 577-9 (in German).

Polishing wheels, adhesives, abrasives, belts and buffs, and deburring are reviewed.

- D269. Kolesnik, N. V., "Vibration Method of Cleaning and Finishing," Vestnik Mashin, 1962, No. 11, 85-6 (in Russian).

A short illustrated description is given of the equipment and method of cleaning, deburring, etc., castings, etc., by vibrating them in containers with abrasive chips. The machine comprises two containers each of 100 l capacity. Driven by a common 7-5 kW motor, they are vibrated at 1,400 cycles/min with an amplitude of 2-5 mm. The process is claimed to be much more effective than tumbling in a rotating drum and output is 4-5 times greater. Spent chips can be restored by blowing with compressed air to remove fines.

- D270. *Matsunaga, Masahisa, "Barrel Finishing in Japan," Cirp Annalen, Vol. 11, No. 4, 1962/63, p. 221-224.

Research study of abrasive action in barrels.

- D271. Nann, H., and G. Heyer, "Deburring, Grinding and Polishing of Zinc Base Die Castings in Barrels and Vibrators," Schleif u. Poliertechnik, 1962, Vol. 2, No. 12, 619-24 (in German).

A review of barrel and vibratory deburring of zinc alloys.

- D272. Nann, H., and G. Heger, "Deburring, Grinding and Smoothing," Schleif u. Poliertechnik, 1962, Vol. 19-26 (in German).

Metal removal rates in barrel and vibratory deburring.

- D273. Nunn, W. P., "Guide to Barrel Finishing," Metal Work Prod., 1962, Vol. 106, No. 8, 83, 85.

Guidelines for barrel finishing.

- D274. Parry, W. P., "First Principles of Barrel Finishing," Electroplating and Metal Finishing, 1962, Vol. 15, No. 1, 10-3.

A review of barrel polishing machines, media, compounds and operating conditions.

- D275. Rakestraw, Arthur, "Barrel Deburring Nylon Parts," Grinding and Finishing, March 1962, p. 13.

General rules for removing burrs from machined nylon.

- D276. Sivak, J. C., "The Barrel Finishing Process-A New Approach," Plating, 1962, Vol. 49, No. 8, 870-1.

Physical and chemical factors in barrel finishing.

- D277. Sivak, J. C., "The Barrel Finishing Process-A New Approach," Plating, 1962, Vol. 49, No. 8, 870-1.

Physical and chemical factors in barrel finishing.

- D278. Tomas, E., "Barrel Polishing," Pinturas y Acabados Ind., 1962, Vol. 4, No. 24, p. 41-45.

A review dealing with barrel operating techniques, auxilliary equipment, media and compounds.

- D279. Tucker, Robert J., "Vibration Deburrs Aluminum Parts," American Machinist/Metalworking Manufacturing, Vol. 106, May 14, 1962, p. 140.

Deburring of aluminum die cast typewriter parts.

- D280. Weihrich, O., "Tumbling Grinding and Polishing of Small Parts in Vibrating Equipment," Blech, 1962, Vol. 9, No. 12, 663-7 (in German).

A review of vibratory finishing equipment.

- D281. Wood, Norton, "Vibratory Deburring Shakes Loose \$100,000 Per Year At North American," Grinding & Finishing, Vol. 8, Mar. 1962, p. 52-53.

Savings produced by vibratory deburring. Comparisons with barrel tumbling and hand deburring.

1963

- D282. "An Improved Barrel Deburring Process," Engineering (London), Vol. 196, No. 5095, Dec. 13, 1963, p. 748-749.

Turbing blades, needles, gears and bearings are harperized.

- D283. *"Barrel Finishing," Metals Handbook, 8th Ed., Vol. 2 (Heat Treating, Cleaning and Finishing), American Society for Metals, New York, 1964, pp. 387-397.

This chapter covers the total game of barrel tumbling and vibratory deburring. It describes equipkent, operations, selection of media and compounds, ccst, floor layout, and safety.

- D284. "Barrel Finishing of Stainless Steel," Galvano, 1963, Vol. 32, No. 318, p. 521-5 (in German).

- D285. "Barrel Finishing of Stainless Steel," Galvano, 1963, Vol. 32, No. 320, p. 615-20. (In German)

Barrel equipment, operating specifications and after treatment are discussed in this final installment.

- D286. "Can Spin-Finish Help You?," Products Finishing, 1963, Vol. 28, No. 1, p. 40-5.

Parts are fixtured in Grav-I-Flo machine.

- D287. "Continuous, In-Line Vibratory Finishing," Precision Metal Molding, Vol. 21, No. 8, Aug. 1963, p. 39-41.

Automatic, continuous vibratory finisher, deburrs and finishes cast parts.

- D288. "Deburring and Surface Finishing Small Components," Metallurgia, Vol. 67, April 1963, p. 177.

Harperizer is described. Machine rotates at 249 RPM to provide 25 g's force on parts and media.

- D289. "Deburring, Polishing and Other Finishing Operations with the Turbula Process," Galvanotechnik u. Oberflächenschutz, 1963, Vol. 4, No. 1, p. 25, 27 (in German).

A brief review of the Turbula barrel machine (Switzerland).

- D290. "Development in Gear Deburring," Automobile Engineer, Vol. 53, April 1963, pp. 158-159.

General discussion of spindle finishing machine includes some data on best speeds.

- D291. "Rapid Deburring of Small Components," Ind. Finishing (London), 1963, Vol. 15, No. 182, p. 36.

Brief note on the Harperizing barrel finishing process.

- D292. "Use of Abrasive Grain in Barrel Finishing," Grinding & Finishing, Vol. 9, No. 10, Oct. 1963, p. 43-45.

Study of effect of shape and size of media.

- D293. "Use of Abrasive Grain in Barrel Finishing. Pt. 2," Grinding & Finishing, Vol. 9, No. 11, Nov. 1963, p. 39-42.

Influence of water level, choice of speed, media, various chemical compounds and cycle length during barrel finishing of Zn, cuprous alloys, extruded Al and ferrous parts. Effect of finishing technique on corrosion and pitting resistance.

- D294. "Vibrator Unifies Finishing Tasks," Iron Age, 1963, Vol. 191, No. 24, p. 134-5.

Description of an automatic vibrating finishing line at Motorola.

- D295. *"Vibratory Finishers or Rotating Barrels?", Precision Metal Molding, Vol. 21, March 1963, pp.52-53.

Comparisons are made point by point between barrels and vibratory units.

- D296. "Volume Burr Removal-Tolerance Retention," Grinding and Finishing, Dec. 1963, p. 29.

Vibratory deburring of steel and aluminum. 15 minute deburring cycle in vibratron 18 cubic feet capacity tub.

- D297. Anderson, R. D., "Abrasives Tumble Finer Finishes," Iron Age, Vol. 192, No. 10, Sept. 5, 1963, p. 76-77.

Techniques to use in tumbling parts.

- D298. Astrop, A. W., "Mechanized Surface-Finishing and De-Burring on Batch Basis," Machinery, (London), 102 (2638), June 5, 1963, pp. 1269-1271.

Vibratory and abrasive blasting are used to deburr a wide variety of cast magnesium parts.

- D299. *Babichev, A. P., and V. I. D'Yachenko, "Investigation of Polishing in Vibratory Drums," Russian Engineering Journal, 1963, No. 6, pp. 41-43.

Brass, aluminum and steel are vibratory finished. Relationships are shown for metal removal rate, amplitude, and vibration frequency, time ratio of workpiece to media, weight of workpiece, hopper fill height, and media size.

- D300. Bacquias, G., "Finishing by Vibration," Galvano, 1963, Vol. 32, No. 317, p. 441-6 (in German).

A review of vibrating finishing plant.

- D301. Borch, E. A., "Which Abrasive is Best for You?", Foundry, Vol. 91, No. 9, Sept. 1963, pp. 139-40, 142, 144-6, 148, 150-1.

Guide to the selection of abrasives.

- D302. Brandt, W. E., "A New Look at Vibratory Finishing," Metal Progress, Vol. 84, Nov. 1963, pp. 96-100.

General summary of vibratory deburring.

- D303. Brandt, William E., "Continuous, In-Line Vibratory Finishing," Precision Metal Molding, August, 1963.

Continuous fully automatic finishing line deburr and radius aluminum die castings. Article is primarily a discussion of the automated approach and the function of specific features of a pangborn unit. Data and cost of finishing are described.

- D304. Brandt, William E., "Vibratory Principles," Automatic Machining, August-November, 1963.

Basic discussion of origin of vibratory deburring; media motion in barrels and vibrators, media consumption and all details of equipment costs and use are described. A table is presented illustrating the comparative time savings over barrel tumbling for various materials and operations.

- D305. Davidson, L. R., "Can Spin-Finish Help You?," Products Finishing, Vol. 28, Oct. 1963, pp. 40-45.

Spindle finishing as well as tumbling and vibratory finishing are described.

- D306. Funabashi, W., "Barrel Finishing Compounds for Zinc Diecastings," Metal Finishing Soc., Jap., 1963, Vol. 14, No. 2, pp. 50-2.

Effects of additives on zinc diecastings.

- D307. Funabachi, W., "Barrel Finishing Compounds for Zinc Die Castings," Repts. Gov. Ind. Res. Inst. Nagoya, 1963, Vol. 12, No. 1, 15-8.

The mechanism of brightening of surfaces of Zn base die castings.

- D308. Hignett, J. B., "Tool for Precision De-Burring," Metalworking Production, Vol. 107, Nov. 13, 1963, pp. 51-53.

Description of harperizing.

- D309. Kartyshev, B. N., "Vibratory Abrasive Finishing," Mashinostr., 1963, No. 4, p. 33 (in Russian).

- D310. *Kohl, Ronald, "Barrel Finishing Trial Runs," Precision Metal Molding, Vol. 21, No. 4, Apr. 1963, p. 47-50.

Determination of suitable loads, water levels, media and speeds for barrel finishing of nonferrous and ferrous metal parts by making trial runs. Compound characteristics for cleaning, deburring, honing and finishing.

- D311. Krydsby, P., "Barrel Finishing," Norsk Galvano-Teknisk, 1963, Vol. 6, No. 1, pp. 9-11.

Equipment, operating details and chips and compounds are reviewed.

- D312. Matarese, Frank R., "Out Go Burrs and Bevels -- Enter Radius Corners," Machinery (N.Y.), Vol. 69, May 1963, pp. 114-117.

Vibratory deburring produces 0.005-0.015 inch radius on stainless steel, aluminum, brass, titanium and other space age materials.

- D313. *McKee, Richard L., "Seven Ways of Deburring," Grinding & Finishing, Vol. 9, No. 11, Nov. 1963, p. 28-31.

'What is a Burr?' is answered. Effect of part size, weight, and burr size influence choice of deburring process. Deburring processes discussed include barrel, brush, sanding, vibratory manual, blasting, and mechanically cutting.

- D314. Metarese, Frank R., "Deburring and Corner Radiusing on Critical Components," Machinery (London), Vol. 103, No. 2652, Sept. 11, 1963, p. 607-609.

A description of a vibratory process for deburring A-286, stainless steel, titanium, Waspoly, Rene 41, 17-4 PH, brass, magnesium, aluminum and mild steel.

- D315. Nann, H., and G. Heger, "Vergleichende Untersuchungen Über Mechanisch-Chemisches Entgraten, Schleifen und Glatten in Trommeln und Vibratoren," Galvanotechnik, Vol. 54, 1963, pp. 19-26 (in German).

- D316. Parthey, W., "Review on Noise Reduction in Cleaning and Tumbling Barrels," Metallverarbeitung, 1963, Vol. 17, No. 8, p. 229-32 (in German).

Methods for reducing noise in German barrel finishing are reported.

- D317. *Pettigrew, D. W., "Barrel Finishing of Stainless Steel," Metal Finishing, Vol. 61, Jan. 1963, pp. 70-73, Feb. 1963, pp. 46-51.

One of the better articles on barrel tumbling of stainless steel.

- D318. *Poll, G. H., "New Machines Deburr Jet Engine Parts," Products Finishing, 28(2): 54-8, 60, 62-4, 66, 1963.

A rather extensive report of G.E.'s use of vibratory deburring on jet engine components.

- D319. Rakestraw, Arthur, "Deburring Delrin, Nylon," Grinding and Finishing, Nov. 1963, p. 23.

Suggestions for barrel deburring delrin and nylon.

- D320. Setzler, Paul H., "Vibratory Deburring of Small Metal Parts," Machine and Tool Blue Book, Vol. 58, No. 2, Feb. 1963, p. 82-89.

- D321. Tomas, E., "Barrel Polishing," Pinturas y Acabados Ind., 1963, Vol. 5, No. 25, pp. 25-34, 36.

Operating conditions, barrel loads, liquid content, speeds, times, colouring and plant are reviewed.

1964

- D322. "Entgraten von Gussstücken Nach dem Vibrations - Fleitschliff - Verfahren," Taschenbuch der Giesserei - Praxis, 1964, pp. 252-260. (in German)

- D323. "Deburring, Grinding and Polishing of Aluminum and Aluminum Alloy Parts in Barrels and Vibrators," Galvanotechnik, 1964, Vol. 55, No. 4, 229-37 (in German).

A review of barrel finishing plant and processes for Al. Types of abrasives are dealt with.

- D324. "Deburring Power Metal Parts," brochure by Southwestern Engineering Co., Los Angeles, California, October, 1964.

- D325. "Vibratory Deburring and Finishing, I.," Product Finishing, Vol. 17, No. 6, pp. 64-8.

- D326. "Vibratory Deburring and Finishing, Pt. 2," Product Finishing, Vol. 17, No. 7, July 1964, p. 52-56, 62.

Selection of media as a controlling factor in the vibratory process. Determination of media size, rules and recommendations for selection. Categories of compounds and their function, including abrasive, cleaning, descaling and burnishing. Importance of trial processing in arriving at best combination of amplitude and frequency of vibration, media, compound, time cycle, etc.

- D327. "Vibratory Deburring Improves Product Reliability," Machinery, Vol. 70, May, 1964, pp. 138-140; See Same in Machinery (London), Vol. 105, Sept. 23, 1964, pp. 758-760.

Refrigeration components are deburred by vibratory equipment.

- D328. "Vibratory Finisher," Modern Metals, Vol. 20, No. 1, Feb. 1964, p. 42, 44-45.

Vibratory deburring removes burrs faster than barrels.

- D329. Bessagnet, M., "Evaluation of Abrasives in Mechanical-Chemical Surface Treatments," Traitements de Surface, 1964, Vol. 5, No. 39, pp. 43-7.

A review dealing with barrelling and use of ceramic abrasives.

- D330. Black, T. W., "Vibratory Finishing Goes Automatic," Tool and Manufacturing Engineer, 1964, Vol. 53, No. 1, 53-6, No. 2, p.72-6.

Discussion of vibratory designs, automation of equipment and media handling.

- D331. Blake, Harvey F., "Tumbling a Million Parts a Day at Parker Pen," Products Finishing, Vol. 29, no. 2, Nov. 1964, pp. 45-50.

Gives specific recommendations on tumbling phosphor bronze, brass, and nonmetallic parts.

- D332. Brandt, William E., "A New Process for the Mass Finishing of Die Castings," Society of Die Casting Engineers Technical Paper, November 17-20, 1964.

Basic discussion of vibratory deburring includes comparisons with barrel tumbling, equipment descriptions and automatic equipment. Examples shown include brass castings, aluminum and zinc die castings, and steel clutch rings.

- D333. Brandt, William E., "Vibratory Deburring Improves Product Reliability," Machinery, May, 1964.

Vibratory deburring is used to deburr cast iron oil pump housings, milling burrs on valves components and connecting rods.

- D334. Byrov, A. M., A.N. Totskiy, and L. D. Kolpakova, "Deburring by Means of Vibrations," Mashinostroitel, 1964, No. 7, 14-5 (in Russian).

The vibration equipment, methods of operation, details of the liquids used, etc., are dealt with.

- D335. Denny, C., "Basis for Evaluation: Barrel or Vibratory Finishing?," Second Nat. Die Castings Congress Trans., 1962, Paper No. B-31, SDCE.

Comparisons between barrel and vibratory deburring. Costs are described.

- D336. Dreher, M., "Possibilities of Rationalisation by Barrel Processes," Galvanotechnik, 1964, Vol. 55, No. 536-40 (in German).

Deburring and related finishing areas of brass, zinc, aluminum and steel are discussed. Effect of barrel size and drum shape on surface quality are also discussed.

- D337. Enyedy, R. F., "Barrel Cleaning and Polishing, II, III," Schleif.-u. Poliertechnik, 1964, Vol. 4, No. 2, 53-5; No. 3, 82-5. (in German)

Review of barrel design and barrel processing.

- D338. Enyedy, R. F., "Barrel Polishing. Special Shapes and Chips (IV)," Schleif.-u.-Poliertechnik, 1964, Vol. 4, No. 5, p. 160-2 (in German)

A review dealing mainly with types of chips and burnishing media.

- D339. Eshelman, R. H., "Parts Gain Controlled Finish in Continuous Vibrator," Iron Age, Vol. 193, June 25, 1964, pp. 86-87.

Clutch plates are vibratory deburred in mechanized process.

- D340. Gustafson, E. L., "Is Deburring or Mass Finishing of Parts Your Problem?" Grits and Grinds, Vol. 55, No. 2, 1964, pp. 3-9.

Summary of barrel, vibratory and harperizing equipment and media selection.

- D341. Gustafson, E. L., "Loose Abrasive Finishing: Selection of Equipment and Materials," Products Finishing, 1964, Vol. 28, No. 11, p. 36-42.

A review of equipment and operating details of vibratory, barrel tumbling and harperizing.

- D342. *Hagiuda, Y., T. Naito, and M. Matsunaga, "Fundamental Researches on Vibratory Finishing," F. Metal Finishing Soc. Japan, 1964, Vol. 15, No. 5, p. 180-7.

A complete study of stock losses and part motion in vibratory deburring.

- D343. Hignett, J. B., "High Speed Precision Deburring," Metal Industry, Vol. 104, Jan. 30, 1964, pp. 150-151.

General summary of harperizing advantages.

- D344. Hignett, J. B., "New Tool for Precision De-Burring," Machine Shop, Vol. 25, No. 2, FEB. 1964, pp 68-69.

Another article on harperizing.

- D345. Kolesnik, N. V., "Vibration Finishing," Mashinostroitel, 1964, No. 4, p.33-4 (in Russian).

In vibration finishing, the parts are treated in an abrasive in vibrating containers. Some details are given of single and double-container machines and applications of the process are mentioned.

- D346. Matarese, F. R., "Out Go Burrs and Bevels - Enter Radius Corners," Machinery (N.Y.), Vol. 69, (No. 9), May 1963, pp. 114-117.
- D347. Matsunaga, M., "Barrel Finishing in Japan," C.I.R.P.-Annalen, Vol. 11, No. 4, pp. 198, 1964.
- D348. Michaelson, G., "Fabricating and Coating Molybdenum Alloy Parts," Metal Progress, March, 1964.
- D349. Nann, H., and K. Stauch, "Entgraten, Schleifen und Polieren von Werkstücken Aus Aluminum und Aluminiumlegierungen in Trommeln und Vibratoren," Galvanotechnik, Vol. 55, 1964, pp. 229-237 (in German)
- D350. Nunn, W. P., "Barrel Finishing--Now a Precision Operation," Prec. Met. Mold., 1964, Vol. 22, No. 3, pp. 51-2, 54, No. 4, p. 46-8.

Types of barrels and operating conditions are reviewed.

- D351. Nunn, W. P., "Barrel Finishing III, Vibratory Finishes, IV, Media," Prec. Met. Mold., 1964, Vol. 22, No. 5, pp. 96, 98-9, No. 6, 49-51, 53.

A brief review of vibratory finishing plant and media.

- D352. Nunn, William P. and Vernon W. Kenney, "Barrel Finishing, Pt. 5. Compounds," Precision Metal Molding, Vol. 22, No. 9, Sept. 1964, pp. 70, 72, 74, 76, 78.

Discussed abrasive compounds and how to use them for barrel finishing.

- D355. Nunn, William P. and Vernon Kenney, "Barrel Finishing. Pt. 6. Water and Machine Speeds," Precision Metal Molding, Vol. 22, No. 10, Oct. 1964, p. 60-63.

This article discusses the determination of water levels and rotating speed for barrel finishing. References to vibratory finishing are also given.

- D356. *Nunn, William P. and Vernon W. Kenney, "Barrel Finishing," Precision Metal Molding, Vol. 22, No. 12, Dec. 1964, p. 43-45.

Contains a number of worthwhile 'How to do it' ideas on modern barrel tumbling and vibratory deburring.

- D357. Sandford, J. E., "Two-Way Spin Speeds Deburring," Iron Age, Vol. 194, No. 2, July 9, 1964, p. 55-57.

Discussion of harperizing.

- D358. Schreur, Neal, "How Shakespeare Tackles Its Barrel Finishing," Products Finishing, Vol. 28, Jan. 1964, pp. 34-46.

Detailed description of conditions used to deburr fishing reel companies.

- D359. Shneider, Yu. G., "Finishing of Metal Surface by Vibratory Finishing," Trattamenti e Finitura, 1964, Vol. 4, No. 3, pp. 126-8.

The theoretical principles of vibratory finishing are discussed.

- D360. Tarpy, James, "Production Up 3X--Finish Down to 3-5 Micro," Production, Nov. 1964.

Hardened steel pump components are deburred by spindle finishing deburring and producing a .001 inch radius requires 15 seconds.

- D361. Young, A. W., "Vibrator Adds Finishing Touches," Iron Age, Vol. 194, Dec. 17, 1964, pp. 93-94.

General summary of one company's use of vibratory deburring. Typical data is presented on media selected and running conditions.

1965

- D362. "Improve Fatigue Strength with Abrasive Tumbling," Grinding Stresses (Collected Papers by the Grinding Wheel Institute), Circa 1965.

Contains data on barrel tumbling effects on residual stresses.

- D363. "Large Automated Cleaning and Deburring Plant," Machinery (London), April 28, 1965, pp. 922-925.

Describes an automated cleaning and deburring line which utilizes barrel tumbling.

- D364. "Problem in Deburring Bearings Solved," Products Finishing, Vol. 29, No. 5, Feb. 1965, p. 153.

Fortune Industries Inc. solves a bearing retainer ring problem.

- D365. "Roto-Finish Spiratron Demonstration," Machinery and Production Engineering, Oct. 20, 1965.

A description of automatic vibratory deburring equipment produced by Roto-Finish.

- D366. "Vibratory Finishing Delicate Parts," Metalworking Production, Sept., 1965.

- D367. Babichev, A. P., and V. I. Dyachenko, "Comercial Potentialities of Vibro-Tumbling (Vibration Polishing)," Stanki Instrum, No. 12, Dec. 1965, pp. 26-29 (in Russian).

Removal of flash from plastics and nonferrous castings and edge radiusing are discussed. Relationship between metal removal and amplitude and frequency, time, volume of parts, media, abrasive compound granularity, part weight, and container fill level.

- D368. *Babichev, A. P., and V. I. D'Yachenko, "Investigation of Polishing in Vibratory Drums," Russian Engineering Journal, Vol. 45, Issue No. 6, 1965, pp. 41-44.

Metal removal rate is evaluated as a function of amplitude and frequency, run time, ratio of media to parts, weight of work-piece, hopper fill height, and size of abrasive media. Effects of chemical additives on surface finish are also described.

- D369. Babichev, A. P., B. B. Khodosh, and V. I. Dyachenko, "Vibration Polishing of Articles on Rotating Spindles," Vestnik Mashin., No. 12, pp. 48-9, 1965.

Outer races of roller bearings are mounted on a spindle and rotated in an abrasive/liquid medium in a vessel standing on a vibrating base. Rotation accelerates finishing.

- D370. *Blundell, B. F., An Introduction to Metal Finishing Equipment, Pergamon Press, Oxford, England, 1965.

Contains an all inclusive section on barrel finishing and vibratory deburring. A rather complete summary of design requirements for vibratory units is also given.

- D371. Brandt, William E., "The Widening Scope of Vibratory Finishing," Grinding/Finishing, April, 1965, pp. 37-39.

General discussion of vibratory equipment. Al and zinc die castings are discussed in addition to ordnance plant metal stampings. Die cast threads are protected by adding small Al_2O_3 chips to the media. Cylindrical screens, M-14 rifle components and hydraulic valve components are routinely deburred and finished.

- D372. Bykov, A. M., A. N. Totskly, and S. K. Lapshina, "Vibratory Deburring Machine," Mashinostroiitel, No. 11, pp. 16-7, 1965 (in Russian)

The machine has a Zoliter capacity container in which the parts are vibrated with abrasive (grinding wheel scrap), debris being removed by a liquid recirculated continuously through the vessel.

- D373. Castle, C. H., "Automated Mechanical Finishing," ASTME collected Papers V65, Book 6, Paper 754, 1965.

Description of materials used in vibratory deburring.

- D374. DeGroat, George, "Vibratory Finishing of Complex Parts," American Machinist, Vol. 109, May 24, 1965, pp. 80-81.

- D375. Fisher, T. A., "Centrifugal Finisher Deburrs Braiding Machine Parts," Products Finishing, Vol. 29, No. 10, July 1965, pp. 60-64.

Harperizer deburrs cast iron and steel parts. Detailed operation is described.

- D376. Goodman, H. A., "Abrasive Slurry Washes Off Burrs," Iron Age, Vol. 196, Aug. 12, 1965, pp. 136-137.

Turbine components are deburred in a spindle finishing machine. Radii of 0.005-0.015 inch are produced in AM-355 alloy.

- D377. Gormly, M. W., "Residual Grinding Stresses," Grinding Stresses (Collected Papers Published by the Grinding Wheel Institute), CIRCA 1965.

- D378. Kramer, Robert M., "Economically Barrel Finishing Different Parts," ASTME Paper FC65-160, 1965 (See also ASTME Collected Paper, V. 65, Book 6, Paper 753, 1965).

Functions of barrel finishing are described as well as barrel geometry and action.

- D379. Kunz, P., "Mechanicochemical Automation in the Treatment of Surfaces," Traitements Sur, Vol. 6, No. 52, June 1965, pp. 39-48.

A review of the action in several types of barrel and vibratory machines.

- D380. Lane, R. O., "Relief of Residual Grinding Stresses," Grinding Stresses, (Collected Papers Published by the Grinding Wheel Institute), CIRCA 1965.

Contains data on barrel tumbling effects on residual stresses.

- D381. *Matsunaga, M., and Y. Haguida, "Vibratory Finishing--Fundamental Research," Metal Finishing, Vol. 63, No. 9, Sept. 1965, p. 52-57; No. 10, Oct. 1965, pp. 88-94, 97.

Excellent study of metal removal rate, media velocity and dynamic force on parts in vibratory finishing.

- D382. Miller, B. S., "Deburring Quality," Metalworking, Nov. 1965.

- D383. Polucha, A. A., "The Evaluation of, and Uses for Vibratory Finishing Equipment," ASTME Paper 65-795, 1965.

Basic guidelines for judging efficiency and life of vibratory equipment. Lists factors to be considered in selecting a machine.

- D384. *Sandford, James E., "Centrifuge Spins Burrs Away," American Machinist, Vol. 109, March 29, 1965, pp. 73-76.

Harperizing deburrs and polishes aircraft components. Stock is removed from unhardened steel balls at a rate of 0.008 inches per hour. A wide variety of samples are shown.

- D385. *Shainskii, M. E., "The Vibratory Cleaning and Polishing of Parts," Russian Engineering Journal, Vol. 45, issue Number 9, 1965, pp. 66-70.

An analysis of part motion in vibratory finishing units.

1966

- D386. *"Automatic Vibratory Finishing of Die Castings," Precision Metal, Jan. 1966, pp. 81-83.

Automated vibratory deburring removes flash from die cast parts. Tolerances of ± 0.001 inch are maintained. Some details are given.

- D387. "Automatic Vibratory Finishing System for Aircraft Stringers Finishes High Costs, Too!" Production, July 1966, pp. 101-102.

Aircraft stringers, 8 feet long, are vibratory deburred in special equipment.

- D388. "Deburring Machine Cuts Finishing Costs," Chemical Processing, Vol. 12, April 1966, pp. 46-48.

- D389. "Harperizers at the Singer Manufacturing Co., Ltd.," Metallurgia, Vol. 73, No. 439, May 1966, pp. 198-199.

Singer Sewing Machine installs a centrifugal barrel finishing unit. This unit has reduced manual deburring, increased production by five fold and is saving 3000 pounds sterling per year on just two components.

- D390. "Harperizing Plant at the Works of Singer Manufacturing Co.," Machinery, Vol. 108, May 25, 1966, pp. 1162-1163.

Singer Sewing Machine uses six harperizers for deburring. These replace 47 barrel tumbling machines.

- D391. "High Speed Deburring for Sewing Machines," Product Finishing, Vol. 19, (No. 3), pp. 46-9, 1966.

Singer uses harperizers to deburr sewing machine components.

- D392. "International Industrial Finishes Exhibition," Machinery and Production Engineering, Vol. 108, June 1, 1966, pp. 1242-1243.

Describes Acmeo supersheen division spindle finishing machine.

- D393. "Mechanical Surface Treatment of Stainless Steel," Tijd. Oppervlakt-Tetechnieken, Vol. 10 (No. 3), pp. 79-84, 1966.

Recommendations of the Verenigen voor Oppenvlaktetechnieken van Metalen, Holland on grinding and polishing of austenitic and martensitic stainless steels. Barrel finishing and abrasive blasting are dealt with.

- D394. "Saddle Hardware Firm Raises Output, Preserves Quality with new Finishing Machine," Modern Metals, Dec. 1966.

Supplier of western trappings uses vibratory deburring to deburr and radius aluminum and stainless steel.

- D395. "Singers Have Deburring Operations All Sown Up," Industrial Finishing (London), Vol. 18, (No. 213,), pp. 32-, 36, 1966; See Also Electroplating and Metal Finishing, Vol. 19, No. 3, pp. 105-6.

Centrifugal barrel finishers save 2000 square feet of space in addition to reducing costs on sewing machine components.

- D396. "Singers Install Harperizers," Mass Production, Vol. 42, March 1966, pp. 20-22.

Singer sewing machine uses centrifugal barrel finishers to deburr parts.

- D397. "Vibratory Finishing System," Product Finishing, Vol. 19, No. 3, March 1966, pp. 100, 102.

Describes Osromatic vibratory equipment operation.

- D398. Babichev, A. P., et al., "Stressed State of Surface Layers After Vibratory Polishing," Russian Engineering Journal, Vol. 46, No. 5, 1966, pp. 69-70.

Vibratory deburring relieves residual surface stresses.

- D399. Bessagnet, "General Evolution in Mechano-Chemical Finishing of Metals," Traitements de Surface, Vol. 7, No. 63, pp. 18-23, 1966.

A review of barrel and vibratory machines and their applications.

- D400. Bonn, Charles A., "Questions and Answers on Mass Finishing with Tumblex Abrasives," Grits and Grinds, 1966.

Questions and answers on barrel and vibratory deburring.

- D401. *Brandt, William E., "The Selection and Use of Chemical Compounds for Vibratory Finishing," Tool and Manufacturing Engineer, Vol. 56, No. 3., March, 1966, pp. 26-30.

Author describes the purpose and selection of abrasive compounds. These compounds are used whenever stock removal is required and time cycles without them exceed 30 or 40 minutes. Examples shown include steel, stainless steel, and brass components.

- D402. Brandt, William E., "Vibratory Finishing of Die Castings for Cost Reduction and Quality Improvement," The Society of Die Casting Engineers, Inc. Paper No. 42, 1967.

Use of vibratory finishing on die cast parts is described. Zinc, Al, and magnesium die castings are discussed. Examples of equipment types are also shown.

- D403. Brandt, William E., "Vibratory Finishing Techniques for Automated Production Processes," Automation, Vol. 13, Sept. 1966, pp. 88-94.

Automated vibratory equipment is illustrated and described. Selection of media shape and sizes are briefly mentioned as are abrasive compounds.

- D404. Collier, Morris, "Tumbling Barrel Pressure Release," Metal Finishing, Vol. 64, March 1966, p. 68.

Describes relief valve to vent gasses formed in tumbling barrels.

- D405. Desemery, P., "Deburring and Surface Finishing," Ind. Franc Achats Entretien, No. 171, Nov. 1966, pp. 955, 957-959.

Large cast, forged, and stamped parts can be deburred by vibrating the workpiece rather than the abrasive media.

- D406. *Matsunaga, M., and H. Kobayash, "Some Experiments on Centrifugal Barrel Finishing," Metal Finishing, Vol. 64, (No. 5), pp. 57-60, 1966.

An excellent study of centrifugal barrel finishing. Six sided barrels removed three times the stock that circular barrels did. Comparisons are given barrel tumbling required 50 times longer than centrifugal finishing to produce the same surface finish. Vibratory deburring required 15 times as long.

- D407. McCormick, William A., "Vibration Finishes Castings Faster," Machinery, Jan. 1966, pp. 134-136.

Peerless pump saves $1\frac{1}{2}$ -2 man days per part by vibratory finishing pump castings. Surface finishes of 400 micro in case are reduced to 75. Fixturing is described.

- D408. McKee, Richard L., "Slurry Takes the Fringe Off," Grinding and Finishing, Feb. 1966, p. 26.

Spindle finishing removes burrs from roller bearing retainers. Machine usage is described. Cycle time for parts up to 18 inch in diameter is 2-5 minutes.

- D409. Mosher, D. A., "Better Parts Finishing Using Modern Barrel Finishing or Vibratory Finishing Equipment," Machinery, Vol. 72, April 1966, pp. 103-108.

- D410. Mosher, D. A., "There's No Secret to Better Parts Finishing," Machinery, Vol. 72, April 1966, pp. 103-108.

Comparisons are made between barrel and vibratory finishing.

- D403. Brandt, William E., "Vibratory Finishing Techniques for Automated Production Processes," Automation, Vol. 13, Sept. 1966, pp. 88-94.

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- D407. McCormick, William A., "Vibration Finishes Castings Faster," Machinery, Jan. 1966, pp. 134-136.

Peerless pump saves 1 1/2-2 man days per part by vibratory finishing pump castings. Surface finishes of 400 micro in case are reduced to 75. Fixturing is described.

- D408. McKee, Richard L., "Slurry Takes the Fringe Off," Grinding and Finishing, Feb. 1966, p. 26.

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- D410. Mosher, D. A., "There's No Secret to Better Parts Finishing," Machinery, Vol. 72, April 1966, pp. 103-108.

Comparisons are made between barrel and vibratory finishing.

- D411. Polucha, A. A., "An Analysis of Automation in Vibratory Finishing Equipment," SME Technical Paper FC 66 - 138, 1966.
- D412. Polucha, A. A., "What Can Vibratory Finishing Do Besides Fast Deburring," Machine and Tool Blue Book, Vol. 61, No. 1, Jan. 1966, pp. 127-131.

Summary of effects of vibratory process.

- D413. Pontzer, Jerry, "Automated System Speeds Production of Powder Metal Parts," Production Equipment, Vol. 47, No. 3, Oct. 1966.

Automated vibratory system removes burrs from powder metal parts.

- D414. *Robbins, G. V., Radius Generation in Vibratory Deburring, Bendix Corp. (Kansas City, Mo.), Sept. 1966, available from NTIS under Accession No. N67-17437.

Presents 120 curves of edge radius produced in three vibratory deburring units. Workpieces include 303 Se stainless steel, 17-4 ph stainless steel, beryllium copper, and low carbon steel.

- D415. Ryan, Robert R., "Vibratory Deburring of Die Castings," Precision Metal Moldings, April, 1966.

Automatic Feeding vibratory unit removes burrs from zinc and aluminum die castings.

- D416. Schwenz, C. W., "Vibration and Tumbling -- A New Dimension in Finishing," Tool and Manufacturing Engineer, Vol. 57, No. 6, Dec. 1966, pp. 28-29.

Vibration is added to barrel tumbling to give faster deburring.

- D417. Stauch, K., "Automation by Spiratron, A New Vibratory Finishing Unit," Galvanotechnik, Vol. 57, (No. 10), pp. 683-5, 1966 (in German).

The spiratron is a new machine for automatic abrasive finishing, polishing, and deburring. Function and operation of this equipment which makes use of a vibration system are described by illustrations.

- D418. Tuvek, Charles G., "Flow-Through Vibratory Finishing Pays Off," Grinding and Finishing, March, 1966, p. 30.

Almco flow through system is discussed.

- D419. *Tuvek, C. G., "Impregnation in Tumbling: How to Avoid; How to Correct," Products Finishing, Vol. 30 (No. 7), pp. 375-6, 1966.

Imbedding of foreign particles in barrel tumbling may cause adhesion and other troubles in subsequent finishing operations, esp. in parts of al, brass, cu and zn. The trouble occurs particularly at excessive barrel speeds, too heavy or wrong type of media, incorrect water level and in part-on-part tumbling. Use of an acid dip after tumbling eliminates machining difficulties.

- D420. Walker, W. F., "Metal Finishing," Edgar Allen News, Vol. 45, No. 524, Feb. 1966, pp. 30-33.

Harperizing and barrel tumbling are described as is the associated equipment.

- D421. *Wise, Robert L, "What Comes After the Make or Buy Decision?," Machine and Tool Blue Book, Oct. 1966, p. 106.

Presents a checklist of items to consider when buying new vibratory equipment.

1967

- D422. "Deburring and Polishing Machine," The Engineer, April 28, 1967, p. 646.

Describes the action in Roto-Finish's osronaut spindle finishing machine. Parts see a toroidal path. Deburring is accomplished up to 10 times faster than by vibratory deburring.

- D423. "G Factor--Another Force in Barrel Finishing," Automatic Machining, Dec. 1967, pp. 63-64.

Discussion of harperizing.

- D424. "New Deburring Machines Cut Costs on Aircraft Parts," Western Machinery & Steel World, April, 1967.

Spindle finishing and vibratory units deburr aircraft parts. Control of radii can be maintained within 0.0001 inch.

- D425. "Osronaut-Significant Development in Barrel Finishing," Electroplating & Metal Finishing, 20(5), May 1967, pp. 156-7; See Also Product Finishing, 20(6), June 1967, pp. 38-39 and Machinery (London), 110(2841), April 26, 1967, pp. 945-946.

- D426. "Pangborn Vibratory Machines to be Made Here," Australasian Manuf., Vol. 51, No. 2650, Jan. 14, 1967, pp. 34-35.

- D427. "Precision Deburring Condition Work Pieces Without Distortion or Change of Dimension," Canadian Machinery and Metal Working, Sept. 1967, Vol. 78, No. 9, pp. 91-93.

General summary of vibratory deburring.

- D428. "Roto-Finish Osronaut De-Burring and Finishing Machine," Machinery, Vol. 110, 1967, pp. 945-946.

Describes new roto-finish equipment which is basically barrel tumbling with a torodial action.

- D429. "Simpler Finishing Halves Costs," American Machinist/Metalworking Manufacturer, Vol. 111, No. 16, July 1967, pp. 70-71.

- D430. "USA Standard Specifications for Tumbling Chip Abrasives," ANSI Standard B74.11--1967.

Describes the standardization of chip sizes.

- D431. "Vibratory Finisher Cuts Costs Speeds Output in Deburring Aerospace Parts," Modern Metals, Vol. 23, Oct. 1967, pp. 30-35.

Sweco vibratory finishing units deburr aluminum, magnesium, stainless steel, 4130 steel, and titanium. Plastic and aluminum oxide media are used.

- D432. Babichev, A. P., A. V. Kudryautseva, and V. I. Dyachenko, "Intensification Of Vibratory Finishing," Vestnik Mashin Ostroeniia, 1967, No. 12, pp. 40-42 (in Russian).

- D433. Birney, C. G., "Deburring Jet Engine Components at G. E.," Production, May 1967.

Jet engine components are spindle finished.

- D434. *Blundell, Brian F., An Introduction to Industrial Finishing Equipment, Pergamon Press, New York, 1967, pp. 4-63.

Author describes how to minimize burrs when machining or blanking. Conceptual model illustrates how larger grains cut faster than smaller grains. Table lists media finishing applications. Brushing, barrel finishing, and vibratory finishing are described in separate chapters. Nomograph is given for finding critical barrel speed. Machine construction, operation and media selection are described. The theory of selecting natural frequency of a vibrating unit is given. Use of fixturing is described. Spindle finishing and harperizing are described.

- D435. Brandt, William E., "Vibrations-Gleitschliff-Verfahren fur automatisierten Produktionsablauf," Industrie-Anzeiger Nr. 33, 2, April 25, 1967 (in German).

Discussion of automated vibratory deburring and finishing. Selection of media size and shape is also discussed.

- D436. *Brandt, W. E., and C. H. Castle, "Vibratory Finishing: The Basics," American Machinist, Jan 30, 1967, pp. 98-103.

As title indicates this is a primer on vibratory capabilities. Heavy broaching and casting burrs must be removed by snagging prior to vibratory finishing. Centered cutoff burrs cannot be economically removed in vibrator. Heat treating makes some burrs easier to remove. Radii of .001 inch can be held if burrs are small. Surface finishes as low as 2 microinches can be produced. Vibrating frequency should be matched to type of finishing required. Lower frequencies are used for polishing. Delicate parts must be processed at slower speeds. Media selection and automated equipment are also discussed.

- D437. *Brandt, William E., "Vibratory Finishing--The First Ten Years," Grinding and Finishing, October, 1967.

A history of vibratory deburring equipment.

- D438. Brandt, William E., "Vibratory Fixture Processing," Precision Metal Molding, Vol. 25, No. 6, June, 1967, pp. 79-83.

Discussion of fixturing approaches and applications for speeding up vibratory deburring.

- D439. Braski, David N., and Dick M. Royster, "X-Ray Measurement of Residual Stresses in Titanium Alloy Sheet," Advances in X-Ray Analysis, Vol. 10, (Proceedings of the fifteenth conference), edited by J. B. Newkirk and F. R. Mallett, Plenum Press, Inc., 1967.

The residual stresses produced by glass bead peening and vibratory finishing titanium are described.

- D440. Collins, C. C. and William Gill, Jr., "27 Different Jobs by Barrel Finishing, Part II," Products Finishing, Vol. 31, No. 8, May 1967, pp. 62-73.

This continuation of an earlier article emphasizes the non-deburring side effects of barrel and vibratory deburring.

- D441. *Collins, C. C., and W. Gill, Jr., "27 Jobs by Barrel Finishing, Part I," Products Finishing, 31(7), April 1967, pp. 50-61, 124-128.

Bendix uses barrel finishing to process 15 million parts per month. Over 2,000 different types of parts are processed. Article answers many questions about barrel tumbling usage.

- D442. Finkelburg, H. H., "Mechanical-Chemical Grinding," Fachber Oberflachen Technik, Vol. 5, No. 5, 1967, pp. 152-9 (in German).

Compounds and chemical aspects of barrel finishing are described.

- D443. Holsinger, Elmer, "Spindle Finishing Cuts Defects," American Machinist, Dec. 18, 1967, pp. 81-82.

Turbing blades are deburred in spindle finish unit. Tub spins at 1000 SFPM.

- D444. Keogh, C. J., "Seven Variables Affect Abrasive Finishing," Metalworking Production, Vol. 111, (No. 20), May 17, 1967, pp. 64-68.

- D445. Matsunaga, M., and Y. Hagiuda, "Researches on Barrel Finishing," Electroplating and Metal Finishing, Vol. 20 (3), 1967, pp. 75-80;; See Also Japan Soc. Grinding Engs.-Bul., Nov. 6, 1966.

Summary of a report published by the Inst. Industrial Science, Univ. of Tokyo, Japan, 1967, dealing with compounds, metal removal, and surface roughness, hardness and structure in barrel finishing and metal removal rate and polishing efficiency in vibratory finishing.

- D446. Matsunaga, M., "Researches on Barrel Finishing," Report of the Inst. of Ind. Sci., University of Tokyo, 17(4), 1967.

- D447. Matasunaga, M., and Y. Hagiuda, "Research on Barreling," Trattamenti e Finitura, Vol. 7, No. 6, 1967, pp. 209-214.

- D448. *Matsunaga, M., "Theory and Experiments on Centrifugal Barrel Finishing," The International Journal of Production Research, published by The Institution of Production Engineers, London, Vol. 5, (No. 4), pp. 275-287, 1967.

The theory of centrifugal polishing in a barrel is developed. Both theory and experimental results indicate that this process is 50 times faster than the conventional barrel. Using needle rollers weighing 0.2 pounds 8.7% by weight of the workpiece was removed after only 30 minutes. Similar results required 24 hours in a conventional barrel.

- D449. McCandless, W. E., and F. Dulaney, "Vibratory Finishing in a Large Plant," American Machinist, Jan. 30, 1967, pp. 104-106.

Automated equipment deburrs 50,000 helicopter parts per week.
Operating details are given.

- D450. Meisel, Robert C., "Look to Mechanization to Cut Deburring Costs," Metalworking, June 1967, pp. 39-42.

General summary of abrasive processes.

- D451. Meier, G., "Vibratory Deburring and Finishing," Machinery (London), Vol. 110 (2845), May 24, 1967, pp. 1139-1142.

Very basic discussion of vibratory equipment and supplies.

- D452. Mowry, Tom, "New Deburring System Takes Edge Off Finishing Costs," Tooling and Production, May, 1967.

Helicopter parts are vibratory deburred.

- D453. Phillips, J. L., "Effect of Machining on High Strength Low Alloy Steels," Iron and Steel Institute Special Report 94, 1967, pp. 93-101.

Contains graph showing effect of tumbling on residual grinding stresses.

- D454. Polucha, A. A., "Fine Finishing--The Development from Hand Operations to Vibratory Methods," ASTME Paper FC 67-184, 1967.

A history of media and compounds used in vibratory deburring.

- D455. Rampe, John F., "Improved Performance With The Triboluster Process for Deburring and Surfacing," ASTME Paper FC 67-182, 1967.

New machine reduces vibratory deburring time.

- D456. Rohre, Thomas, "Vibratory Finishing in a Job Shop," American Machinist, Jan. 30, 1967, pp. 107-108.

Summary of vibratory deburring as used in a job shop.

- D457. Sanford, J., W. Brandt, C. Castle, W. McCandless, F. Dulaney, and T. Rohrer, "Vibratory Finishing," American Machinist, Jan. 30, 1967, pp. 99-108.
(Similar in American Machinist/Metalworking Manufacturer, Vol. 111, No. 3, Jan. 30, 1967, pp. 97-108.)

Brief introduction to a series of articles on vibratory finishing.

- D458. Shainskii, M. E., "Vibratory Grinding and Polishing," Russian Engineering Journal, Vol. XLVII, No. 1, 1967, pp. 63-65.

High speed photography was used to capture part motion in vibratory deburring. Results were expressed mathematically. A constant, K_a , calculated from dimensions of the elliptical path can be used to determine a machine's usefulness in deburring or polishing.

- D459. Shoemaker, W. G., "Compounds, Types and Properties for Barrel or Vibratory Finishing," Automatic Machining, May, 1967, pp. 35-37.

Vibratory compounds can be obtained which provide the following properties: soil suspension, cleaning power, brightness, corrosion inhibitors, acid inhibitors, cushioners, water conditions, burnishing and coloring, and cutting.

- D460. "Simpler Finishing Halves Costs," American Machinist, July 31, 1967.

- D461. *Spencer, Lester F., "Mechanical Finishing Procedures," Metal Finishing, October, 1967, pp. 62-66.

Summarizes the four basic types of loose abrasive finishings and the equipment which is available.

- D462. *Spencer, Lester F., "Mechanical Finishing Procedures," Metal Finishing, Nov. 1967, pp. 59-63.

A good summary of operating considerations required for loose abrasive processes.

1968

- D463. "Aerospace Manufacturer Shakes Out a Saving," Products Finishing, Vol. 33, (No. 2), pp. 76-68, November, 1968.

General summary of vibratory deburring applications by one aerospace company.

- D464. "Deflash, Deburr and Surface Improvement-Simultaneously," Precision Metal, Vol. 26, No. 1, Jan. 1968, pp. 91-92.

- D465. "Finishing Marine Hardware Requires Exact Processing," Production Equipment, May, 1968.

Vibratory finishing of marine hardware.

- D466. "Long Machine Ready for Shakedown," Iron Age, Dec. 19, 1968, Vol. 202, p. 63.

Wing spars 14 ft. long are vibratory deburred by Roto-Finish equipment.

- D467. "Making Vibratory Installations Versatile. Precision Vibratory Finishing, Pt. 4," Precision Metal, Vol. 26, (No. 11), pp. 112-113, Nov. 1968.
- D468. "Mechanical Deburring Saves Money on Precision Parts," Modern Machine Shop, June, 1968.

Vibratory deburring removes burrs and maintains 0.0001 inch tolerances.

- D469. "Plating Die Castings: Cutting The Cost of Preplate," Products Finishing, Oct. 1968.

Vibratory finishing deburrs and polishes license plate frames.

- D470. "Through-Feed Vibratory Finisher Operates Continuously," Metalworking Production, Vol. 112, (No. 17), Apr. 24, 1968, pp. 86-87.
- D471. "Universal Cleaning Machine for Deburring," Rationalisierungs Leitblatter, No. 34/35, 1968, 1 p.; Finish, 1968, No. 10, p. 316 (in German).

Deburr machine consists of turn table with 4 spindles with grinding wheels.

- D472. "Use of Abrasive Grain in Mass Finishing," Booklet Number 7, Abrasive Grain Association.

Review of common barrel and vibratory equipment and their processes.

- D473. Brandt, William E., "How to Get the Most out of Vibratory Finishing," Precision Metal, Vol. 26, Sept. 1968, pp. 105, 108.

Summary of some vibratory deburring applications.

- D474. Brandt, William E., "Making Vibratory Installations Versatile," Precision Metal, Vol. 26, Nov. 1968, pp. 112-113.

Describes the versatility built into a vibratory deburring facility.

- D475. Brandt, W. E., "Precision Vibratory Finishing," Precision Metal, August, 1968-May, 1969.

This 10 part series describes equipment, how to get the most out of vibratory finishing, minimizing media inventory, planning for growth, powder metal parts and finishing large parts. Examples described include most common metals.

- D476. Brandt, W. E., "Vibratory Finishing Research Finds a Production Payoff," Machinery, Vol. 75, (No. 2), pp. 81-85, October 1968; See Also Machinery (London), Vol. 114-(2947), May 7, 1969, pp. 727-731.

Equipment design is discussed. The use of a resonant beam driver for large parts is described as is a uniform pressure machine.

- D477. Burkhart, W., "Barrel Polishing Processes for Small Metal and Precious Metal Parts," Fachber. Oberflächentechnik, Vol. 6, No. 1, 1968, pp. 16-7 (in German).

Describes the use of dry tumbling and polishing with wood media and abrasive.

- D478. DeGroat, George, "Vibration Breaks a Bottleneck," American Machinist, August. 12, 1968, Vol. 112, p. 124-5.

IBM uses vibratory deburring for magnetic tape drive components.

- D479. Dietiker, A., "Abrasives and Methods," Oberflache-Surface, Vol. 9, No. 8, 1968, pp. 182-4 (in German).

Lists abrasives used for wet and dry processes. Polyamide granules or spheres are recommended for deburring plastics.

- D480. Diez, Harold, "Proper Media, Compounds Make Mass Finishing," Abrasive Engineering, Dec. 1968, pp. 34-36.

Workpiece discoloration, wedging and impingement are discussed for barrel finishing.

- D481. Feinberg, David, "Surface Finishing of P/M Parts," Paper from Progress in Powder Metallurgy, Vol. 24, 1968.

Complete discussion on deburring of powder metal parts. Barrel, centrifugal and vibratory operations are discussed.

- D482. Gubin, V. I. and S. A. Pikovskii, "Vibratory Deburring Machine With Automatic Unloading," Avtom. Prom., No. 10, 1968, pp. 32-3 (in Russian).

Description and design calculations for machine built as Gorkii automobile works. Parts and abrasive are separated by wire grid screen.

- D483. Gustafson, E. L., "Mass Finishing," Metal Finishing Guidebook, 1968.

Complete discussion on loose abrasive processes.

- D484. Hazlet, R. N., "Vibratory and Barrel Finishing for Small Shops," Grinding and Finishing, Vol. 14, No. 6, June 1968, pp. 40-41.

General summary of barrel finishing applications.

- D485. Michalek, Joseph, "Spindle Machine Cuts Finishing Costs," Machinery, June, 1968.

Spindle finishing deburrs and finishes sewing machine hook.

- D486. Post, Benjamin F., "Mass Finishing," Proceedings of the 1968 ASAM National Technical Conference, 1968, pp. 45-47.

Brief review of mass finishing.

- D487. Roadarmer, Kenneth W., "An Engineering Approach to Vibratory Finishing," Tool and Manufacturing Engineer, Vol. 61(4), Oct. 1968, pp. 20-24.

Review of the action which occurs in a vibratory deburring operation.

- D488. Schaft, Ed, "Automated Deburring for Fastener Production," Grinding and Finishing, Vol. 14, No. 6, June, 1968, pp. 38-39.

Flat weld nuts are self tumbled to deburr and radius.

- D489. Stein, B. A., H. B. Dexter, and R. M. Royster, "Coatings and Surface Treatments for Long Time Protection of Ti-8Al-1Mo-1V Alloy Sheet from Hot Salt Stress Corrosion," Langley Research Center, Report No. NASA-TN-D-4319, March, 1968, pp. 13-14, 25, 45 (available from NTIS under Accession No. N68-17377).

Effects of vibratory finishing on residual stresses and corrosion resistance.

- D490. Szyrle, W., "The Results of Studies on Home-Made Abrasives for Surface Smoothing in Vibratory Equipment," Prace Inst. Mech. Prec., Vol. 16, No. 3, 1968, pp. 76-81.

For good results abrasive consumption factor Z should be less than 1% per hour. The cutting strength S should be greater than 50 c mm for brass and steel and greater than 120 c mm for aluminum parts. An amplitude of $2A_y - 4.2$ mm and frequency of 24 Hz were used.

- D491. Tarasov, L. P., "Trends in Cleaning and Finishing," Machinery (N.Y.), 74 (10), June 1968, pp. 90-96.

Brief summary of EC deburring, vibratory finishing, harperizing and extrude hone deburring.

- D492. Tuvek, Charles G., "How to Tumble-Finish Tungsten Carbide Parts," Products Finishing, Vol. 23, pp. 64-66, August 1969.

A .003-.005 inch radius can be formed on carbide parts by tumbling six to seven hours at slow speed. Aluminum oxide chips are used. Prevention of chipping, nicking and cracking is discussed.

- D493. Vernon, Ivan R. (Ed.), Realistic Cost Estimating for Manufacturing, Society of Manufacturing Engineers, Dearborn, Michigan, 1968.

This book contains a short reference to calculating barrel tumbling costs. Data is also given on media wear rates.

- D494. Whited, Harry, "High G Media Lower Finishing Costs," Tool and Manufacturing Engineer, April, 1968.

1969

- D495. "Automatic Deburring at American Standard," Products Finishing, Vol. 34, No. 1, Oct. 1969, p. 76.

Vibratory deburr machine deburrs tube ends.

- D496. "Deburred, Burnished Soleplates for the Hoover Upright," Products Finishing, Vol. 33, (No. 8), pp. 80-82, May 1969.

- D497. "For Faster Vibratory Finishing," Metalworking Production, Vol. 113, (No. 37), Sept. 10, 1969, pp. 34-35.

- D498. "Putting the Brakes on Tumbling Barrels," Products Finishing, Vol. 34, Oct. 1969, p. 96.

Brake design for large tumbling barrels is described.

- D499. "Specialized Deburring Machine Processes Jet Engine Parts," Products Finishing (Cincinnati), Vol. 34, No. 8, pp. 82-4, 1969.

Christmas tree edges and turbing rotors are deburred in spindle finishing machine. Resulting edges have radii of 0.005-0.020 inch.

- D500. "Unload Feature Boosts Vibratory Finishing Output," Products Finishing, Vol. 33, Sept. 1969, p. 97.

Semi automatic unloading feature for vibratory finisher is described.

- D501. "Vibratory Finishing for Zinc Die Castings," Plating, Vol. 56, (No. 11), pp. 1211-1212, 1214-1215, 1218-1219, November, 1969.

- D502. "Vibratory Finishing of Zinc Die Castings," American Machinist, Vol. 113, No. 4, pp. 121-122, Feb. 24, 1969.

- D503. Barker, A. J., "Highly-Effective Vibratory Finishing on Centrally-Vibrated Machines," Machinery, London, Vol. 114 (2945); April 23, 1969, pp. 648-651.

- D504. Brandt, William E., "A Better Shake for Finishing," American Machinist, April 21, 1969, Vol. 113(8), pp. 146-148.

Describes effects of eccentric location. Metal removal rates are described as a function of vibrating frequency. Three types of machines are illustrated.

- D505. Brandt, William E., "Deburring and Radiusing P/M Parts," Precision Metal, Vol. 27, April 1969, pp. 65.

Vibratory deburring removes burrs and puts 0.003-0.005 inch radius on powdered metal rotors.

- D506. Brandt, William E., "Developments in Mechanical Finishing," Die Casting Engineer, January, February, 1969, Vol. 13(1), pp. 12-14, 16, 18-20.

History of vibratory deburring equipment and the factors making them necessary. Several modern types of machines are illustrated.

- D507. Brandt, William E., "Finishing the Large Ones -- 22 Times Faster," Precision Metal, Vol. 27, May 1969, pp. 57-83.

Helicopter shafts and housings are vibratory deburred 22 times faster than manual methods.

- D508. *Brandt, William E., "New Developments Raise Vibrator Efficiency," Abrasive Engineering, Sept. 1969, Vol. 15(9), pp. 32-35.

Research on action in vibratory machines.

- D509. *Brandt, William E., "Precision Vibratory Finishing," Brochure, Lorco, Co., Mishawaka, Indiana, 1969.

Rather complete summary of media and compounds.

- D510. Brandt, William E., "Vibratory Finishing Methods Improved by Research," Machinery, (London), Vol. 114(2947), May 7, 1969, pp. 727-731.

New equipment innovations in vibratory and related methods are described.

- D511. *Brandt, William E., "Vibratory Finishing With Special Emphasis on Latest Developments Including Sonic Orboresonant Cleaning and Finishing," ASTME Paper MR69-906.

Comparisons between barrel tumbling and vibratory deburring are made. Data is given on force produced by vibrator eccentrics and metal removal rates at various locations within a vibratory machine. Several types of machines are illustrated.

- D512. Brandt, William E., "Whats New in Vibratory Finishing of Castings," Foundry, Vol. 97(2): 62-65, February, 1969.

Metal removal rates are a function of location in the machine. New machines have been designed to provide uniform removal rates. Large parts are deburred on a resonant beam unit. Heavy work is deburred best at 6,000-18,000 RPM but most machines are confined to 1750-1800 RPM.

- D513. Brody, J., "Deburring: Burroughs Likes Variety," Products Finishing (Cincinnati), Vol. 33, No. 7, April 1969, pp. 38-40.

Tumbling, vibratory, centrifugal and specialized machines are used in this plant.

- D514. *Clarke, P. K., "Determining Finishing Costs Accurately," Metal Finishing J., Vol. 15, No. 179, 1969, pp. 396-8.

Illustrates how to calculate the true cost of barrel finishing and vibratory equipment.

- D515. Feinberg, David, "How to Finish Powder Metal Parts," Machinery (N.Y.), Vol. 75, No. 6, Feb. 1969, pp. 72-73.

Summary of processing problems for powder metal parts.

- D516. Field, M., W. Koster, J. Kohls, R. Snider, and J. Maranchik, "Machining of High Strength Steels with Emphasis on Surface Integrity," Air Force Machinability Data Center Report AFMDC 69-7, August, 1969.

- D517. Finkelnburg, H. H., "Surface Machining by Barrelling," Metal, Vol. 23, (No. 7), pp. 684-689, July 1969 (in German).

- D518. Inukai, Takeshi, Noboru Yahata Hiroshi Anazawa, and Kenji Yoneyama, "The Effect of Grinding, Lapping, and Barrel Finishing Operations on the Fatigue Strength of 13 Percent CR Steel," J. Soc. Mat. Sci., Vol. 18, (No. 187), pp. 275-279, April 1969, (in Japanese).

- D519. Hamm, J., "Vibratory Finishing, Light Media Vs Heavy Parts," Tooling and Production, Vol. 35(1), April 1969, pp. 96-97.

Plastic media successfully deburrs hydraulic components.

- D520. Johnson, K., "The Economics of Surface Preparation," Paint Technol. Vol. 33, (No. 6), pp. 32-36, 1969

- D521. Kittreoge, J. B., "Vibratory Finishing of Zinc Die Castings," American Machinist, Feb. 24, 1969, pp. 121-122.

- D522. Kittredge, J. R., "Vibratory Finishing Procedures for Zinc Die Castings," Paper from Transactions Fifth National Die Casting Congress, Society of Die Casting Engineers, Detroit, Michigan, 1969, Tech. Paper No. 24, 0 p.

Describes vibratory finishing, equipment and compounds. Deburring and finishing of zinc die castings.

- D523. Lutes, Frank, and Frank Wright, "For Faster Vibratory Finishing," American Machinist, June 16, 1969, Vol. 113, p. 71-72.

Discussion of automated vibratory finishing equipment.

- D524. Lyalikov, N. T., and N. A. Erofeev, "The Mechanism of Wear of a Metal in a Vibrating Abrasive Medium," Izpr. Vyssh. Uchebn. Zaveoenii, Mashinostroenie, 1969, No. 10, pp. 145-8, (in Russian).

- D525. Marhan, H., "Mechanical and Chemical Surface Treatment of Metal Parts in Automatic Shakers," Mitt. Deut. Forschungsges. Blechverarbeitung, Vol. 20(12), Dec. 31, 1969, pp. 255-258 (in German).

Deburring and polishing of cast, forged, and machined parts in through-flow shakers.

- D526. Mosher, Donald A., "Abrasives and Tumbling Technology," Proceedings of American Society for Abrasive Methods National Technical Conference, 1969.

Summary of vibratory deburring media. Author claims there is no such thing as impregnation of abrasives in barrel-finishing.

- D527. Polucha, A. A., "The New Trends in Vibratory Finishing," ASTME Technical Paper, MR 69-411, 1969.

Examples of uses of vibratory finishing in addition to deburring.

- D528. Porter, Charles, "Abrasives Widen Scope of Investment Casting," Abrasive Engineering, Vol. 15 (No. 3), March 1969, pp. 28-29.

general summary of cleaning and deburring of investment castings.

- D529. Pushkarev, V. F., and Melnik, V. A., "Vibration Finishing of Medium-Carbon, High-Carbon, and Alloy Steel," Kuznechno-Shtampov, (2), Feb. 1969, pp. 46-47, (in Russian).

- D530. Radtke, S. F., "Vibratory Finishing and Cost Analysis of Zinc Die-Castings," Proc. 6th International Pressure Die-Casting Conf., (Paris - June, 1969) 32 pp.

- D531. Silin, R. I., "Vibrational Machining of Metals," In "Automation of Production Processes in Engineering and Instrument Construction; Avtomatiz. proiz. Protsessov v mashinostro. i priborstr. No. 7, Lvovsk University, 1969,, p. 155-65 (Referat. Zh. Tekhnol. Mashino., 7B281, 1969.) (In Russian)

The basic principles of vibrational machining are reviewed and the advantages of the technique compared with barrel finishing are indicated. The main factors affecting productivity and surface finish in vibrational machining are listed, and an optimum motion trajectory for the working chamber of the vibration machine is indicated.

- D532. Uhlig, Werner, "Movement of Media in a Polishing Barrel," Galvano (Paris), Vol. 38, No. 392, 1969, pp. 662-4 (in French).

Hexagonal barrel was studied. Polishing is only produced on the internal surface of the 'polishing line'. Above a given speed the polishing is reduced because media drops.

- D533. Uhlig, W., "On the Motion Path in the Polishing Barrel," Galvanotechnik, 1969, No. 2, pp. 110-113 (in German).

- D534. Waschull, Horst, "Stress on Materials in Vibration Polishing," Neue Hutte, Vol. 14, (No. 8), pp. 491-494, August, 1969 (in German).

1970

- D534. "Centrifugal Finisher Speeds Deburring of Jet Engine Parts," Products Finishing, (Cincinnati), Vol. 35, No. 1, 1970, pp. 97-8.

- D535. "Drives for Rotating, Vibrating, Tumbling Barrels," Power Transmission Design, Vol. 12(6), June, 1970, pp. 53-55.

- D536. "Making Precision Jet Engine Components," Machinery, April, 1970, pp. 86-89.

- D537. "N/C Vibratory Finishing Brings Media Flexibility," Abrasive Engineering, Vol. 16(11), Nov. 1970, pp. 14-16.

Media handling is automated.

- D538. "Plastic Media Proves Answer to Deburring Jet Engine Parts," Products Finishing, Vol. 35, No. 3, Dec. 1970, pp. 96-97.

Plastic media deburrs jet engine vanes.

- D539. "Vibratory Finishing Retains Die Casting Savings," Precision Metal, Vol. 28 (No. 2), pp. 69-71, Feb. 1970.

- D540. "Vibratory Mill Deburrs Jet Engine Parts," Products Finishing, Vol. 34, No. 12, Sept. 70, p. 100.

Stellite turbing nozzles are deburred by vibratory equipment.

- D541. Bacquias, G., "How Can Polishing Pastes be Removed," Galvano, Vol. 39, (No. 401), pp. 479-481, June, 1970, (in French).
- D542. Burris, Fred, "Deburring Machines Break a Bottleneck, Cut Costs," Abrasive Engineering, Dec. 1970, p. 16.

Vibratory deburring saves money. Hand deburring costs are compared to vibratory finishing costs.

- D543. Davenport, Warren H., Manufacture and Content of Ceramic Media, SME Paper FC 70-281, 1970.

- D544. Dreher, M., "Mechanical-Chemical Treatment of Bulk Parts," Galvanotechnik (Saulgau), 1970, 61, No. 5, 402-7.

Review dealing with immersed and open-ended finishing barrels, vibratorys and centrifugal machines.

- D545. Fortune, L. L., W. W. Welborn, and W. A. Ackley, "Tumbling-Vibration - Past, Present and Future," Proceedings: Ninth Annual Society of Die Casting Engineers National Technical Conference, pp. 36-38, 1970.

- D546. Herb, Charles O., "Through Feed Vibratory Deburrs 20 Half-Pound Parts Per Minute," Abrasive Engineering, Dec. 1970, pp. 14-15.

Throughfeed machine reduces deburring costs.

- D547. Hurst, Tommy, "Vibratory Deburring 24 Foot Wing Spars," Industrial Finishing, April 1970, pp. 38-41.

Wing spars, 24 ft. long, are vibratory deburred.

- D548. Kulakov, Yu M., "Vibro-Chemical Cleaning and Polishing of Parts," Stanki Instrument, (2) February, 1970, pp. 28-30, (in Russian).

- D549. Lyalikov, N. T., and N. A. Erofeev, "The Mechanism of Wear of a Metal in a Vibrating Abrasive Medium," Izp. vyssh. uchebn. Zavedenii, Mashinostroenie, No. 10, 1969, pp. 145-8; Ref. Zh. Tekhnol. Mashin. 1970, 1B376.

Surface wear of metal parts depends on micro-cutting, chipping of micro roughness and attrition of surface layers by sharp abrasive edges.

- D550. Orlando, Joseph, "1970 Techniques for Vibratory Finishing the Model 1894," Products Finishing, Vol. 35, Nov. 1970, pp. 88-90.

Describes a rotary vibratory deburring fixture for deburring large parts. Fixture is produced by Almco.

- D551. Polucha, A. A., "The Organic and Plastic Media in Mass Finishing Today," SME Paper FC70-280, 1970.

History, use and purpose of wooden shoe pegs. Leather strips, newspapers, ground corn cobs, walnut, peach and apricot shells and rubber and plastic shapes.

- D552. Povidailo, V. A., Silin, R. I., and Yurevich, R. V., "Principal Characteristics of the Dimensional Machining of Hard-Alloy Parts by Oxidation of the Surface Layer and Subsequent Vibrational Treatment," Fiziko Khim Mekhan Mat., Vol. 6, (6) pp. 35-37, 1970 (in Russian).

- D553. Rodarmer, Kenneth W., "Advances in Vibratory Finishing Equipment," SME Paper FC70-282, 1970.

Details of new media handling systems and vibratory equipment design.

- D554. Safranek, William H., and Miller, Hugh R., "Case for Vibratory Finishing of Zinc Die Castings," Metal Progr., Vol. 97 (No. 6), pp. 88-90, June 1970.

- D555. Spencer, L. F., "Abrasives and Their Application in Metal Finishing," Metal Finishing, Vol. 68, (no. 8), Aug. 1970, pp. 41-47, 51.

Complete discussion of abrasive grains and their properties.

- D556. Szyrle, W., "The Effect of Certain Parameters on the Results of Surface Treatment in Vibratory Apparatus," Prace. Inst. Mechaniki Precyzjnej, Vol. 18, 1970, No. 6913-B (in Polish).

Cutting in vibratory operations increase with amplitude and frequency. Coarser media and fine abrasive powder also increases the cutting.

- D557. Way, Ken, "Making Precision Jet-Engine Components," Machinery, (N.Y.), Vol. 76(8), April 1970, pp. 86-89.

Spindle finishing machine deburrs jet engine components.

1971

- D558. "Rotolishing of Small Parts," Metallpraxis(Coburg), Vol. 20, No. 7, 1971, pp. 266, 271-5.

Swiss barrel finishing equipment is described and the operating conditions which are used.

- D559. "Super-Sized Media Proves Answer to Deburring Problems," Products Finishing, March 1971, pp. 88-89.

Large plastic media deburrs gear box housings.

- D560. Brandt, William E., "Improvements in Vibratory Equipment and Supplies for Finishing Zinc Die Castings," Society of Automotive Engineers, Report No. 710196, January 11-15, 1971.

A basic discussion of equipment and metal removal rates at various locations inside a vibrating unit.

- D561. *Brandt, William E., "Thoroughgoing Efficiency for Vibratory Finishing," Tooling and Production, January, 1971, pp. 40-42.

Discussion of effects of vibrator design and frequency on metal removal rates.

- D562. Dreher, Manfred, "Deburring, Grinding, and Polishing of Mass-Produced Articles in Barrels," Galvanotechnik, Vol. 62, August 15, 1971, pp. 652-657. (in German).

Description of barrels used and automated plant.

- D563. Gillespie, L. K., Deburring: A Bibliography, Bendix Kansas City Report BDY-613-593, Dec. 1971 (Available from NTIS).

A bibliography of 258 articles on deburring of metal and plastics.

- D564. Goldman, Hubert M., and C. Heamon Castle, "Barrel Finishing Methods," Electroplating Engineering Handbook, 3rd Edition, A. Kenneth Graham (ed.), Reinhold Publishing Co., New York, 1971, pp. 84-108.

Complete discussion of barrel tumbling both large and small parts. Selection of media, compounds, equipment and equipment floor plans are described.

- D565. Gustafson, E. L., and H. B. Rano, "Improve your Tumbling," Products Finishing, Vol. 36, Dec. 1971, pp. 46-51.

Solutions are given for impingement and distortion in tumbling.

- D566. Gustafson, E. L., "Mass Finishing," Metal Finishing Guidebook and Directory, 1971, pp. 150-174.

Complete summary of loose abrasive processes.

D567. Gustafson, E. L., and H. B. Rand, "Mass Finishing: A Versatile Tool," American Machinist, Vol. 115, No. 12, June 14, 1971, pp. 67-71.

D568. Kramer, Robert M., "Barrel and Vibratory Finishing of Precision Metal Parts," Precision Metal, Vol. 29, (No. 1), pp. 77-79, January, 1971

General summary of vibratory and barrel finishing.

D569. Kramer, Robert, "Deburring Powdered Iron Parts," Precision Metal, June, 1971.

Steel shot removes flash without affecting size.

D570. Kramer, Robert, "Good Die Design Makes Barrel Trimming Easy," Precision Metal, Sept. 1971.

Design of sprue influences burr removal time.

D571. Kramer, Robert, "Prevent Unwanted Deposits With Liquid Compounds," Precision Metal, Oct. 1971.

Compounds can deposit on workpiece. Liquid compounds can prevent this deposit.

D572. Kramer, Robert, "use Foam as a Brake," Precision Metal, August, 1971.

Part impingement is prevented by letting compound become foamy.

D573. Loeschbart, Hans-Martin, "Deburring Die-Castings by Wet Vibratory Plant," Giesserei, Vol. 58, No. 1, pp. 6-9, January 14, 1971. (in German)

Plant uses 'roto-finish' equipment to give spiral circulatory movement. Synthetic abrasive shapes are used and illustrated.

D574. Marhan, H., "Mechano-Chemical Surface Treatment of Metal Parts in Automatic Vibratory Machines," Metalloberflache, Vol. 25, No. 9, pp. 326-329, Sept. 1971 (in German).

D575. *Matsunaga, M., "Microcrystalline Abrasive Media for Mass Finishing," Metal Finishing, May, 1971, Vol. 69, n. 5, pp. 97-104.

An empirical study of abrasive media and its effect on surface finish and removal rate. Special microcrystalline abrasive results in only minute amounts of media impregnation.

D576. *Murphy, James A. (Ed), "Barrel and Vibratory Finishing," Surface Preparation and Finishes for Metals, McGraw Hill, New York, 1971, pp. 62-114.

Relatively complete section of barrel and vibratory finishing.

- D577. Patterson, William C., "Finishing Aluminum P-M Parts," Precision Metal, March 1971, Vol. 29 (3), p. 61-63.

Barrel and vibratory finishing can be used to finish powder metal parts. A suggested sequence is given for 60LAB and 20LAB aluminum.

- D578. Sidorov, A. I., and E. N. Kirilin, "Mechanism of Deburring of Instrument Components by Vibroabrasive Treatment," Pribery i Sistemy Upr. 1971, No. 6, pp. 50-2 (See R. Zh. Mash. , 1971, 9B352) (in Russian).
- D579. Strom, J. R., and D. R. Lavalley, "Vibratory Finishing," Automation, September, 1971, pp. 74-78.

General summary of vibratory finishing and the equipment involved.

1972

- D580. *"Ice Media -- A Finishing Breakthrough," Finishing Highlights, Nov./Dec. 1972, pp. 4-5.

A complete description of ice bonded media and the equipment required to use it.

- D581. "Vibration: Speedy Solution to Finishing Problems," Ceramic Age, March, 1972.

Ceramic parts are deburred by vibratory equipment.

- D582. "Vibratory Finisher Deburrs Facilitates Zyglo Inspection," Products Finishing, Vol. 36, No. 5, February 1972, p. 90.

Plastic media deburrs jet engine vanes.

- D583. "Vibratory Finishing Process Uses Ice-Bonded Media," Automation, Feb. 1973, p. 16.

Ice as a media eliminates loding.

- D584. Ford, G., and R. Allen, "Moving Media Massage Away the Blemishes," Metalworking Production, Vol. 116, May 1972, pp. 65-67.

General summary of the centrifugal barrel finishing process.

- D585. Kramer, Robert, "Kramer on Finishing," Precision Metal, Nov. 1972, pp. 39, 76.

Describes characteristics of ceramic media in vibratory deburring.

D586. Kramer, Robert, "Kramer on Finishing," Precision Metal, Dec. 1972, p. 20.

Describes plastic tumbling media impregnated with abrasives. Finishes produced, comparisons with ceramic media, and applications for the media are discussed.

D587. Krupp, Robert, and Jerry Larson, "Cleaning Complex Castings," American Machinist, June 12, 1972, pp. 55-56.

Orboresonant machine deburrs large parts one at a time.

D588. Marciniak, M., "Barrel Tumbling," Werkstatt Betr., Vol. 105, (No. 10), Oct. 1972, pp. 743-744 (in German).

Design of new barrel with three times the removal capacity of other barrels.

D589. Rodarmer, Kenneth W., "Barrel, Vibratory Finishing Compounds," Abrasive Engineering, Vol. 18 (No. 1), Jan-Feb. 1972, pp. 6-7.

General review of abrasive compound principles.

D590. *Schaefer, F., and D. Wolfhart, "Machines and Equipment for Surface Finishing," Werkstattstechnik, Z Ind Fertigung, 62(7), July 1972, pp. 409-414 (in German).

Review of most types of finishing equipment.

D591. Schmolz, K., "Centrifugal Grinding and Polishing," Galvanotechnik (Saulgau), Vol. 63, No. 4, 1972, pp. 325-34 (in German).

Describes German and Italian centrifugal finishers. Results are compared to polishers. Operating methods and fixturing are described.

D592. Winship, John T., "Steel Media Puts Slick Finish on Stampings," American Machinist, Vol. 116, No. 10, May 15, 1972, pp. 69-71.

Automated system for vibratory deburring and finishing steel stampings.

1973

D593. "A Finish at Guaranteed Cost," Production, August 1973, p. 82.

Sweco's guaranteed performance plan attracts General Electric. Stampings are vibratory deburred.

D594. "Ice-Bonded Vibratory Finishing Media," Products Finishing, Vol. 37, No. 4, January 1973, pp. 120-122.

D595. "New Media Aids Vibratory Finishing," Machinery, Feb. 1973, p. 13.

Brief description of an ice-bonded media which minimizes removal costs of media lodged in holes.

D596. "Vibratory Finishing Process Uses Ice-Bonded Media," Automation, Feb. 1973, p. 16.

Describes an ice-bonded media and how it is used in vibratory deburring.

D597. Brandt, J. N., "Fundamental of Media Selection," Abrasive Engineering, Nov.-Dec. 1973, pp. 18-21.

Review of principles for selecting media.

D598. Kramer, Robert, "Saves Money Finishing Die Castings," Precision Metal, Feb. 1973.

Equipment removes casting gates and separates them from media and workpieces.

D599. Loschy, Bernard, "Techniques of Barrel and Vibratory Finishing," BJI Company, St. Paul, Minnesota, 1973.

A general treatment of barrel finishing and vibratory deburring. Author also spends one page discussing burr properties.

D600. Brandt, J. N., "Fundamentals of Media Selection," Abrasive Engineering, Nov.-Dec. 1973, pp. 18-21.

Brief and to the point summary of media and compound selection for use in vibratory deburring.

D601. Gillespie, L. K., Vibratory Deburring, Bendix Corporation (Kansas City Division), Report BDX-613-735, August 1973.

This study describes the repeatability of vibratory deburring on precision miniature components. Effects of part size on deburring is given as are effects on surface finish, part flatness and cleaning. The effects of end milling and drilling conditions on burr properties are described.

D602. Hinz, H. E., "Abrasives and their Effects-Material Removal and Chips Wear," Galvanotechnik (Saulgau), Vol. 64, No. 3, 1973, pp. 214-24, (in German).

Metal removal rates on steel and zinc are described by operating condition. For sensitive components barrel finishing is best.

- D603. Koster, William P., Surface Integrity of Machined Materials, (Interim Report: Aug. 1973-Oct. 1973) Metcut Research Associates, Inc., Oct. 1973.

This research report illustrates and discusses the surface integrity produced by tumbling and related processes on Ti-6AL-4V, and René 41. The residual stresses produced by vibratory finishing these metals are shown and compared to related finishing processes.

- D604. Kramer, Robert, "Kramer on Finishing," Precision Metal, March 1973, pp. 31, 68.

Brief note on the care and cleaning of vibratory media, gla^zing, screening, and rust inhibitors are discussed.

- D605. Khodosh, B. B., "Instruments for Simulating The Motion of Particles of the Medium and Components in the Working Chamber of a Vibratory Finishing Device," Vibrats. Obrabotka detalei mashini priborov, Rostov-on-Don, 1972, pp. 185-90; (See R. Zh. Mash., 1973, 3B464 (in Russian)).

Instrument simulates motion in vibratory unit and allows motion of components to be viewed.

THERMAL SHOCK

1971

- E1. "Deburring at 6000° F," American Machinist, July 12, 1971, p. 53.

Brief summary of thermal shock deburring.

- E2. *"Ford, GM Take Detroit Lead in Thermal Deburring," Metalworking News, June 14, 1971, p. 11.

A summary of thermal shock deburring applications in the automotive industry.

- E3. "Heat Deburring System Includes Indexing Table," Automation, Vol. 18, No. 8, August 1971, p. 9.

General description of surf/tran's thermal shock deburring process.

- E3. "On Camera," Machinery, December, 1971, pp. 46-47.

Close up photos of equipment and parts associated with thermal shock deburring.

- E4. "Thermal Deburring," Tooling & Production, August, 1971.

Discussion of thermal shock deburring applications. Radii as small as 0.0002 inch can be produced.

- E5. "Thermal Deburring Finds Immediate Acceptance," Production, August 1971, p. 9.

Another general summary of thermal shock deburring.

- E6. "Thermal Deburring Ousts Tedious Handwork," Metalworking Production, Vol. 115, Oct. 1971, pp. 86-87.

- E7. "Thermal Method Removes Burrs," Iron Age, June 24, 1971, pp. 58-59.

Another general summary of thermal shock deburring. Examples of power steering pistons, transmission valve bodies, transmission clutch drums and carburetor components deburred by this process are shown.

- E8. Wick, Charles H., "The Advent of Thermal Deburring," Mfg. Eng. Manage., Aug. 1971, 67, (2), 32-33.

In thermal deburring, parts are placed in a sealed and locked chamber, a pressurized mixture of H and O gases is ignited and both internal and external burrs or flash are burned off-all in a 12-s cycle. The process is applicable to a wide variety of metals and plastics. Parts leave the chamber at a temp. of 160°F (71 °C) for nonferrous materials and 220 °F(105 °C) for ferrous. Operations are illustrated for deburring brass carburetor nozzles and a steel power-steering piston.

1972

- E9. "Flash Deburring for Hydraulic Valve Components," Machine and Tool Blue Book, Dec. 1972.

Brief summary of Parker-Hannifin's use of the surf tran process for deburring steel, brass, and stainless steel hydraulic components.

- E10. Habel, Arthur, "Put the Heat on Burrs," Machinery, July 1972, pp. 63-67.

Thermal deburring removes burrs from Ford carburetors. The 14 second cycle deburrs 36 holes ranging in size from 0.030 to 3/16 inch in diameter. Materials for which the process is effective include zinc, brass, and thermoplastics.

- E11. "Thermal Deburring," Tooling, Vol 26, Sept. 1972, pp. 15-17.

- E12. Botsford, Richard L., "Thermal Deburring of Die Castings," SDCE Paper No. 2572, 1972.

Paper emphasizes experience with zinc die cast carburetor parts. History and use are also described.

1973

- E13. "A Hot Production Boost from Thermal Deburring," Production, July 1973, pp. 82-83.

Machined and drilled die cast pneumatic parts are deburred by surf/tran equipment. Workpieces are zinc, aluminum and brass. Preventive maintenance is performed on a weekly basis.

- E14. "Deburr in a Flash," Tooling & Production, January, 1973, p. 42.

Brief discussion of surf/tran's thermal shock deburring unit.

- E15. "Hydraulic Valve Components Deburred in a Flash," Hydraulics & Pneumatics, Vol. 26, Feb. 1973, p. 24.

EXTRUDE HONE

1970

- F1. "Extrusion Process Deburrs Difficult Jobs," Automation, Sept. 1970, pp. 14-15.

Summary of process operation.

- F2. "New Process Cuts Deburring Time 90% on Hydraulic Part; Rejects Slashed to Zero," Modern Metals, Vol. 26, Dec. 1970, p. 60.

Examples of parts deburred by the extrude hone process are described. Edge radii of 0.001 inch maximum have been maintained while not exceeding ± 0.0003 inch tolerances on bores.

- F3. "New Process for Those Problem Deburring Jobs," Production, Nov. 1970, pp. 94-96.

Description of extrude hone process and its applications.

- F4. *Rhoades, Charles R., "Explanation of the Nature and Application of the Extrude Hone Process," SME Paper MR70-517.

1971

- F5. "The Application of the Extrude Hone Process to Surface Finish Improvement," Extrude Hone Corp. Brochure, 1971.

Effect of extrude hone process on surface finishes, and process operation.

- F6. *Hauri, H., "Entgraten Mit Plastischen Schleifmassen," Technische Rundschau, Nr. 47, Vom 5, November 1971, p. 17-18 (in German)

Discussion of the extrude hone deburring process. Examples shown and discussed include Christmas tree slots and hydraulic valve bodies having many intersecting holes.

1972

- F7. Extrude Hone, Extrude Hone Corporation Brochure, 1972.

- F8. "New Chapter in Deburring Story," American Metal Market/Metalworking News, April 17, 1972, p. 10.

Summary of extrude hone process and history.

- F9. Rhoades, Lawrence, "An Explanation of the Extrude Hone Process and the Tooling Concepts Employed in Using It," SME Paper TE72-818, 1972.

An explanation of the tooling required for extrude hone deburring.

1973

- F10. *Gillespie, L. K., and Larry H. Luebbert, Jr., Extrude Hone Deburring, Bendix Corporation (Kansas City Division), Report No. BDX-613-948, August 1973.

A study of variables which influence metal removal and edge radiusing. Workpieces evaluated include brass, aluminum and stainless steel.

1974

- F11. "Finishing: Essential Last Step in Holemaking," Tooling & Production, March, 1974, pp. 42-44.

EDM recast material is removed by a process similar to extrude hone. Holes 0.017 inch in diameter are radiused by this process.

BRUSH DEBURRING

1943

- G1. McAleer, H. J., "Polishing, Buffing and Burring Compounds are Playing Vitally Important Part in War Program," Metal Finishing, Vol. 4, (No. 3), March 1943, pp. 144-145; SEE ALSO Metal Industry (London), Vol. 63. (No. 1), July 2, 1943, p. 9.

Describes the brush deburring compounds available in 1943.

1944

- G2. Rowland, G. O., "Deburring Aluminum and Light Steel Parts," Iron Age, Vol. 153, No. 4, Jan. 27, 1944, p. 65.

Removing burrs from slots, etc. Relation between fatigue and surface finish.

1950

- G3. Peterson, R. O., "Power Brushing Deburrers Gears Ten Times Faster," Steel, Vol. 127, Oct. 9, 1950, p. 80-81.

Semi-automatic workholder and lathe brush deburrers gears.

1951

- G4. "A Modern Approach to a Production Problem," Production, Engineering & Management, Vol. 28, Oct. 1951, p. 79-81.

Brush deburring saves work.

- G5. "How to Find an 800% Production Increase in a Piece of Pipe," American Machinist, Vol. 95, Oct. 29, 1951, p. 202.

Two approaches to brush deburring cylindrical parts are shown.

- G6. "Roller-Spun Gears Get Deburred Fast," American Machinist, Vol. 95, July 23, 1951, p. 155.

Internal gear sets on rollers to provide easy part rotation for internal brushing.

- G7. "Trio Air-Operated Machine Automatically Deburrers Rotors," American Machinist, Vol. 95, March 5, 1951, p. 155.

Machine uses wire brushes to remove grinding burrs from powdered cast iron rotor.

- G8. Linsley, H. E., "Slick Tricks with Brushes," American Machinist, Vol. 95, August 20, 1951, p. 93.

Four setups for brush deburring are illustrated.

1952

- G9. "Automatic Brushing Speeds Gear Cleaning," Steel, Vol. 131, Aug. 4, 1952, p. 94-95.

Unskilled worker using machine brushing setup keeps up with pace set by modern gear cutters. Gear finishing is stepped up from 20 to 125 per hr.

- G10. Charvat, V. K., and R. C. Sasena, "Power Brush Finishing," Machine Design, Vol. 24, (No. 2), Feb. 1952, pp. 112-121.

1953

- G11. Maund, William J., "Gear Deburring. Brush Setup Matches Production Pace," Steel, Vol. 133, Sept. 28, 1953, p. 120-122.

Equipment and operation of automatic deburring machine.

- G12. Peterson, R. O., "Brushes: Production Tools for Good Surface Finishes," Iron Age, Vol. 171, (No. 12), March 19, 1953, p. 134-137; SEE ALSO Tooling & Production, Vol. 19, (No. 4), July 1953, pp. 50-53, 124-125.

1954

- G13. DePastina, R. and R. E. Eyre, "Automatic Brushing Deburr Turbine Disks," American Machinist, Vol. 98, July 5, 1954, pp. 124-125.

Turbide blades and compressor discs are deburred by brushes. Automated brushing machine saves \$41,000 per year. Edge breaks of 0.005-0.015 inch are produced on one side of the part and 0.010-0.025 inch breaks are produced on the opposite side. A 180 grit abrasive compound is used with the tampico fiber wheels.

1955

- G14. "Automatic Deburring Machine Developed by Fuller Brush," American Machinist, Vol. 99, Dec. 5, 1955, p. 190.

Transmission parts brush deburrs 200 pieces per hour. Brushing at an angle removes burr without radiusing edge.

- G15. *"Power Brushing," Machinery (London), Vol. 87 (2236), Sept. 23, 1955, pp. 741-746.

Flash on molded rubber parts is removed by brushing. Trouble shooting guide is given for metal parts.

1956

- G16. "Machine Tools: Unit Deburs 200 Parts in One Hour," Iron Age, Vol. 177, Jan. 26, 1956, pp. 53-54.

Automatic machine brushes burrs from gears.

- G17. Product Engineering, Sept. 1956, p. 166.

Abrasive laden brush deburrs aluminum gears. Automatic brushing produces 0.003 to 0.007 inch radii. Gears anodized without radiusing greatly accelerated gear failure.

1957

- G18. "Two-End Brush Boosts Production," Iron Age, Vol. 179, June 20, 1957, pp. 127.

Machine brushes both ends of cut tubing at same time.

1958

- G19. "Power Brushing For Finishing Without Burrs," Tool Engineer, Vol. 41, (No. 5), Nov. 1958, pp. 110-112.

Christmas tree slots in turbing disks are brush deburred.

1959

- G20. "Gear and Sprocket Deburring," Mechanical Engineering, Vol. 81, August 1959, p. 81.

Flap wheel with abrasive coating is hydraulically fed to workpiece. Device produces a chamfer rather than radius.

- G21. "Semi-Automatic Gear Deburring Reduces Operation to Seconds," Grinding & Finishing, August 1959, pp. 31-32.

Redin gear deburring machine is described. Gears are deburred semi-automatically in 32 seconds.

- G22. Charvat, Verne K., "Power Brushing Deburrs and Finishes Hydraulic Pump and Motor Components," Machinery, May 1959, pp. 124-126.

Power brushing maintains 0.001 tolerance on hydraulic pump and motor components edge radii of 0.003 and 0.005 can be maintained. Examples of brush deburring are shown.

- G23. Wright, Stanley, "Brushes for Surface Finishing, I - Cleaning and Polishing," Industrial Finishing, Vol. 11 (128), 1959, p. 30-33.

Type of brush to use for polishing and deburring is presented for several materials. Flexible brushes are usually selected for deburring.

1960

- G24. *"Can Power Brushing Help you in Finishing?," Products Finishing, Vol. 24, (No. 7), April 1960, pp. 36-45.

Lengthy discussion of brushing parameters, how to select brushes, speeds to use, and equipment available.

1961

- G25. "Nylon Abrasive Discs Pass Critical Deburring Tests," Steel, Vol. 149, Dec. 4, 1961, p. 94.

A carbide impregnated, flexible nylon disk deburrs Al and stainless steel miniaturized parts while holding tolerances as close as ten millionths of an inch.

- G26. "Nylon Pads Deburr Fine Parts," Iron Age, Vol. 188, Dec. 7, 1961, p. 126.

Precision missile components are deburred with nylon discs impregnated with silicon carbide.

- G27. *"Power Driven Brushes," American Machinist, Vol. 105, May 15, 1961, pp. 144-156.

Description of brush selection and steel usage. This is one of the more complete articles on brush selection.

- G28. "Surface Finishing of Metals, Plastics, Wood," Brochure by Lea Manufacturing Co., Waterbury, Conn., 1961.

Summary of how to use and select burring compounds with brush and polishing wheels.

- G29. Fisher, Edward P., "Brushing Gear Burrs and Radii," Grinding and Finishing, Vol. 7, August 1961, p. 28-30.

Wire brushes deburr and radius automotive gears.

1962

- G30. "Automatic Deburring and Chamfering Machine," Machinery, Vol. 68, Feb. 1962, p. 164.

Describes #Michigan Tool Co. machine for grinding and brushing burrs from automotive components.

- G31. "De-Burring Machine for Small Diameter Gears," Machinery, Vol. 100, June 20, 1962, pp. 1432-1433.

Machine uses a diamond impregnated rubber wheel and a nylon brush are used to deburr small gears.

- G32. "Kehr & Wichmann Automatic Deburring Machines," Machinery (London), Vol. 100, Jan. 31, 1962, pp. 247-248.

Crankshafts are brush deburred on a chain-type transfer mechanism. 700 parts are deburred per hour.

- G33. "New Product for Removal of Machine Burr from Miniaturized Parts," Austral. Machinery, 1962, Vol. 15, No. 169, p. 43.

Deburring of miniaturized parts by nylon discs impregnated with fine SiC abrasive at 60,000 r p m is described. Deals principally with profile-and thread grinding.

- G34. "Nylon Abrasives Deburr Missile Controls," Grinding and Finishing, Jan. 1962, p. 39.

"Bear-Tex' non-woven nylon fabric is used to deburr stainless steel components. Tolerances maintained while using this material is 50 to 200 millionths of an inch.

- G35. Agler, W. B., "Brushes Deburr Expanded Sheet in One Pass," Grinding & Finishing, Vol. 8, Apr. 1962, p. 36-37.

Metal sheet is deburred and edge blended using power brush.

- G36. Keller, Henry L., "Metal Surfaces Preparation and Cleaning. Pt. B. Polishing, Brushing and Buffing," Chapter 3 from "Electroplating Engineering Handbook." 2nd Edition. Reinhold Publishing Corp., New York 22, 1962, p. 68-83.

Types of abrasives and equipment used in brush finishing.

- G37. Pickrell, A. L., "Forming, Trimming and Edge Finishing of Molybdenum-0.5 Per Cent Ti Sheet Material," ASME Transactions (Series B - Journal of Engineering for Industry). May 1962, pp. 289-299.

In this study of edge quality band sawing conditions were determined which produced little burr in Mo-0.5Ti. Six approaches to edge radiusing were studied. Barrel tumbling, vibratory finishing, power brushing, hand polishing, grinding and buffing were evaluated.

1963

- G38. "Burr Removal with the Lea Method," Brochure by Lea Manufacturing Co., Waterbury, Conn., 1963.

Brief summary of use of burring compound with brushes or polishing wheels.

- G39. "Developments in Gear Deburring: Rotary Technique Evolved by Roto Finish, Ltd.," Automobile Engineer, Vol. 53, Apr. 1963, pp. 158-159.

- G40. "Ideas from the Shop," Grinding and Finishing, April 1963, p. 20.

Miniature brushes replace hand filing of aluminum potentiometer cases. Two brushes rotating in opposite directions are used.

- G41. *Proskuryakov, Yu. G., and V. A. Kulikovskikh, "Wire Brush Polishing," Russian Engineering Journal, Vol. 43, No. 2, 1963, pp. 39-40.

A analysis of factors which influence surface finish in wire brushing. While polishing can improve surface finish it can also produce a wavy surface. Coolants aid in improving surface finish.

1964

- G42. "Fibre Discs for Metal Working," Schliff u. Scheibe, 1964, Vol. 2, p. 11-5; Galvanotechnik, 1964, Galvano-Ref., 11, No. 9, 33.

A review of properties and applications of fibre wheels for deburring, removing weld seams, polishing, removing surface defects, especially from stainless steel surfaces.

- G43. *"Power Brush Cleaning and Finishing," Metals Handbook, Vol. 2, 1964, (1969 Printing), pp. 405-408.

Describes brush characteristics and techniques to use in brush deburring and radiusing.

1965

- G44. "Deburring Machine," Mechanical Engineering, Vol. 87, July 1965, p. 57.

Machine uses abrasive discs to deburr sheet metal.

- G45. Passmore, L. W., "Power-Driven Brushes for Finishing Metal Goods," Mass Production, Vol. 41, (No. 10), Oct. 1965, pp. 41-44.

1966

- G46. "Brush Finish Cuts Costs 40%," Canadian Metalworking/Machine Production, Vol. 29, March 1966, p. 47.

Pump rotors are brush deburred with Osborn brushes.

- G47. "Deburring Time Cut From Hours to Minutes," Steel, Vol. 159, Oct. 24, 1966, pp. 64V, 64X.

Large herringbone gear is brush deburred in 27 minutes.

1967

- G48. McKee, Richard L., "Are You Missing a Bet on Power Brushing," Grinding and Finishing, March, 1967, pp. 31-35.

General discussion of brush characteristics.

1968

- G49. "Brushing Guide Information," Modern Machine Shop, June, 1968, pp. 170-171.

Basic summary of brushing characteristics and horsepower requirements.

1969

- G50. "What You Should Know About Power Brushes and Equipment," Metalworking, March, 1969, pp. 51-54.

Basic discussion on brush selection.

1971

- G51. "Brush Cleaning Achieves Surface Functional Acceptability," Industrial Finish Surf. Coatings, Vol. 23, (No. 282), December, 1971, pp. 42-43.

- G52. "Impregnated Nylon Speeds Deburring," Materials Engineering, April 1971, p. 47.

General description of non-woven nylon web used for removing small burrs.

- G53. *Kellner, Henry L., "Polishing, Brushing and Buffing," Electroplating Engineering Handbook, 3rd Edition, A. Kenneth Graham (Ed.), Van Nostrand Reinhold Company, New York, 1971, pp. 69-84.

An excellent and complete discussion on the use of polishing wheels and abrasives. Although burring is only briefly mentioned directly the majority of principles described are applicable.

- G54. *Murphy, James A. (Ed), "Power-Driven Brushes," Surface Preparation and Finishes for Metals, McGraw Hill, New York, 1971, pp. 114-125.

Rather complete discussion of brush characteristics, selection and use. Examples of burr removal are given.

- G55. Wakefield, B. D., "Fuzzy Deburs the Inaccessible," Iron Age, August 12, 1971, p. 78.

Non-woven nylon mat is impregnated with aluminum oxide for deburring. Material is cut to shape desired and used similar to rotary brushes. Used on aircraft hydraulic valves and computer components having 0.001-0.005 inch tolerances. This material is used for deburring and radiusing holes, recessed areas, and stampings.

1972

- G56. Fernley, Robert C., "Finishing with Power Brushes," Metal Finishing, Vol. 70, (No. 1), January, 1972, pp. 57-60.

1973

- G57. *"Cleaning and Deburring with Power Brushes," Metal Progress, Vol. 103, (No. 4), April 1973, pp. 118-120, 122, 140.

Good short discussion on selecting brushes for deburring.

- G58. *"Put Power Brushes to Work," Tooling & Production, pp. 38-39, January, 1973.

Excellent short article on how to use brushes for deburring. Brush construction and operating conditions are described. Carbon, steel, stainless steel, aluminum diecastings, plastics and jet engine components are used as examples.

1974

- G59. Gillespie, L. K., Brush Deburrings, Bendix Corp. (Kansas City Division) Report BDX-613-1056, March, 1974.

Describes tests performed with many types of brushes. Grinding burrs were readily removed by most brushes. Only two types were successful on milling burrs. Edge radii of 0.002 inch were maintained on some specimen.

SANDING

1957

- H1. "Abrasive Belts Slash Finishing Costs," American Machinist, April 22, 1957, pp. 134-135.

Cash register bodies are deburred with 180-grit aluminum oxide belt running dry over a 70-durometer rubber wheel.

1961

- H2. "Belt Grinder Deburrs 28 Types of Aluminum, Steel and Titanium," Grinding & Finishing, Vol. 7, March 1961, p. 35.

Deburring of Al, steel and Ti parts to 120-250 micro-in. finishes, using a belt grinding machine.

1963

- H3. "Coated Portable Attacks Deburring," Grinding and Finishing, June 1963, p. 48.

Air powdered portable sander deburrs die cast automotive parts.

1966

- H4. "Arrangement for Feeding Blanks for De-Burring," Machinery, Vol. 108, May 18, 1966, pp. 1098-1099.

Vibrating hopper feeds fine edge blanked parts to flat belt sander. Parts are fed to sander with burr side up.

1970

- H5. "Saving on Deburring," Engineering, Vol. 209, Mar. 20, 1970, p. 287.

Tube plates are deburred with wide belt sander.

- H6. Bennie, A. J. O., "Wide Abrasive—Belt Machining of Sheet Metal," Metal Finishing Journal, Vol. 16, No. 184, Apr. 1970, pp. 107-109.

Wide belt deburring sands burrs to within 0.0003 inch of work-piece surface.

ELECTROCHEMICAL DEBURRING

1963

- I1. "Eine neue Art des Elektrochemischen Entgratens," Werkstattstechnik, Vol. 53, 1963, p. 579 (in German).
- I2. *Christenson, Jack D., "The Use of Electrochemical Machining for Selected Metal Removal," ASME Paper 63-MD-52, 1963.

Details of EC deburring 400 series stainless steel roll pin.

- I3. Kollner, S. V., I. I. Moroz, and I. P. Kharlamov, "Semi-Automatic Electrochemical Deburring Machine Model MA-31," Stanki i Istrum, No. 4, 1963, p. 26 (in Russian).
- I4. Schoffler, Ing. G., "Electrolytic Deburring, A New Method of Rationalizing Production," Werkstatt u. Betrieb, Vol. 96 (12), December, 1963, pp. 865-870 (in German).

Describes advantage and application of EC deburring. Process principles are also described.

1964

- I5. "Electrolytic Deburring," Engineer, Vol. 217, March 20, 1964, pp. 537-538.
- I6. "Electrochemical Machining Provides Low-Cost Deburring at General Motors," Machinery (N.Y.), Vol. 71, December, 1964, p. 109.
- I7. Bartkiewicz, B., "Niedrigere Fertigungskosten durch das Elysier-Formentgraten" Werkstattstechnik, Vol. 54, No. 10, Oct. 1964, pp. 496-499.

EC deburring process, operation, advantages, and applications are described as is a deburring installation.

- I8. Boyle, S. C., "Electro-Chemical Deburring for Aluminum Components," Light Metals, Vol. 27, May, 1964, pp. 48-49.

1965

- I9. "Connecting Rods Deburred via ECM," Steel, Dec. 13, 1965, p. 49.

Milled grooves an automobile connecting rods are deburred by ECM.

- II0. Wick, C. H., "Electrochemical Machining: A New Tool for Deburring," Machinery, (N.Y.), Vol. 71, March, 1965, p. 143.
- II1. Siegel, Bruno, "Elektrolytisches Polieren und Entgraten von Massenteilen," Industrie Kurier, Vol. 18, 1965, No. 104, pp. 454-456 (in German).
- II2. Williams, L. A., "Connecting Rods Deburred Via ECM," Steel, Vol. 157, Dec. 13, 1965, p. 49.

1966

- II3. "Electrolytic Boring, Turning and Deburring as Modern Metal Working Methods," S. Crisan and M. Ivan, Constructia de Masini, Vol. 18, No. 11, 1966, pp. 641-644.
- II4. Schekulin, K., "Use of Electromachine Operations in Industrial Production," Tz Prak Metallbearbeitung, Vol. 60, No. 3, March 1966, pp. 168-173 (in German).

Discussion and actual applications of ECM and EC deburrings are given. Plain and alloy steel and titanium workpieces are utilized.

- II5. Williams, Lynn A., "ECM Moves Into New Fields of Metalworking," ASTME Paper MR66-213, 1966.

1967

- II6. "Electrochemical Deburring: Bad News for Tough Burrs," Metalworking, Vol. 23, No. 1, Jan. 1967, pp. 36-38.

Diesel fuel injector nozzles are EC deburred. Details of techniques required for one part are described.

- II7. Anders, Heinz, "Elektrolytisches Polieren und Entgraten," Metallober Fläche, Vol. 21, 1967, N. 8, pp. 248-249 (in German)

- II8. *Cross, Jack, "A Discussion of Electrochemical Deburring," ASTME Paper MR67-234, 1967.

EC deburring applications.

- II9. Hauschild, Elmar R., "Das Elektro-Lytische Entgratver Fahren und Seing Anwendung," Die Maschine, Vol. 22, 1967, Jueil Aussause, pp. 114-116 (in German)

- I20. Molinelli, John, Gordon J. Michaels, and George Owens, "ECM Deburring," ASTME Paper MR67-647, 1967.

Description of EC deburring equipment and electrolytes. Two case histories are described.

- I21. Ratmansky, Samuel C., "ECM-What is New?," ASTME Technical Paper MR67-311, 1967.

EC deburring of internal cross holes is mentioned. Major thrust of article concerns ECM tooling.

- I22. Reinhold, R., "Anwendung des Elektro-Chemische Formentgratens," Fertigungstechnik und Betrieb Fur Technologie und Organisation, Vol. 17, 1967, N. 11, pp. 679-681 (in German)
- I23. Reinhold, R., "Rationelles Elektrochemisches Formentgraten Mit Einfachem Handgerat," Fertigungstechnik und Betrieb fur Technologie und Organisation, Vol. 17, 1967, N. 12, pp. 731-733 (in German).

1968

- I24. "ECM System Cuts Deburring Time," Can. Mach. Metalworking, Vol. 79, No. 4, April 1968, pp. 137, 142.

Summary of ECM process and its use on diesel engine connecting rods.

- I25. "Electrochemical Machining Speeds Deburring Process," Iron Age Metalworking Int., Vol. 7, No. 8, pp. 40-41, August, 1968.

General summary of EC deburring.

- I26. "Electrochemical Method Erases Burrs," Product Engineering, Vol. 39, Oct. 7, 1968, p. 87.
- I27. Bacquias, G., "Ebavurage et Usinage Electrolytique," La Metallurgie et la Construction Mecanique, Vol. 100, 1968, No. 12, pp. 652-655 (in French)
- I28. Bartkiewicz, B. and G. Hahmann, "Reduction in Production Costs by Electrochemical Deburring," Fachber. Oberflächen Technik, Vol. 6, No. 2, pp. 37-43, 1968 (in German)

The process and its applications are reviewed. Costs are compared with manual deburring.

- I29. Bussack, V., "Elektrolytisches Entgraten Von Stirnrädern," Fertigungstechnik und Betrieb fur Technologig und Organisation, Vol. 18, 1968, No. 8, pp. 501-503.
- I30. DeBarr, A. E., and D. A. Oliver, editors, Electrochemical Machining, American Elsevier Publishing Co., Inc. 1968.

Very brief mention of EC deburring.

- I31. Hawkins, W. A., "ECM Deburring Breaks Production Bottleneck," Metalworking Production, Vol. 112, Oct. 23, 1968, pp. 41-42.
- I32. Michaels, Gordon T., "Closer Tolerances Made Possible by Electrochemical Deburring," Automation, Vol. 15, Nov. 1968, pp. 84-86.
- I33. Movich, Richard C., "Electrochemical Machining Titanium Alloys," ASTME Paper MR68-207, 1968.

1969

- I34. "Electrochemical Honing and Deburring," ASTME Student Quarterly, Spring, 1969, pp. 10-11.
- I35. "Electrolytic Deburring," Engineering, Vol. 207, March 28, 1969, p. 504.

Summary of Bosch's EC deburring equipment.

- I36. "Metal Finishing Concept Offers Burr-Free Metal," Materials Engineering, Vol. 70, August, 1969, p. 52
- I37. "Electrochemical Processes for Deburring of Gear Wheels," Bulletin of Techniko-Econom. Informazii, 1969, No. 3, No. 12, p. 357 (in Russian).
- I38. "Electrochemical Technique Takes Burr Off as Fast as it Forms," Product Engineering, Vol. 40, August 11, 1969, p. 86.

Parts are EC deburred in fixture used to drill them.

- I39. "Metal Finishing Concept Offers Burr-Free Metal," Materials Engineering, Vol. 70, August 1969, p. 52.

Proposed method utilizes EC deburring to remove burrs in same setup as parts are machined.

- I40. *Bigony, Frank, "Electrochemical Deburring of Aerospace Components," ASTME Paper MR69-413, 1969.

Tooling and process for deburring 17-4 ph and 440C stainless steel. Blind slots and holes are deburred. Effects of process on hole size and radius are shown.

- I41. Gettelman, Ken, "Burrs Blitzed with ECM," Modern Machine Shop, March, 1969, pp. 124-128.

EC deburring and equipment used by International Harvester.

- I42. Gosger, P., "Examples of Electrochemical Deburring," Werkstattstechnik, Vol. 59, No. 6, pp. 272-275, June, 1969 (in German).

Examples of localized electrolytic etching are given. Plant deburrs 30,000 parts per day.

- I43. Hawkins, W. A., "Deburring Auto Parts with ECM," American Machinist, Vol. 113, Feb. 10, 1969, p. 97.

Diesel engine connecting rods are deburred in seven seconds via ECM.

- I44. Klein, John, "Electrochemical Machining: A Space-Age Way to Refine Forged, Extruded and Cast Shapes. Pt. 2," Precision Metal, Vol 27, No. 3, March 1969, pp. 65-67.

- I45. Meslink, M. C., "Electrochemical Deburring--A Tool for Precision Production Deburring," ASTM Paper MR69-907, 1969.

- I46. *Michaels, Gordon, "Precision Deburring by ECD," Products Finishing, Vol. 33, No. 4, Jan. 1969, pp. 48-54.

Summary of EC deburring.

- I47. *Rolstein, Dr. Robert F., and E. James Manning, "New Solution to an Old Problem--Electrochemical Deburring," Tool and Manufacturing Engineer, March, 1969, pp. 14-16

Tooling and examples of EC deburring.

- I48. Schmidt, J., "Successful Attack of Burrs," Produktion, 1969, Vol. 8, No. 1, pp. 49-52; No. 5, p. 133 (in German).

1970

- I49. "Electromechanical Deburring Process," Material Cutting, Shaping, and Forming, NASA SP-5922(01), 1970, pp. 1-2.

Special electrode is used to electropolish deburr drilled pipe.

- I50. ECM, ECD, ECG Simplified (75 Page Booklet) Chemform Corp., Pompano Beach, Florida, April, 1970.

- I51.* *Bogue, David, and Ralph Hach, "How to Cut Deburring Costs," American Machinist, Vol. 114, No. 11, June 1, 1970, pp. 97-99.

EC deburring applications and use are described.

- I52. Mauz, "Electrochemical Deburring," Proceedings of the 3rd International Symposium for Electromachining, October 12-15, 1970.
- I53. Melamed, Z. O., "Electrochemical Deburring Setup," et. al., Stroit. i. Dor. Mashin; 1970, No. 7, 32 (in Russian).
- I54. Rüb, Friedmund, "Processes and Machines for Electrochemical Metal Working," Metalloberfläche, Sept. 1970, Vol. 24, (9), 342-345 (in German).
- I55. Rüb, Friedmund, "Machines for Electrochemical Grinding, Deburring, and Milling," Klepzig Fachber, Vol. 78, No. 2., p. 88-90, Feb. 1970 (in German).

German ECD machines are described.

- I56. Siegel, Bruno, "Continuous Process for Electrolytic Deburring and Polishing of Metals," Jahrbuch Oberflächentechnik, 26, 73-79, 1970 (in German).

1971

- I57. *Chemform Electrochemical Deburring Tool Design Manual, Chemform Brochure, 1971.

Excellent manual dedicated to explaining tooling principles.

- I58. "Electrochemical Deburring," Manufacturing Engineering and Management, March, 1971, p. 10.

IBM uses EC deburring to remove hobbing burrs from silicon-iron housings.

- I59. Dusek, J., "The Electrolytic Deburring Machine Vuma Echol," Die Schwerindustrie der Tschechoslovakei, 1970, No. 12, pp. 26-28; 1971, No. 3, p. 78 (in German).
- I60. Gosger, P., "New Possibilities for Electro-Chemical Sinking and Deburring," Electrowarme Internat., Vol. 29, No. 4, pp. 213-216, April, 1971 (in German).

EC deburring uses ECM electrolytes and currents but lower electrolyte pressure. This type of deburring can be fully automated even for difficult burr locations.

- I61. Kulikov, V. M., "Electrochemical Device for Deburring," Mashinostroitel, 1971, No. 4, pp. 34-35 (in Russian).

Semi-automatic device deburrs small components with many holes.

- I62. Mauz, Dr., "EC Deburring," Proceedings of the International Symposium for Electromachining, Vienna, Austria, Oct. 12-15, 1971.
- I63. Mauz, Wolfgang, "Elektrochemisches Formentgraten," Die Elektrische Ausrüstung, Vol. 12, 1971, N. 2., pp. 11-17 (in German).
- I64. Tschritter, Reuben, "Electrochemical Deburring Applications," SME Tech. Paper No. MR71-815, 1971.

Applications of electrochemical deburring to uniform and nonuniform burrs, types of electrolytes and designs for tooling are discussed. The recommendations given are illustrated by three applications, an emitter housing of Si iron, an air bearing of sintered nickel silver alloy and a hammer block of Al. Machine voltage, machining time, electrolyte concentration, electrolyte pressure and temp. and other parameters are listed for each application.

1972

- I65. Gent, William E., "Tooling for ECD," Manufacturing Engineering and Management, May, 1972, pp. 35-37.

Summary of EC deburring.

- I66. Keck, B. T. K., "Electrochemical Machining in Production," SME Paper MR72-182, April, 1972.

EC deburring applications.

- I67. Miller, Jerome F., "Electrochemical Deburring Process," SME Paper MR72-540, 1972.

Discussion of EC deburring.

- I68. Siegel, B., "EC-Plant for Electrochemical Polishing and Deburring," Paper Presented at 'Elektrochemische Abtragverfahren in der Produktionstechnik' (Dusseldorf), 1972 ; Finish 1972, no. 6, 180 (in German).

A review of ECM and electropolish.

- I69. Schaaf, H. A., "Electrolytic Deburring of Die Castings," SDCE Paper No. 2472, 1972.

A complete discussion of ECD as related to die cast parts.

ELECTROPOLISH

1945

- J1. Crout, J. S., "Electrolytic Polishing," Metal Industry, Vol. 66, June 8, 1945, pp. 357-359.

Brief comment on electropolish deburring.

1952

- J2. Shriver, George L., "Complex Stainless Parts Resist Corrosion When Electro-Polished," Western Metals, Vol. 10, June 1952, p. 51-52.

Electropolishing increases corrosion resistance of 400 series stainless steel by 450% and 300 series stainless steel by 750%.

1953

- J3. "Elektrochemisches Entgraten und Polieren," Draeger-Hefte, Vol. 4, 1953, p. 391 (in German).

1954

- J4. "Controlled Electrolytic Deburring Replaces Costlier Hand Methods," Iron Age, Vol. 174, Oct. 28, 1954, p. 94.

IBM uses electropolish deburring to process 4-5 million parts annually at the Edicott New York plant. A 12 volt, 500 amp rectifier is used with 180°F electrolyte. The electrolyte is 42½% sulfuric acid, 47 % phosphoric acid, 10% water and 5% brightener. A 10-minute dip removes 0.001 inch stock from the stainless steel workpiece.

1955

- J5. Mondon, R., "Some Successful Applications of Electrolytic Polishing in Industry," Sheet Metal Industries, Dec. 1955, pp. 923-934.

Air injection holes in turbo-jet combustion chambers are electropolish deburred. This relieves sources of fatigue failure.

- J6. Stockl, E., "Elektrochemisches Entgraten und Polieren," Metallwaren-Industrie; Vol. 46, 1955, pp. 331-334 (in German)

1956

- J7. Jumer, John F., "Electropolishing Increases Spring Fatigue Life," Electrical Manufacturing, June 1956, pp. 152-153.

Electropolish removes punching burrs of contact springs.

- J8. Naruse, Masao, and Akira Nannichi, "Gear "Burring" by "Electrolytic Polishing," I. "Electrolytic Burring" of Aluminum Gears," Technology Reports Tohoku University, Vol. 20, 1956, p. 225-233.

Polishing was carried out in phosphoric acid solution of 1.4 density, with the gear as the anode connected in parallel with an aluminum plate cathode.

1958

- J9. Kohlhasse, H., "Hinweise Über Das Elektrolytische Polieren und Entgraten von Stahl," Feingerate-Technik, Vol. 7, 1958, pp. 418-422 (in German).

1960

- J10. "Local Electrolytic Polishing," Metal Industry, Vol. 96, Apr. 29, 1960, p. 363-364.

New apparatus, known as the "Ellopol", consists of a portable rectifier unit to which is connected a water-cooled polishing plug. The standard polishing plug ("Ogipol") has a rounded head made of stainless steel. A plug with a pointed head ("Sharpol") is used for special work, that is for small specimens, narrow tubes, or thin sheets, for example, or for certain metals that respond better to polishing with the differently shaped head.

- J11. "Precision Parts Electro-Deburred in Seconds," Metalworking Production, Vol. 104, 1960, N. 16, pp. 699-701.

- J12. Bredin, Harold W., "Electropolishing -- A Multipurpose Process," Machinery, Vol. 66, July 1960, p. 113-115.

Electropolish deburring of aircraft components.

- J13. Fishlock, D., "Electrochemical Machining: What it Can do," Metalworking Prod., 1960, Vol. 104, No. 49, 94-8; No. 51, 53-8.

Electrolytic deburring, grinding and machining of tools, gear wheels, gun barrels, etc., are reviewed.

- J14. Wulhorst, Galvanotechnik und Oberflächenschutz (Switzerland) Vol. 1, No. 2., p. 25, 1960. (Copies available from New York Public Library)

1961

- J15. Striegler, C., "Electrolytic Deburring and Polishing of Metals," Maschinenbau, Vol. 10, Apr. 1961, p. 140-148 (in German).

Review and theoretical analysis of anodic erosion with comparison of properties of mechanically and anodically polished surfaces. Survey of polishing and deburring techniques and equipment; process technology such as electrical data, temperature conditions, course of operation and efficiency and reconditioning of electrolytes.

- J16. Tiranskaya, S. M., "Influence of Microstructure on Quality of Electro-Polished Surfaces," Izu. Vyssh. Uchebn. Zavedeniy Chern Met., 1961, No. 12, 135-43 (Ref. Zhur. Met., 1962, No. 5, 51696) (In Russian)

Investigations on carbon steels and Armco iron electropolished in acid baths yielded information regarding effect of bath composition and microstructure on polishing mechanism and its effects and regarding recommendations for suitable surface preparation.

1962

- J17. "Anwendung des Anodischen Polierens und Entgratens von Metallen," Galvanotechnik, Vol. 53, 1962, pp. 302-33, (in German).
- J18. Boyle, S. C., "The Principle of Electropolishing, Electrodeburning and Electromachining," Metal Finishing Journal, Vol. 8, No. 95, Nov. 1962, p. 381-392, 403.

Electropolish deburring of stainless steel and other components.

- J19. *Faust, Charles L., "Electropolishing," Electroplating Engineering Handbook, 2nd Edition, A. Kenneth Graham (ed.), Reinhold Publishing Corp., New York, 1962.

In depth discussion on electropolishing in general.

- J20. Kol'ner, S. V., I. J. Moroz, and I. P. Harlamov, "Elektrolytischer Halbautomat zur Entgratung von Werkstücken," Maschinenbau, 1962, pp. 3-8 (in German).
- J21. Weiner, Robert, "Anodic Polishing and Deburring of Metals," Galvanotechnik, Vol. 53, No. 9, Sept. 15, 1962, p. 428-434, 448 (in German).

Surface quality of stainless steel, silver, nickel, molybdenum workpieces.

- J22. Weiner, R., "The Properties of Anodically Polished Metals," Blech, 1962, 9, No. 5, 260-4 (in German).

A review of optical, frictional, corrosion and electrical properties of mech and electropolished surfaces.

1963

- J23. Boyle, S. C., "Electro-Deburring Delicate Components," Machinery, Vol. 102, No. 2619, Jan. 1963, p. 199-201.

Plant automatically deburrs copper, steel, and stainless steel.
Process variables are described.

- J24. Mondon, Robert, "Industrial Electrolytic Polishing in France," Metal Progress, Vol. 83, No. 1. Kan. 1963, p. 95-100, 144, 147.

Electropolish is used in Europe for deburring.

- J25. Peter, Hamns, "Der Einsatz von Vibratoren Zum Mechanisch - Chemischen Entgraten, Schleifen, Glatten und Polieren von Massenteilen in Der Metallindustrie," Maschinenmarkt, Vol. 69, 1963, No. 24, pp. 33-34
(In German)

1964

- J26. "Hand-Held Stylus "Erases" Metal," Iron Age, Vol. 193, No. 7, Feb. 13, 1964, p. 90.

Electropolish deburring using a portable wand.

- J27. Boyle, S. C., "Electro-Chemical Deburring for Aluminum Components," Light Metals, Vol. 27, No. 312, May 1964, p. 48-49.

Electropolish deburring of aluminum.

- J28. "Unit Combines Metal Cleaning, Machining," Steel, May 11, 1964.

Electropolish can be used to deburr. Author indicates that 0.0001 inch metal removal removes 0.001 to 0.002 inch burr.

- J29. Faust, Charles L., "Electropolishing," Metals Handbook, Vol. 2, 1964, pp. 484-488.

Summary of electropolish deburr treatments.

- J30. Powers, R. W., "The Electropolishing of Copper Specimens," Electrochemical Technology, Vol. 2, No. 9-10, Sept.-Oct. 1964, pp. 274-281.

1965

- J31. "An Interesting Machine for Electrolytic Deburring," Fachber. Oberflächen Technik, Vol. 3, No. 4, pp. 156-7, 1965 (in German)

An electrolytic deburring machine is described and illustrated.

- J32. "Electrolytic Deburring and Machining Equipment," Australasian Manufacturer, Vol. 50, No. 2570, July 3, 1965, pp. 40-41, 43.
- J33. Blundell, Brian F., An Introduction to Industrial Finishing Equipment, Pergamon Press, Great Britain, 1965.

Brief comment on electropolish deburring.

- J34. Nicholson, James C., "Electro-Polishing, the Space Age Tool," ASTME Paper FC65-163, 1965.
- J35. Seabright, Lawrence, H., "Electrodeburrring Solves Difficult and Costly Problem," Cutting Tool Engineering, Vol. 17, No. 11-12, Nov-Dec 1965, pp. 25, 28.

General article on the use of electropolish deburring of miniature gears and shafts.

1966

- J36. "Elektrolytisches Polieren und Entgraten von Massenteilen Aus Blech," Blech, Vol. 13, 1966, pp. 240-241 (in German)
- J37. "Electrolytic Polishing and Deburring," Schleif Poliertechnik, No. 6, June 1966, pp. 192-194 (in German)

Titanium is used as the contact material for deburring large quantities of small parts. Automatic equipment is described as is a new electrolyte for large parts.

1967

- J38. Abrams, H., "Electrolytic Polishing of Copper and Nickel Silver," Electrochemical Technology, Vol. 5, No. 5-6, May-June, 1967, pp. 287-292.
- J39. Anders, H., "Electropolishing and Deburring," Metalloberflache, Vol. 21, No. 8, 1967, pp. 248-249, (in German)
- J40. Curti, T. H., "Electrolytic Polishing and Deburring," Schleif-und Poliertechnik, No. 2, pp. 52-54, 1967 (in German).

Description of an unnamed proprietary electropolishing process and plant requirements for Cu alloys, Al, Ni, and stainless steel.

- J41. Pohlman, R., "Ueber Beenin Flussong und Bearbeitung Metallischer Oberflaechen in Ultraschallerregten Baedern," Metallober Flaeche, Vol. 21, No. 1, Jan. 1967, pp. 6-9 (in German).

State of the art of finishing by electropolish deburring and related areas in ultrasonically activated baths.

- J42. Siegel, B., "Applications of Electropolishing and Electrolytic Deburring with Special Reference to the Treatment of Large Surfaces," Galvanotechnik u. Oberflachenschutz, Vol. 8, No. 12, 1967, pp. 24-7 (in German).

Describes applications to dishwashers, sieves, heat exchangers, pressure vessels, and other items.

- J43. Siegel, B., "Progress in the Field of Electrolytic Polishing and Deburring," Schleif-U. Poliertechnik, 1967, No. 4, pp. 124-132 (in German).

A brief review of recent advances in electropolishing copper alloys and austenitic stainless steels. Description of equipment used is also given.

- J44. Van Horn, Kent R. (ed.), Aluminum, Vol. III, ASM, 1967.

Brief but detailed description of solution for deburring aluminum.

1968

- J45. Bartkiewicz, B., and G. Hahmann, "Reduction in Production Costs by Electrochemical Deburring," Fachber. Ober flachentechnik, Vol. 6, 1968, pp. 37-43 (in German)

- J46. Busack, U., "Electrolytic Deburring of Gear Wheels," Fertigungstechn. Vol. 18, No. 8, 1968, pp. 501-3 (in German).

Gear wheels were deburred in 15% HCL soln. at 70 A/dm² 14V, 25°C and an electrolyte pressure of 6-12 Kp/cm² in 15 sec.

- J47. Heyes, J., "Electrolytic Grinding, Deburring and Hole Sinking," Interfinish '68 Tagungsberichtsband, Deutsche Gesellschaft fur Galvanotechnik e.V., Dusseldorf, Germany, 1968, pp. 235-9.

A review of processes for electrolytic deburring, grinding and hold sinking using ECM electrolytes.

- J48. Krickau, O., "The Application of New Production Processes in the Manufacture of Screw Springs (2) Electrolytic Deburring of Screw Pressure Springs," Z. Wirtsch. Fertg., Vol. 63, No. 3, 1968, pp. 111-4 (in German).

Deburring machine uses bitrate electrolyte at 3 ATM pressure, 20V, 45 AMP for 3-4 sec.

- J49. Schulze-Berge, Klaus, "Electrolytic Machining -- An Economic Process," Werkstatt u. Betrieb, Vol. 101, No. 4, Apr. 1968, pp. 206-208 (in German).

Brief mention of gear deburring.

- J50. Siegel, B., "Equipment for Electrolytic Deburring and Polishing of Small Parts," Synopsis of Papers of 7th International Metal Finishing Conference, Hannover Germany, May 1968.

Advantages of electrolytic deburring are given. Equipment for batch operations is described.

- J51. Siegel, B., "New Development Trends in Electropolishing and Deburring," Mitt. Deutsch. Forschungsgesell. Bleichverarb., Vol. 19, No. 6, 1968, pp. 70-3 (in German)

A review of applications.

- J52. Siegel, B., "Plant for Electrolytic Deburring and Polishing of Small Parts," Interfinish '68 Tagungsberichtsband, Deutsche Gesellschaft fur Galvanotechnik e.v., Dusseldorf, Germany, 1968, pp. 263-8 (in German)

Description of a barrel electropolish plant. Applications are described.

1969

- J53. "Anodic Polishing and Deburring of Metals," Fachber. Oberflachentechnik, Vol. 7, No. 1/2, 1969, pp. 31-6 (in German)

A review of the electropolish processes.

- J54. "Electrolytic Finishing Process Promises to Revolutionize Many Metal Working Areas," Western Machinery and Steel World, April, 1969.

Electropolish deburring removes 0.002 inch burr with 0.0001 stock loss.

- J55. Horn, H., "The Anodic Polishing and Deburring of Metals," Fachen Oberflachentechnik, Vol. 7, No. 1, 1969, pp. 31-6 (in German).

Electropolishing methods and applications are reviewed.

- J56. Siegel, B., "Equipment for Electrolytic Deburring and Polishing of Small Parts," Metalloberflache, Vol. 23, No. 4, 1969, pp. 108-11 (in German).

Barrel electropolishing review.

- J57. Siegel, B., "Plant for Electrolytically Deburring and Polishing Small Metal Mass-Produced Components," MetallOberfläche, Vol. 23, No. 4, pp. 108-111, April, 1969 (in German).

1970

- J58. "Electrolytic and Chemical Polishing," Finishing Handbook, 1970, pp. 195-196.
- J59. "Electrolytic Polishing," Metal Finishing Journal, April, 1970, p. 114.
- J60. "Electropolished Stainless Steel Yields Functional Advantages," Products Finishing, (Cincinnati), Vol. 34, No. 7, April 1970, pp. 46-55.

Author reports that drilling burrs up to 0.030 inch thick have been removed without altering critical tolerances. One shop electropolish deburrs 2 million parts per year.

- J61. Parlapanski, M., "Corrosion Resistance of Electropolished Metals," Protection of Metals, March/April, 1970, Vol. 6, No. 2, pp. 151-153.
- J62. Shchigolev, P. V., Electrolytic and Chemical Polishing of Metals, p. 258, 1970.
- J63. Siegel, Bruno, "Continuous Process for Electrolyte Deburring and Polishing of Metals," Jahrbuch Oberflächentechnik, 1970, Vol. 26, pp. 73-79 (in German)

Describes automatic plant for electropolishing in barrels and by racks.

- J64. Siegel, B., "Electropolishing and Deburring," Oberfläche (Berlin), 1970, N. 12, pp. 498-500, 502. (in German)
- J65. Siegel, B., "The Applications of Electropolishing and Electrodeburrring in Industry Today," Electroplating and Metal Finishing, March, 1970, p. 21, 36; similar in Galvanotechnik V. Oberflächenschutz, Vol. 8, No. 12, 1967, pp. 24-27.
- J66. Swain, J. D., "Electrolytic Polishing and Deburring for Mass Produced Parts," Mass Production, Vol. 46, July 1970, pp. 17-22.

Automated electropolish deburring equipment is shown and described.

- J67. *Swain, J. D. "Modern Methods for the Electrolytic Polishing and Deburring of Mass Produced Components," Product Finishing, Vol. 23, No. 5, pp. 33-38, 1970.

Advantages of electropolish deburring are described. An automated electropolish deburring unit is illustrated. Photos are presented of ball bearing cages, and screws. Watch components and electrical contacts are discussed.

1971

- J68. "Technical Data Sheet No. 81," MacDermid Inc., Circa 1971.

Six page data sheet on electropolish deburring using Electro-Gleam 55.

- J69. "Technical Data Sheet No. 95," MacDermid Inc., Circa 1971.

Three page data sheet on electropolish deburring stainless steel.

- J70. *Faust, Charles L., "Electropolishing," Electroplating Engineering Handbook, 3rd Edition, A. Kenneth Graham (ed.), Reinhold Publishing Co., New York, 1971, pp. 108-127.

Contains a brief discussion of burr size which can be removed by electropolish deburring.

- J71. Siegel, Bruno, "Electropolishing and Electrochemical Deburring Baths," Jahrbuch Oberflächentechnik, 1971, 27, 63-70 (in German).

1972

- J72. Siegel, B., "Electrochemical Polishing and Deburring as Finishing Process," Paper Presented at 'Elektrochemische Abtragungsverfahren in der Produktionstechnik' (Dusseldorf,) 1972, No. 6, P. 181 (in German).

Electropolishing and deburring of machine components are compared with electrochemical machining.

- J73. Siegel, Bruno, "Electropolishing and Electrochemical Deburring in Processing Plants," Jahrbuch Oberflächentechnik, 28, 72-79, 1972 (in German).

Describes plant and process for electropolishing and deburring.

ULTRASONIC DEBURRING

1957

- K1. *Wright, John P., "Ultrasonic Deburring," American Machinist, Vol. 101, Feb. 11, 1957, pp. 129-136.

Examples of burrs removed and edges resulting from ultrasonic deburring. 180 d.p. brass gear 0.015 inch thick is shown as are stamped paliney metal part requiring 0.003 to 0.005 inch radius, and 416 stainless steel ground part. Ultrasonic deburring improves ground finish of 16 rms to 8 rms while parts are deburred at a rate of 63 parts per hour. The 0.0856 inch diameter stainless steel part has a total tolerance of 0.0002 inch. Electropolishing was not as effective on this part. Spacers of 4130 steel maintained 5 millionths size tolerance while ultrasonic deburring produced a 0.003 inch radius on the lapped parts. Other interesting examples include stainless steel hypodermic tubing and brass blocks which have requirements for both large and small radius on the same part. Burrs and sharp edges are predominantly attacked before flat surfaces. Intensive training of technicians is required to produce successful operators.

1958

- K2. "Deburring with Ultrasound," Steel, Vol. 142, April 7, 1958, pp. 102-103.

Research Associates Labs of Los Angeles use ultrasonics to deburr parts having 5 millionths tolerances. Parts are deburred at 100 an hour.

1962

- K3. "Ultrasonic Deburrer Cuts Production Costs," Engineering, Vol. 193, June 29, 1962, p. 853.

Describes Powertron Ultrasonics Corporation ultrasonic deburring unit. The slurry used is critical to the success of the operation.

- K4. "Ultrasonic Deburring," Aircraft Production, Vol. 24, No. 11, Nov. 1962, p. 376.

Ultrasonic deburring of aluminum, chromium, copper and nickel alloys and beryllium copper and steel. Data is presented on surface finish and tolerance.

- K5. "Ultrasonic Deburring," Metal Treatment and Drop Forging, Vol. 29, No. 207, Dec. 1962, p. 524.

Deburring of cast Al, mild steel, soft and hard Be-Cu, Cr, Cu and Ni alloys, 300 and 400 series stainless steels and other metals by a cavitation ultrasonic method using a slurry at 50 to 60 C. Details of the process time and tolerances.

- K6. "Ultrasonic Deburring Cuts Costs," Machine Shop Magazine, Vol. 23, August 1962, p. 462.

1963

- K7. "Ultrasonic Deburring Equipment," Canada's Machine Production, Vol. 24, No. 6, June 1963, p. 25-26.

Design and operating parameters of a combination generator-transducer ultrasonic deburrer for deburring, cleaning and micropolishing of Al, Be-Cu, Cr, Cu and Ni alloys, mild steels and 300 and 400 steels.

1965

- K8. *"Sound Waves Strip Off Burrs," Iron Age, Vol. 196, No. 6, August 5, 1965, pp. 62-63.

Ultrasonic deburring removes thin 'feather' burrs and 0.0003 inch stock. An acid slurry combined with 10 watts per square inch is used.

- K9. "Ultrasonics-Chemistry Ease Deburring Chores," Steel, vol. 156, March 1, 1965, p. 41.

Delta Sonics Inc., Hawthorne Calif., uses ultrasonic deburring to deburr copper, brass, zinc, aluminum.

- K10. *Blundell, Brian F., An Introduction to Industrial Finishing Equipment, Pergamon Press, 1965.

Brief but notable comment on ultrasonic deburring.

1966

- K11. *"Ultrasonic Deburring," Electroplating & Metal Finishing, Vol. 19, Sept. 1966, p. 349.

Description of how ultrasonic deburring is performed.

- K12. "Ultrasonic Deburring," Tooling, Vol. 20, Sept. 1966, pp. 17-21.

- K13. "Westinghouse Put Ultrasonic Deburring on Production Basis," Diecasting & Metal Moulding, Vol. 2, No. 3, pp. 13, 1966.

1969

- K14. Ginnever, B. J., "Introduction to Ultrasonic Deburring," Metal Finishing, Vol. 15, No. 174, pp. 221-222, June, 1969.

Theory and techniques of ultrasonic deburring are presented. Honing burrs are removed from electric razor heads. Process lends itself to automated lines.

- K15. *Korshunov, B. S., "Ultrasonic Flash Removal from Small Components," Russian Engineering Journal, Vol. 49, No. 12, 1969, pp. 45-46.

Ultrasonic deburring is performed at 6 ATM. pressure. Glycerine and 5 micron ruby particles reduce 0.04 mm burr to 0.01 mm after 25 minutes. Effects of different abrasives and grain size are described.

1970

- K16. "Entgraten Kleiner Teile Mit Hilfe von Ultraschall," Maschinenvau und Fertigungsdienst der UdSSr., Vol. 9, 1970, F. 91, pp. 115-116.

CHEMICAL VIBRATORY DEBURRING

1956

- L1. *Sachs, K., M. Odgers, "Smoothing of Mild Steel by Barrel Treatment in Oxalic Acid--Hydrogen Peroxide Solution," Transactions of the Institute of Metal Finishing, Vol. 33, 1956, pp. 245-276.

Mild steel is tumbled in oxalic acid to produce bright surfaces and to improve surface finish. Although not pointed out in article this process could shorten deburring times as well as improve finish.

1967

- L2. Blagodeteleva, E. S., "Aqueous Solution for Vibrational Deburring of Sharp Edges," No. 236,183 (filed 6.6.1967). (Russian Patent)

The soln, which is intended for use with bronze components, contains 35-60 g/l NaOH and 35-60 g/l NH_4Cl in a wt. ratio of 1 : 1, and provides improved productivity and improved surface finish.

1971

- L3. Hinz, Heinz Erich, "The Effect of Chemical Additives on the Surface Treatment of Mass Produced Components," Galvanotechnik, Vol. 62, No. 4, 1971, pp. 298-304 (in German).

1972

- L4. *Safranek, W. H., and H. R. Miller, "Vibratory Finishing with Chemical Accelerators," Plating, Vol. 59, Jan. 1972, pp. 38-40.

Results of study of metal removal rates and surface finish produced by adding chemicals to the vibratory finishing process. Results show a 10 fold increase in stock removal rates.

- L5. Safranek, W. H., and H. R. Miller, "Vibratory Finishing with Chemical Accelerators," Industrial Finish Surface Coatings, Vol. 24, No. 283, pp. 18-20, 29, January, 1972.

- L6. Safranek, W. H., and H. R. Miller, "Vibratory Finishing with Chemical Accelerators," Die Cast Eng., Vol. 6, No. 2, pp. 12-14, 16, March-April, 1972.

ELECTROCHEMICAL VIBRATORY DEBURRING

1966

- M1. Massad, Robert B., "Electro-Abrasive Machining," Technical Paper presented at the Fifth National Technical Conference of the American Society for Abrasive Methods, March 7, 1966.

1968

- M2. British Patent (1, 238, 073), 1968

Electrolytic deburring process uses random conducting bodies to transmit current. Electrolyte may also contain abrasive particles and a magnetic field.

- M3. "Electrolytic Deburring," British Patent (1, 194, 649), International Business Machines Corp., Filed 1-10-1968.

Electronic components are deburred in H_3PO_4 solution containing silicon carbide abrasive. Electric current is passed through the medium to heat and oxidize the burrs. Copper coated Al_2O_3 may be used as the media. Vibratory action removes surface oxides.

1969

- M4. *DeGroat, George, "ECM Deburring with Graphite," American Machinist, Dec. 1, 1969, pp. 78-79.

Brass wristwatch housing is deburred in 35 seconds using tiny graphite spheres. Stainless steel tube with 1120 1/4 inch holes is deburred in 48 seconds.

- M5. Ino e, K. U.S. Patent 3,533,928, 1969

Electrolysis and mechanical abrasion remove burrs. Magnetic particles may be used to increase the abrasive action.

1970

- M6. "Electrolytic Vibratory Finishing," International Business Machines Corp., U. S. Pat. 5 523 834, 1970.

Metal articles are deburred in a vibratable container with abrasive in conducting soln. Current is passed and the container vibrated. Conductive abrasive gives automatic current regulation for any predetermined voltage.

WATER JET DEBURRING

1971

- N1. Jacques, M. E., and M. C. Kurko, "Machining with High Velocity Hydraulic Jets," Hydraulics & Pneumatics, Feb. 1971.

Summary of equipment used to machine and deburr with high speed water jets.

- N2. *Kurko, M. C., and R. F. Chadwick, "High Pressure Jet Machining Equipment and Applications," Paper Presented at National Conference on Fluid Power, Chicago, Illinois, Oct. 1971

Air conditioner housing made from resin, asbestos, sisal and clay is deflashed by water jet.

- N3. Wick, Charles H., "Deburring with High Pressure Water Jets," Mfg. Eng. Manage., Aug. 1971, 67, (2), 30-31.

High pressure stream of water deburrs die cast aluminum valve bodies for automatic transmissions. Parts are processed at 350 parts per hour.

- N4. Wrigley, Al, "Water Jet Deburring Earns Quick Favor in Auto Industry," Metalworking News, Feb. 7, 1971, pp. 1 & 6.

CHEMICAL DEBURRING

1959

01. *Poll, Gerard H., Jr., "Chemical Deburring Solves Problem for A. C. Spark Plug," Products Finishing, Vol. 24, No. 2, pp. 44-7, Nov. 1959.

Zinc die cast filter caps are chemically deburred to remove internal burrs. Part is dry blasted to remove external burrs, cleaned soaked in alkali for 2 1/2 minutes, rinsed, dipped in 3 percent sulfuric acid, rinsed, then deburred in heat bath chemburr No. 3. The process is automated and uses tumbling barrels in the chemical deburr solution. Process handles 1200 pieces per hour.

1965

02. "Aqueous Solution Deburs and Polishes Steel Surfaces," Steel, Vol. 156, No. 22, May 31, 1965, pp. 54-55.

Chemical deburring is used to remove burrs from deep threaded holes. The metal in a burr is more highly stressed than the body of the part. That makes the burr more anodic than the adjoining metal--so it is preferentially attacked.

1966

03. "Chemical Deburring & Surface Purification," Tooling & Production, Vol. 32, April 1966, pp. 154, 172.

0.020 thick steel stamping is deburred chemically in 5 minutes. Metal removal varies from 0.00005 to 0.002 inch.

04. Kern, J. E., "Chemical-Energy Deburring as Applied to Hydraulic Components," SAE Paper 660606, 1966.

1967

05. Kern, J. E., "Chemical-Energy Deburring as Applied to Functional Components," ASTM Paper FC67-183, 1967.

Process and equipment required for chemically deburring carbon steel, stainless steel, aluminum, and copper base alloys.

06. Lydick, Chris, "See Huge Potential in Chem Deburring," Metalworking News, September 25, 1967, p. 37.

1968

07. "New Horizons in Finishing," Galvano, Vol. 37, No. 378/379, 1968, pp. 479-81.

Describes the use of electrochemical or chemical techniques for deburring, hole production and grinding.

08. "Tight Dimensional Tolerances Attained by Chemical Deburring and Silver Plating," plating, Vol. 55, No. 4, April 1968, p. 404.

Finned brass variable capacitors have only 0.0002 in clearance in assembly. Complete sequence for chemical cleaning two parts is described.

09. Purdon, Bill, "Advanced Techniques for Chemical and Mechanical Machining of Beryllium," SAE Paper 680649, 1968.

1969

010. Kern, J. E., "Surface Leveling Effects of Chemical Energy Deburring Procedures on Precision Functional Components," ASTM Paper MR69-412.

Examples and techniques of chemical deburring.

LIQUID HONE DEBURRING

1947

- P1. Prince, C. A., "Liquid Honing: Further Developments in Vapor Blast," Machinery Lloyd (Overseas Edition), Vol. 19, Aug. 2, 1947, p. 68-69.

Liquid honing is a surface cleaning deburring and finishing method based on the use of a fine abrasive mixed with a chemical emulsion discharged by compressed air against the surface to be treated. Industrial applications are given.

1958

- P2. Grant, D. McLean, "The Technique of Hydrabrasion," Proceedings of the Conference of Technology of Engineering Manufacture, 1958.

Gives brief mention of deburring using a liquid hone process.

FLAME DEBURRING

1967

- Q1. Ivanov, B. G., and Yu. I. Zhuravitsky, "Firecutting in the Trimming and Cleaning of Castings," Liteinoe Proizv, No. 12, Dec. 1967, pp. 9-11 (in Russian)

Theory and application of using air-arc machine for removing flash from steel and alloy castings.

MULTIPLE PROCESSES

1943

- R1. "Equipment for Solving Burring Problems," Iron Age, Vol. 152, July 1, 1943, pp. 61-62.

Describes the use of brush and barrel deburring.

- R2. Reck, Franklin M., "Surface Finishing Methods for Aircraft Engines," Aero Digest, Vol. 42, June 1943, pp. 213-217.

General summary of shot blasting and tumbling uses for aircraft parts.

1954

- R3. Hyler, John E., "Deburring: Modern Methods, Tools Cut Costs," Iron Age, Vol. 173, Mar. 11, 1954, p. 140-143.

Improved methods, equipment and tools can cut costs of operation.

1955

- R4. *Bryan, J. H., "Deburring of Small Machined Components," Metal Finishing Journal, Vol. 1, March 1955, pp. 123-127, 134.

History of barrel finishing as well as complete discussion of process. Article also includes discussion of brush deburring.

1958

- R5. *Mueller, Harold W., "Precision Cleaning and Deburring of Missile Guidance Components," Plating, Vol. 45, Sept. 1958, pp. 937-940.

Gyroscope components require removal of all contaminants and burrs over 50 millionths of an inch. 30-50 power magnification is used in conjunction with abrasive set, EC deburring, electropolish, chemical deburring, and mechanical methods.

1959

- R6. Stevens, L. O., "How to Select the Right Precision Finishing Process," Metalworking, Vol. 15, Dec. 1959, p. 8-9.

Factors to consider in choosing between barrel finishing and wet blasting.

1960

- R7. "Mechanical Burr Removal," Precision Metal Molding, Vol. 18, July 1960, p. 53-54, 56, 75.

Process details and equipment used in airless blasting, vibratory finishing, barrel finishing and wet blasting.

1961

- R8. Spears, V. C., and D. E. Keener, "To Cut Deburring Costs, Mechanize," Metalworking, Vol. 17, May 1961, p. 15-16, 24.

Comparison of four deburring methods (barrel and vibratory finishing and airless and liquid blast) in terms of selection factors.

- R9. Spencer, Lester F., "A Design Guide for Specifying Mechanical Finishes for Metal Parts," Machine Design, Vol. 33, Aug. 17, 1961, p. 164-172.

Review of mechanical finishing. Types of finishes and finishing methods including abrasive blasting, grinding, polishing, buffing and barrel finishing. Abrasive belts and contact wheels. Surface finishing characteristics of Al, Mg, Cu, Ni and their alloys, Zn alloys, Ag, Steel and stainless steel. Mechanical finish specifications for stainless steel, Cu and Al parts.

1962

- R10. "Abrasive Engineer's Corner," (Methods of Deburring), Grinding & Finishing, March 1962, p. 14.

Brief reply to reader's letter asking for a list of the various deburring processes.

- R11. "Deburring and Pre-Finishing," Metal Industry, Vol. 101, No. 2, July 13, 1962, p. 30-31.

Review of conference on techniques of finishing by use of barrel processes, vibratory machines and electrochemical methods.

- R12. "The Importance of Deburring Operations," Machinery (London), Vol. 100, Feb. 28, 1962, p. 459-506.

Evaluation of deburring methods including mechanical, chemical, ultrasonic, vibration, electrolytic, vapor blasting and barrel finishing relative to particular applications.

- Rl3. *Green, R. E., "Making Super-Accurate Gyroscopes," Machinery, Vol. 100, May 2, 1962, pp. 976-985.

This article describes the many deburring techniques used to deburr precision miniature gyroscope components.

- Rl4. Patterson, M. M., "The Problems: Deburring, Descaling and Finishing," Grinding & Finishing, Vol. 8, No. 11, Nov. 1962, p. 42-44.

Techniques for deburring, descailing, dry blasting, radiusing, vibratory and barrel finishing and cleaning of thin and flat surfaces, internal surfaces and protruding areas of ferrous, nonferrous and nylon parts and brass bearing materials.

- Rl5. Roll, F., "Influence of Surface Treatment of Fe-C Cast Alloys," Werkstoffe u. Korrosion, 1962, 13, No. 8, 465-8 (in German).

Results of tests on the effect of abrasive blasting, barrel tumbling, grinding and polishing on the corrosion resistance of cast steel, malleable cast Fe and ordinary cast Fe are reported.

- Rl6. Saxby, G., "Deburring Regarded Scientifically," Schleif-u. Poliertechnik, 1962, 2, No. 6, 294-9 (in German).

Methods of deburring by brushing, vibratory equipment, honing, abrasive blasting, chemical and electrolytic processes are discussed.

- Rl7. *Saxby, George, "The Scientific Approach to Deburring," Metal Finishing, Vol. 60, Feb. 1962, p. 41-47.

Mechanical, chemical and electrolytic deburring methods including tumbling, loose and fine abrasive deburring and power brushing. Application to superalloys, Al, stainless steel, Ni, carbides and other materials.

- Rl8. Weiner, R., "Deburring of Metals," Schleif-u. Poliertechnik, 1962, 2, No. 7, 346-51 (in German)

Formation of burrs and removal by lapping, barrelling and electro-polishing, etc., are discussed.

1963

- Rl9. "Developments in Deburring Methods," Machinery (London), Vol. 102, Jan. 16, 1963.

General summary of chemical and electrochemical deburring developments.

- R20. *McKee, Richard L., "Seven Ways of Deburring," Grinding and Finishing, November 1963, pp. 28-31; March, 1964, pp. 41-43; Nov. 1964, pp. 38-58.

Author describes abrasive blasting, vibratory, sanding, brushing and mechanical deburring applications.

- R21. Saxby, G., "The Scientific Approach to Deburring," Metal Finishing F., 1963, 9, No. 105, 361-9.

Barrel finishing, abrasive blasting and loose abrasive deburring and use of electrolytic and chemical polishing methods is described, including the use of ultrasonic agitation.

1965

- R22. "Finishing Stamped Parts," Metalworking, Vol. 21, Feb. 1965, pp. 73-79.

Contains brief summary of deburring techniques used on stamped parts.

- R23. *Miller, Bernard S., "Control Deburring Quality," Metalworking, Nov. 1965, pp. 40-48.

Outstanding article summarizing Hamilton Standard's approach to deburring. Approach consisted of investigating actual edge requirements and evaluating new deburring processes.

1967

- R24. *Meisel, Robert C., "Look to Mechanization to Cut Deburring Costs," Metalworking, June 1967, pp. 39-43, 146.

One of the better summaries of deburring processes available in 1967. A list of manufacturers of deburring equipment is also included.

- R25. Reynolds, William, "Finishing of Parts and Components," Proceedings of the 1967 ASAM National Technical Conference, 1967, pp. 69-70.

Brief discussion of barrel tumbling, vibratory finishing, and blast deburring equipment.

- R26. Springborn, R. K. (ed.), Non-Traditional Machining Processes, Society of Manufacturing Engineers, Dearborn, Michigan, 1967.

Applications of non-traditional machining processes for burr prevention and removal are discussed throughout this book.

1968

- R27. Tarasov, Leo P., "Trends in Cleaning and Finishing," June, 1968, pp. 90-96.

EC deburring, harperizing, vibratory and brushing are described.

1970

- R28. "Commutators Ground, Deburred at 1200/Hour Clip, 3 Times Faster than Alternate Method," Modern Metals, Vol. 26, Dec. 1970, p. 57.

Automated machine sands and wire brushes starter motor commutators.

- R29. "Some Developments in Deburring Processes," Machinery, Vol. 117, Dec. 9, 1970, p. 933.

Very general review of burr removal processes available in 1970.

- R30. Benninghoff, Hanns, "Mechanical, Chemical, and Electrolytic Surface Treatment of Copper and its Alloys," Galvanotechnik, Vol. 61, No. 12, pp. 1009-1018, December 15, 1970 (in German)

- R31. Siegel, B., "Applications of Electropolishing and Electrodeburring in Industry Today," Electroplating Metal Finish, Vol. 23, No. 3, pp. 21, 36, March, 1970.

1971

- R32. Gillespie, L. K., Deburring - A Bibliography, Bendix Corporation (Kansas City Division), Report BDX-613-593, Dec. 1971 (Available from NTIS)

This bibliography lists 154 articles on deburring. All major processes are included.

- R33. *Hauri, H., "Deburring," Technische Rundschau, Circa 1971-Mid 1972 (in German). (Translation available from Extrude Hone Corp. Irwin Pa.)

Brief discussion of stamping and machining burrs. Burr formation increases as workpiece hardness increases. Watch gears are being deburred on the gear cutting machine by a spring loaded cutter. This approach is used primarily on small watch pinions. The use of hand held tools, bevelers, are described as are dry blasting of plastic parts, barrel tumbling, vibratory deburring, electro-polishing, electrochemical and extrude hone deburring. Sixty examples are shown in this excellent survey article.

1972

- R34. *"Bridging the Gap 'Twixt' Forming and Finishing," Metalworking Production, Vol. 116, May 1972, p. 61.

Summary of the history of deburring processes.

- R35. Brookes, K. J. A., "Acid, Heat and Current Attack Surface Problem," Metalworking Production, Vol. 116, May 1972, pp. 68-70.

Summary of electropolish, EC deburring, thermal shock, chemical and hot chlorine gas deburring.

- R36. Hinz, Heinz-Erich, "Surfaces Ready for Plating," Galvanotechnik, Vol. 63, No. 9, Sept. 15, 1972, pp. 828-832 (in German).

Describes methods of deburring and polishing in mechanical and chemical processes. Equipment and solutions are described.

1973

- R37. Hishaw, R. J., Mechanical Deburring of Plastics, Bendix Corp. (Kansas City Division), Report BDX 613-988, Nov. 1973.

This research report describes removal of mold flash and machining burrs from plastic parts, both thermosetting and thermoplastic. Abrasive jet, flame, barrel tumbling, vibratory deburring, extrude hone, thermal shock and low temperature vibratory deburring were studied. The abrasive jet process was found best suited to the miniature plastic parts although vibratory deburring is effective on external edges.

MECHANICAL METHODS

1930

- S1. "Time-Saving Double-Spindle Burring Machine," Machinery (London), Vol. 36, No. 917, May 1, 1930, pp. 153-154.

Design details of a machine for removing burr from both sides of small drilled holes. Opposed spindles are utilized.

1945

- S2. "Burrs on Screwheads Removed by Modified Screwdriver," American Machinist, Vol. 89, March 15, 1945, p. 127.

File is inserted in end of screwdriver handle to remove burrs from screw slots.

- S3. "Pneumatic Machine Does Tube Burring Quickly and Accurately," American Machinist, Vol. 89, Dec. 20, 1945, p. 140.

Air motor with fly cutter is used in mechanized tube deburring.

- S4. "Roller Cutter Tool Cuts Fuel Line Without Burring," American Machinist, Vol. 89, Feb. 15, 1945, p. 136.

Tool with knife edge and backup is used to slit tubing.

- S5. "Sanding Machine Deburrs Bushing Faces," American Machinist, Vol. 89, Dec. 20, 1945, p. 144.

Gravity feed through channel next to rotary sanding head removes burrs from bushings.

1950

- S6. "Special Countersink Burrs Hidden Edges," American Machinist, Vol. 94, Sept. 18, 1950, p. 129.

Simple tool burrs inside of u shaped part having two crossholes.

1951

- S7. "Dentist's Burr Adapted for Deburring inside Holes," American Machinist, Vol. 95, March 5, 1951, p. 132.

Dentist burr toll is combined with hole locator to remove burrs inside tubing cross holes.

- S8. Collens, Jonathan L., "Faster Flash Trimming with Turning Bandsaw Fixture," American Machinist, Vol. 101, March 11, 1951, p. 128.

Rotating fixture holds part while bandsaw cuts flash from cast aluminum bronze rotors.

- S9. Linsley, H. E., "High Production Requires Ingenious Methods of Deburring Aircraft Sheets," American Machinist, Vol. 95, June 25, 1951, pp. 99-101.

Inclined tables combines with drum sanders deburr sheet metal cutouts. Steel wool and beeswax on high speed spindle provide finish required. Hand deburring equipment is also shown. On some sheets burrs are rolled over rather than removed.

1952

- S10. *"Deburring Flat Surfaces on a Drill Press," Machinery (N.y.), Vol. 58, April 1952, p. 197.

Simple fixture is shown for use with sanding disk and drill press to deburr small milled, flat parts. Device maintains flatness which is not possible using belt sander.

1955

- S11. "Deburring Tool Has Wide Range," American Machinist, Vol. 99, March 28, 1955, p. 143.

Universal tool for deburring internal and external diameters while on lathe is shown.

- S12. "Deburring Tool Shop-Made Simply," American Machinist, Vol. 99, Oct. 24, 1955, p. 158.

Manual deburring tool for use with tubing is shown.

- S13. "Scrapped Saw Blades Deburr Hole," American Machinist, Vol. 99, July 18, 1955, p. 150.

Describes manual deburring tool for holes.

1956

- S14. Chase, Herbert, "Trim Flash Quickly With Press Die Setup," Iron Age, Vol. 178, 1956, N. 14, pp. 96-97.

Gates, sprues and flash are removed from diecastings by power presses.

1957

- S15. "Deburring Titanium" Steel, Vol. 141, Sept. 9, 1957, p. 119.

North American Aviation design of machine to cut burrs from titanium strips and radius the edges.

- S16. Weaver, Dick J., "Two Little Machines Deburr Gears," American Machinist, Vol. 101, March 25, 1957, p. 132.

Grinding wheel chamfers gear edges to remove burrs. Machine automatically rotates gear and raises grinder for next tooth. Grinding burrs are removed in subsequent gear shaving operation.

1959

- S17. "Rid Burrs from Sheet Edges with Rotary-File Machine," Iron Age, Vol. 184, Nov. 26, 1959, p. 96-97.

Flexible rotary files used to deburr undulating sheet and bar copper.

- S18. *"Semi-Automatic Gear Deburring Reduces Operation to Seconds," Grinding and Finishing, Vol. 5, p. 31-32, August, 1959.

Description of redin gear deburring machine. Device uses a 1/8 inch by 4 inch diameter wheel rotating at 11,000 rpm to cut off burr. This semi-automatic equipment takes about 32 seconds per side to remove hobbing burrs from a 10-inch diameter gear of 8620 steel.

1960

- S19. Eshelman, R. H., "New Machine De-Fins Castings to Boost Foundry Output," Iron Age, Vol. 186, July 21, 1960, pp. 131-133.

Mechanical automated unit chips off casting fins with punches and chisels.

- S20. Smith, Robert A., "Combination Deburring Tool," Metalworking Production, Vol. 104, 1960, N. 4, p. 164.

1961

- S21. "Burrs Spur Finishing Progress," Iron Age, Vol. 187, Apr. 13, 1961, p. 77.

Use of bearingizing tools and highspeed steel cutting blades to deburr materials of 300 Bhn. and above.

- S22. "Tap and Deburr in One Operation," Metalworking Production, Vol. 105, May 3, 1961, p. 65.

Removal of burrs from tapped holes in materials such as Al, cast iron, steel, brass, Cu and plastics, as the tap is withdrawn using attachments to the tap shank, including a chamfering bit, bit body, compression spring and collar.

- S23. Eshelman, R. H., "Burrs Spur Finishing Progress," Iron Age, Vol. 187, April 13, 1961, p. 77.

Cogsdill Tool products Inc. removes drill burrs in a single in-and-out operation.

- S24. Waller, John, "Removing Burrs from Splined Holes, Heavy Duty Machine Vice, Internal Stop for Collet," Mechanical World and Engineering Record, Vol. 141, Dec. 1961, p. 418-419.

Deburring of steel gears with splined holes after broaching and chamfering using a rotating cutter.

1962

- S25. "Acme Automatic deburring machine can handle Machined Rolls, Shafts, and Rods," American Machinist, Vol. 106, Dec. 24, 1962, p. 79.

Deburring lathe uses brushes or abrasive wheels to deburr machined bars.

- S26. "Automatic Deburring and Chamfering Machine," Machinery, Feb. 1962, pp. 164-165.

Description of a brushing machine built by Michigan Tool Co.
Total cycle time is 15 seconds.

- S27. "Burflex Deburring Tool," Machinery, Vol. 100, May 23, 1962, p. 1182.

Three conical cutters are mounted on a shaft and used to deburr tube and bar ends.

- S28. Construction and Use of Automatic Screw Machines, Brown & Sharpe, Co., 1962.

Burring attachment for B & S automatic screw machine.

- S29. "Improved Burraway De-Burring Tool," Machinery, Vol. 100, April 18, 1962, p. 876; SEE ALSO Machinery, Vol. 108, June 22, 1966, p. 1389.

Describes Cogsdill Tool Products, Inc. tool for deburring both sides of through holes.

- S30. "Self Contained Broaching Fixture for Deburring Metal Parts," Machinery, Vol. 68, August, 1962, p. 178.

- S31. Pickrell, A. L., "Forming, Trimming, and Edge Finishing of Molybdenum - 0.5 Percent Ti Sheet Material," Transactions of the ASME - Journal of Engineering for Industry, May, 1962, pp. 289-300.

Abrasive sawing molybdenum - 0.5 Ti produces little burr when silicon carbide wheels are used. Wheel speed, traverse rate and recommended coolants are given. Under proper conditions band sawing produces little burr. In edge finishing tests, six approaches were studied. These include hand polishing with sandpaper, barrel tumbling, vibratory finishing, and three grinding techniques. A .004 minimum radius was the desired edge condition. Vibratory finishing produced a 0.005 inch radius after two hours. Barrel finishing required $3\frac{1}{2}$ - $4\frac{1}{2}$ hours. Off hand grinding using a cloth buffing wheel and a buffing compound produced the best edge radiusing.

- S32. Sukegawa, Masayuki, "Shearing Process That Cuts the Costs of Castings," Metals, Vol. 32, No. 11, June 1, 1962, p. 34-36 (in Japanese).

Removal of gates and burrs from castings using a one-stroke shearing process; study of distribution of stress caused by shearing and of energy requirements.

- S33. "Vorrichtung Zum Entgraten Scharfgelaufener Spurkranze," Werkstatt, Vol. 6, 1962, pp. 335-336 (in German).

1963

- S34. Darch, A. E., "Deburring Can Be Automated," Western Machinery and Steel World, February, 1963, pp. 40-42.

- S35. Matarese, Frank R., "Out Go Burrs and Bevels..." Machinery, Vol. 69, May, 1963, pp. 114-116.

1964

- S36. "Chamfering and Deburring Machine," The Engineer, Vol. 217, March 27, 1964, p. 590.

Automatic ten spindle machine cuts burrs off then brushes edges.

1965

- S37. "Westwind Air Bearings," Engineering, (London), Vol. 203, No. 5184, Aug. 27, 1965, pp. 265-267.

Describes construction and characteristics of airbearing spindle for use in gear deburring and drilling.

- S38. Barker, A. A., and H. A. Mead, "The Removal of Burrs from Pressure Tappings," Journal of Scientific Instruments, Vol. 42, 1965, p. 503.

Magnet moves cutter along inside of 3 inch diameter pipe. Special cutter stem is then drawn through hole and powered from outside of pipe.

- S39. Young, A. W., "Rollers Deburr Strip on the Fly," Iron Age, Vol. 195, Feb. 4, 1965, pp. 62-63.

Sheet metal edges are rolled to cold form burr to sheet. Sufficient pressure is used that burr as such disappears.

1966

- S40. "Portable Tool Removes Burrs from Pipe and Tubing, Restores Original Shape," Welding Engineer, Vol. 51, April 1966, pp. 109-110.

Tube deburring and end sizing tool is designed by McDonnell Aircraft.

- S41. Gazan, George, "Better Holes by Ballizing," Tool and Manufacturing Engineer, Sept. 1966, pp. 54-56.

- S42. Gettelman, K. M., "Spring Loaded Holder Increases Deburring Tool Versatility," Modern Machine Shop, Vol. 38, Feb. 1966, pp. 110-115.

Buick transmission and axle housings use automated line and tool which goes through holes to chamfer and deburr backside of holes.

- S43. Savishchenko, V. M., and Yu. G. Proskuryakov, "Calculation and Construction of Vibration Devices for Internal Deburring of Welded Tubes," Stal, No. 2, Feb. 1966, pp. 163-167 (ISI Translation, pp. 138-141) (in Russian)

Design and operation of vibration deburring device for removing internal burrs (flash) during welding of carbon steel tubes. An electro-magnetic oscillator drives the tool inside 40 mm i.d. tubes during the welding operation.

1967

- S44. "Tiki Gear Deburring Machine," Machinery (London), Vol. 110, No. 2835, March 15, 1967, pp. 596-598.

Describes gear brushing machine.

1968

- S45. "Automatic Deburring Machine," Mass Production, Vol. 44, Apr. 1968, pp. 64-65.

Carbide cutters chamfer edges on gas turbine compressor blades.

- S46. "Universal Cleaning Machine for Deburring," Ration Alisierungsleit Blatter, 1968, No. 34/35; No. 10, p. 316 (in German)

1970

- S47. Guide to De-Burring of Machined Components, Part IV-Power Tools, Published by PERA, Melton Mowbray, Leicestershire, England, approx. 1970.

- S48. DePauw, Art, "Pneumatic Control Automates Piston Pin Deburring," Hydraulics & Pneumatics, Vol. 23, Sept. 1970, pp. 110-111.

Pneumatic cylinders actuate opposed end chamfering tool.

- S49. Law, Douglas A., "Special Cork Honing Stick Gives Clean Burr-Free Finish to Diesel-Cylinder Bores," SAE J., Vol. 78, No. 4, pp. 46-49, April 1970.

1971

- S50. "News Digest," Production, August, 1971, p. 9.

- S51. "Ultrasonics Gets 3 New Jobs," American Machinist, Feb. 8, 1971, pp. 60-64.

Ultrasonic machining is used to degate and deflash plastic and diecast parts.

1972

- S52. Machining Data Handbook, Metcut Research Associates, Inc., Cincinnati, Ohio, 1972.

This handbook includes information on honing stone grades to use on deburring.

1973

- S53. "Spinning Governor Throttles Speed," Tom Balmer, Design News, Jan. 8, 1973, pp. 28-29.

Describes hand held grinder capable to rotating at 95,000 rpm.
The turbing grinder is used for manual deburring.

BURR FORMATION AND PROPERTIES

1958

- T1. Wukusik, C. S., and R. S. Zeno, "Improving Punchability of Silicon Steel," Tool Engineer, 41(12): 63-70, December, 1958.

Illustrates the Burr Height as a function of grain direction and tool life. Burr Height is measured optically.

1959

- T2. American Society of Tool and Manufacturing Engineers, Tool Wear in the Cutting of Thin-Gauge Steel Sheets; ASTM Research Report No. 22, May 1, 1959. Translation and discussion of article by Otto Kienzle and Werner Kienzle, Stahl Und Eisen, 78(12): 820-828, 1958.

Summary of punching of stainless steel and silicon alloy steels. Includes a summary of Burr Formation and Burr Height.

1960

- T3. *Strasser, Federico, "How Control of Burrs Aids Sheet Metal Stamping," The Iron Age, 185(3): 90-92, January 21, 1960.

Excellent discussion of die design factors which affect Burr size. Data is given on how to specify maximum allowable Burr Height.

1961

- T4. Biegel, John E., and Robert E. Holmes, "Development of a Punchability Rating Method for Electrical Steels," ASTM Research Report No. 30, March 1, 1961.
- T5. Haggerty, W. A., "Effect of Point Geometry and Dimensional Symmetry on Drill Performances," International Journal of Machine Tool Design and Research, 1:41, 1961.

Burrs produced by spiral-point drill produce lower thrust and smaller Burrs. The sheet metal spiral-point drill produces a slug of material at the exit side.

1963

- Bell, Clarence L., and Blaine Kearsley
- T6. The Effects of Drill Point Geometry, Feed and Speed on Cutting Forces and Burrs, , Dept. of Tool and Manufacturing Engineering, Utah State University, Logan, Utah, 1963.

Experimental study of the effects of drill point angle, feed, and speed on hole accuracy, cutting forces and Burr Length.

1965

- T7. Holiga, L. A., Punch-to-Die Clearance - Its Effect on Punched Hole Characteristics in Cold Rolled Steel; ASTME Paper 65-713, 1965.

Burr Height in punching is a minimum at 18% clearance.

.1967

- T8. Seidel, Jurg R., "Machinability Evaluation of Free Cutting Materials with Specific Reference to Copper Alloys," Proceedings of the International Conference on Manufacturing Technology; ASTME Dearborn, Michigan, 1967, pp. 729-746.

Presents criteria for determining when Burrs will form in brass alloys.

- T9. Seidenberg, H., "Schnittgrad Und Messverfahren," Werkstatt Und Betrieb, 100(6): 471-475, Jung, 1967.

The measurement of stamping Burrs was studied for repeatability. Using light shadow techniques the measurement uncertainly was 116 microns on an average Burr Height of 50 microns. Using improved commercial equipment the error was reduced to 18 microns. Additional measurement techniques are described as are their errors.

1968

- T10. Zaima, S., A. Yuici, and S. Kamo, "Drilling of Aluminum Alloy Plates with Special Type Point Drill," Journal of Japan Institute of Light Metals, 18(5): 269-276, May 1968; 18(6): 307-313, June, 1968.

Brief mention of drill point design effects on Burrs in aluminum.

1969

- T11. "Blanking and Piercing of Magnetically Soft Materials," Metals Handbook, Vol. 4, ASM, Metals Park, Ohio, 1969, pp. 60-68.

Provides general information on effects of workpiece hardness on Burr size. Effect of tool wear on Burr size is also shown.

- Tl2. *"Piercing of Low-Carbon Steel," Metals Handbook, Vol. IV, ASM, Metals Park, Ohio, pp. 44-55, 1969.

An excellent summary of burr formation in piercing operations.

- Tl3. "Press Forming of Low-Carbon Steel," in Metals Handbook, Vol. 4, ASM, Metals Park, Ohio, 1969, p. 118.

Illustrates how part origination in forming can eliminate the need for deburring.

- Tl4. "Selection of Material for Blanking and Piercing Dies," in Metals Handbook, Vol. 4, ASM, Metals Park, Ohio, 1969, pp. 69-78.

Describes the effect of die life as measured by burr size.

- Tl5. "Slitting and Shearing of Coiled Sheet and Strip," in Metals Handbook, Vol. 4, ASM, Metals Park, Ohio, 1969, p. 272.

The effect of slitting parameters on burr size is described.

- Tl6. McBride, James Nielsen, The Magnitude of Burrs Caused by Electrical-Discharge Machining, unpublished thesis, Utah State University, Logan, Utah, 1969.

Summary of how EDM variables affect the size of burrs in solid and laminated metals.

- Tl7. *Wang, K. K., Khalil Taraman, and S. M. Wu, "An Analysis of Punching Variables by Two Level Fractional Factorial Design," ASME Paper 69-WA/Prod.-27, 1969.

An analysis of punching variables reveals that only die radius significantly affects Burr height. Average burr height is 50 times more repeatable than maximum height.

1970

- Tl8. Bühler, Hans, Fedor Pollmar, and Adolf Rose, "The Effect of Tool-Steel Material and its Heat Treatment on the Cutting of Sheet Steel," Arch. Eisenhüttenwesen, Oct. 1970, 41, (10), 989-996 (in German).

The wear resistance of seven tool steels was examined by making up to 320,000 cuts on two grades of sheet steel. The amount of wear increased linearly with the number of cuts but the size of the burr depended on the type of wear on the tool cutting edge; the absolute amount of wear was of secondary importance. The 12% Cr steels and the high-speed steels had the lowest wear rate. The major influence was the carbide volume in the cutting edge. 8 ref.-D.W.E.

- T19. *Masuda, Kazuaki, "Some Observations of the Surface Roughness of Mild Steel Finished by Turning," Bulletin of the Japan Society of Mechanical Engineers (in English), Vol. 13 (57), 1970, pp. 462-473.

Provides a general theory accounting for burrs forming by side flow.

- T20. Saito, Yuzo, Kinji Sato, Tsuneo Saga, Makoto Ogawa, and Shozo Mizusawa, "Drilling Machinability of Aluminum Sheet," J. Japan Inst. Light Metals, 20 (2), Feb. 1970, pp. 69-76 (in Japanese).

Torque and burr height increased with feed rate in this study of five drills.

1971

- T21. Bühler, Hans, and Fedor Pollmer, "The Formation of Burrs in the Cutting of Thin Sheet," Bänder-Bleche-Rohre, 12(3): 105-111, March 1971.

- T22. Funke, P., I. Piorko and C. Pavlidis, "The Shear Properties of Silicon Iron Sheet for Electrical Machinery," Mitt. Deut. Forschungsges. Blechverarbeit., 22(10), Oct. 1971, pp. 207-210.

Tool wear and burr height are measured in a study of nibbling with a punch on silicon-iron sheet.

- T23. Hugo, Harding R., "How to Improve Metal-Stamping Die Performance," Sheet Metal Ind., Feb. 1971, 48 (2), 120-126, 131-135 (in English)

The types of imperfect cut edge that can result from punching holes in sheet are considered. Factors influencing the force on the punch and its rate of wear are discussed. Graphs presented to show burr height (on sheet surface) as a function of the number of punch strokes confirm that the amount of burring increases as the punch wears.

1972

- T24. Gillespie, L. K., Drilling Printed Circuits, Bendix Corporation (Kansas City Division), Report No. BDX-613-279, Jan. 1972.

Contains some data on burr sizes produced by drilling of printed circuit boards.

- T25. Kishi, Kozo, and Hiroshi Eda, "Analysis of Transitional Structure of the Machined Surface Layer Due to Built-Up Edge," Journal of The Japan Institute of Metals, 36(1), Jan. 1972, pp. 14-21.

Author describes the roughness of machined surfaces and the effect the three types of burr have on this roughness. Fragments adhering to the surface are called burrs.

- T26. Kishi, Kozo, and Hiroshi Eda, Analysis of Transitional Structure of the Machined Surface Layer Due to Built-Up Edge. J. Japan Inst. Metals, Jan. 1972, 36, (1), 14-21 (in Japanese).

The relation between built-up edge and the burr or rotational slip in the machined surface layer of 0.25 and 0.48 wt.-% C steel was examined. Changes of structural features in different types of built-up edge and in the burr or rotational slip are discussed. The burr and the rotational slip are disintegrated fragments of built-up edge and in the range of cutting speeds 0-20m/min, the nose-type built-up edge seems to become a rotational slip. For cutting speeds of 20-40 m/min, the trapezoid-type built-up edge becomes a burr but above 40 m/min the burr and rotational slip almost disappear.

1973

- T27. "High-Speed Cutoff-No Burrs, No Deformation," Manufacturing Engineering and Management, Dec. 1973, p. 21.

Burrs are prevented from forming on a tube cutoff operation by using abrasive cutoff wheels. Wheels 0.015-0.050 inch wide are used to slice 302, 303, 304, and 316 stainless steel tubing with wall thicknesses of 0.015-0.025 inch. Spindle speeds are 22,500-35,000 rpm with 4-inch diameter 80 grit wheels. Three seconds are required to cutoff a 3/4 inch diameter tube.

- T28. *The Birth of a Hole, brochure published by Dayton Progress Corporation, Dayton, Ohio, 1973.

This brochure illustrates the material flow occurring in piercing operations and the resulting effects on burr length. The use of 10% clearance per side produces shorter burrs than conventional clearances and greatly increases the number of parts which can be produced for any given burr height.

- T29. Fleming, C. M., Precision Hole Generation Methods, McDonnell Aircraft Co., Technical Report AFML-TR-73-135, Volumes I and II, March, 1973.

An evaluation of drill and reamer geometry on hole quality. Burr height could not be corrected to hole quality or wearland at the drill or reamer corners. A drill with dubbed corners performed better than other drills.

- T30. *Gillespie, L. K., The Formation and Properties of Machining Burrs, M. S. Thesis, Utah State University, Logan, Utah, 1973, 151 pp.

This thesis presents the three basic mechanisms of burr formation in machining operations. In addition to deriving the theory involved, empirical results are given for drilling, milling, turning and grinding of 303 Sc stainless steel.

1974

- T31. *Gillespie, L. K. "The Effect of Cutting Edge Radius on Poisson Burr Properties," SME Paper 74-990, 1974.

Cutting tool sharpness affects the properties of burrs produced in cutting. This paper compares some empirical data with previously derived theory. Although an exact correlation is not obtained, predicting correct order of burr size magnitudes is possible with the concept presented.

- T32. Gillespie, L. K. The Effects of Reaming Variables on Burr Properties, Bendix Corp. (Kansas City Division) report No. BDX-613-1083, March, 1974.

The amount of stock removed is found to be the most significant factor on burr sizes. Burr thickness is influenced by feedrads but the actual effect is small. A discussion on best reamer geometry is also given.

- T33. Gillespie, L. K., Properties of Burrs Produced by Ball Broaching, Bendix Corp. (Kansas City Division) Report No. BDX-613-1084, March, 1974.

Presents empirical and analytical data on burrs produced by ball broaching (ballizing). Materials tested were hiperco 50 (a magnetic alloy) and 304L stainless steel.

- T34 *Gillespie, L. K., and P. T. Blotter, "The Formation and Properties of Machining Burrs," Paper pending publication by ASME, Feb., 1974.

The three basic mechanisms of burr formation in machining operations are described. Equations predicting burr properties are derived.

BURR PREVENTION

1945

- U1. "Elimination of Burr Caused by Drill Break Through," American Machinist, VOL 89, November 22, 1945, p. 143.

Artillery cartridge case is indented with ball on back side prior to drilling. When drill breaks through it is almost tangent to indentation thus minimizing burr size.

- U2. Crane, E. V., Plastic Working of Metals and Non-Metallic Materials in Presses, John Wiley & Sons, Inc., New York, 1945.

Describes the effects of punching variables on burr size and hole flanging.

1950

- U3. "Pin-Cutoff Tooling Chamfers and Cigars Burrs," American Machinist, VOL 94, July 10, 1950, p. 118.

Automatic screw machine stop holds part and provides backup during cutoff operation.

1954

- U4. "'Plaster Cast' Solves Tough Deburring Problem," American Machinist, VOL 98, May 24, 1954, p. 142.

Plaster of Paris is poured around the part prior to machining in order to prevent burr formation. Plaster is removed from part by soaking in water.

- U5. Cope, Stanley R., "Choice of Die Type Depends on the Burr," American Machinist, VOL 98, Sept. 27, 1954, pp. 120-123.

This article describes the tooling required to produce an intentional burr (lip of material) around sheet metal holes.

- U6. *Cope, Stanley R., "Stampings Often Require Burred or Flanged Holes," American Machinist, VOL 98, Sept. 13, 1954, pp. 140-143.

Sheet metal parts often require a lip of material around holes. To produce this an intentional 'burr' of solid metal is formed. This article describes and illustrates the types of 'burrs' which can be produced.

- U7. Cope, Stanley, R., "Three Kinds of Burrs Require Different Dies," American Machinist, Vol. 98, Dec. 6, 1954, pp. 166-169.

Article describes the dies required to produce an intentional burr around sheet metal holes.

1955

- U8. Wilson, Frank W. (ed.), Die Design Handbook, ASTE, Dearborn, Michigan, 1955.

Illustrates how to roll edges to eliminate deburring.

- U9. Barton, H. K., and L. C. Barton, "The Relation of Runner Layout to Ease of Trimming," Machinery (London), Vol. 90, 1957, N. 2319, pp. 945-955.

Illustrates how to design casting runners for easiest removal.

- U9a. Zierk, Donald E., "Tool Engineering for Production of Miniature Parts," The Tool Engineer, Oct. 1957, pp. 86-93.

Elgin Watch capitalizes on burr presence by using burr to help hold screws in place.

1958

- U10. "Simple Devices for Removing Burrs," Machinery, Vol. 64, March, 1958, p. 154.

Author claims that by backing up milling cuts with a plate having 0.010 clearance per side will minimize burr size. For drilling a backup plate should have a hole 1/64 inch larger than the drill size.

1959

- U11. Andrews, C., "Drill Jigs Designed for Minimum Deburring," Machinery, March, 1959, p. 143.

Author suggests designing drill jigs such that exit burr is on side which will later be counterbored or countersunk. These operations will eliminate the need for removing drilling burrs.

1962

- U12. "Screw Machine Parts," Machine Design, Sept. 27, 1962, Vol. 34, p. 176.

Brief discussion of burrs formed on screw machine parts.

- U13. Jessen, J., "Turnable Automatics as Universal Machinery", Galvanotechnik, 1962, 53, No. 100, 511-3.

Describes possibilities and devices to increase the number of polishing positions. The components are mounted in such a way that two polishing or buffing heads can be employed at the same time on the pedestal..

1963

- U14. *Lord, G. W., "Slitting Very-Thin Cold-Rolled Metal Tapes Without Edge-Burr," Sheet Metal Industries, February, 1963, pp. 111-116.

Equipment design for slitting thin sheet metal.

- U15. Wightman, J. C., "Jig for Burrless Drilling of Threaded Studs," Machinery, Vol. 69, May, 1963, p. 119.

Threaded stud is drilled using two close fitting half-nuts as drill bushings. The half-nuts prevent burr from forming since they fill all available voids in the threads.

1964

- U16. *"Design of Screw Machine Products, 4," American Machinist, December 7, 1964, p. 127.

Fine summary of processing considerations for minimizing deburring operations on screw machine parts.

- U17. Foertmeyer, E. Evans, "The Versatile Metal Removal Process," ASTME Paper 64-643, 1964.

Author shows a stainless steel metering component in which total costs were lowered by slowing the metal removal rate and using ECM to eliminate deburring. In addition, the edges produced by EDM, ECM and conventional drilling are shown for Haynes Satellite Alloy 25. A 0.010 thick burr is produced by conventional drilling in this material at 0.040 l p.m.

- U18. K'o'wu, Yeh, and Li Chin Chih, "Vibration Finishing of Edges of Punched Parts," (English translation dated May 5, 1964, of Shang-hair Chi-hseh (shanghai), No. 4, April 25, 1963, p. 4-9) available from NTIS under Accession Number N64-21693.

- U18a. Trott, L. L., "Electrolytic Grinding Finishes Microminiature Parts," Tool and Manufacturing Engineer, Jan. 1964, pp. 81-82.

Electronic components are EC ground to prevent burrs.

1965

- U19. "Stress-Free, Burr-Free Production Grinding Tooling and Production, May, 1965.

Electrical relay parts are EC ground to prevent burrs.

- U20. "Tool Cost Down, Burr Problems Out as Form Grinding Replaces Tracer Turning," Metalworking, May, 1965, pp. 22-24.

Form grinding replaces tracer turning. Burr removal time is reduced from 45 to 5 minutes and machining costs were greatly reduced. Parts are Inco 713 or Hs-21 super alloy turbine nozzles.

- U21. Gurklis, John A., Metal Removal by Electrochemical Methods and Its Effects on Mechanical Properties of Metals, Defense Metals Information Center Report 213, Jan. 7, 1965.

This report describes the impact of most EC machining techniques on surface integrity (and burrs). Photos are shown of drilled and ECM'd holes in Haynes Alloy No. 25. A 0.010 inch radius is produced by ECM'ing, while mechanical drilling produces large rough burrs, and work hardens the hold surface.

- U22. Wilson, John C., Electrolytic Surface Grinding, Thompson Grinder Co., Springfield, Ohio, 1965.

Examples of burr free conditions produced by ECG are given. Parts illustrated include electronic components, stainless steel honeycomb and hypodermic needles.

1966

- U23. Massad, Robert B., "Electro-Abrasive Machining," American Society for Abrasive Methods Technical Paper, March 7, 1966.

ECG makes burr free cuts in hypodermic needles and piston rings. In addition to being burr free, there is no impregnation from abrasives in a normal grinding wheel.

1967

- U24. "New Shearing Process Makes Accurate, Burr-Free Blanks," Machinery, Vol. 74, No. 4, December, 1967, pp. 100-101.

Shear blade is guided to prevent lateral motion which is responsible for burrs and workpiece distortion.

- U25. *Arzt, Peter, "Why Burrs Form - and How to Avoid Them," Metalworking, Vol. 23, No. 6, June, 1967, pp. 44-45.

An excellent summary of how burrs form. Includes a list of materials and a ranking of their tendencies to form burrs.

1968

- U26. Howe, Raymond E. (Ed.), Producibility/Machinability of Space-Age and Conventional Materials, Society of Manufacturing Engineers, Dearborn, Michigan, 1968, p. 9.

Indicates that 135° point drills produce less burr than 118° point drills.

1969

- U27. Machining of High Strength Steels with Emphasis on Surface Integrity, Air Force Machinability Data Center Report AFMDC 69-7, Cincinnati, Ohio, August, 1969.

This surface integrity study includes two photo sets of burrs produced in 4340 quenched and tempered to 48 Rc. Using a 0.250 inch diameter standard point drill at 600 rpm and 0.001 lpr a sharp drill produced a 0.0015 inch thick x 0.0005 inch long triangular burr. A dull drill produced a 0.020 inch thick by 0.090 inch long burr with a triangular base. A 15/64 inch diameter reamer removing 0.015 inch per side at 350 rpm with hand feed produced no measurable burr. A dull reamer produced a 0.0005 inch thick by 0.0026 inch long burr.

- U28. Francis, Howard T., "Burr Free Machining," Proposal No. 69-412B, Illinois Institute of Technology Report and Proposal, February 15, 1969.

- U29. Massad, Robert B., "The Electrochemical Grinding System for Tool Steels, Stainless Steels, Super Alloys and Others," ASTM Paper MR 69-564.

This paper on ECG illustrates the burr free conditions produced in tube slotting and tube cutoff. Tool designs and operation are described.

1970

- U30. "Machine, Deburr, Machine," Products Finishing, Vol. 35, No. 3, Dec. 1970, p. 96.

Allison Division of General Motors revises machining sequence to save deburring costs.

- U31. Allison, Charles R., "Economic Justification of ECM," SME Paper MR 70-554, 1970.

Points out that ECM can eliminate the need for deburring and polishing.

- U32. Brockhaus, J., and H. Goldschmidt, "New Cut-Off Process for Obtaining Smooth Cutting Surfaces and Burr-Free Edges," (Neues Schneidverfahren zum Erzielen glatter Schnittflaechen und gratfreier Kanten), Blech, Vol. 17, N. 8, Aug. 1970, p. 16-20.

A new process is described in which the cutting is divided in two separate sequences. Besides other advantages the process offers completely new solutions for especially difficult cutting-off problems. (in German).

- U33. Clark, Tom, "EDM Makes Better Dies," American Machinist, 114(11), June, 1970, pp. 92-96.

Author claims 'smooth-edge blanking' makes burr-free parts.

- U34. Law, Douglas A., "Special Cork Honing Stick Gives Clean Burr-Free Finish to Diesel-Cylinder Bores," SAE Journal, 78(4), April 1970, pp. 46-49.

Honing with a cork honing stick removes all and provides a clean surface. Photos taken at 700 x typically show smeared metal on parts finished by other processes. Some of this smeared metal is considered to be a burr.

1971

- U35. "Assembly and Finishing," American Machinist, July 26, 1971, p. 41.

- U35a. "Burrless Slots," Tooling & Production, Nov. 1971, p. 68.

Special screw slotting machine eliminates the traditional slotting burr and produces 600 parts per minute.

- U35b. Kramer, Robert, "Simple Change for Better Deburring," Precision Metal, Dec. 1971, p. 11.

Forged steel fitting was deburred after tapping to reduce deburring. Previously hole was drilled, deburred, then tapped. Deburring after tapping weakens the root of the burr enough that vibratory finishing removes the burr.

1972

- U36. "AM Practical Ideas," American Machinist, Vol ():78, Nov. 13, 1972.

Electrochemical Vibratory

M 1-6

Water Jet Deburring

N 1-4

Chemical Deburring

O 1-10; R 5, 12, 16, 17, 19, 21, 35

Liquid Hone Deburring

P 1-2

Flame Deburring

Q 1

Articles Describing More Than One Process

A 1, 2; R 1-37

Mechanical Deburring Processes

D 313; R 5, 12, 20; S 1-53

Burr Formation and Properties

T 1-34

Burr Prevention

U 1-40

Unclassified

V 1-35

FOREIGN LANGUAGE ARTICLES

French

D 80, 190, 220, 228, 329, 379, 399, 532, 541; I 27; O 7; V 6, 7, 9

German

C 17, 23, 29; D 145, 150, 161, 183, 201, 261, 264, 265, 268, 271, 272, 280, 284, 285, 289, 300, 315, 316, 322, 323, 336-338, 349, 417, 435, 442, 471, 477, 479, 533, 534, 544, 558, 562, 573, 574, 588, 590, 591, 602; F 6; G 43; I 1, 4, 7, 11, 14, 17, 19, 22, 28, 29, 42, 48, 54-56, 59, 60, 63, 68; J 3, 6, 9, 14, 15, 17, 20-22, 25, 31, 36, 37, 39-43, 45-49, 51-53, 55-57, 63-65, 71-73; K 16; L 3; R 15, 16, 18, 30, 33, 36; T 2, 9, 18, 21, 22; U 38; V 1-5, 10-18, 20-26, 28, 30-34

Russian

D 269, 309, 334, 345, 369, 372, 432, 482, 524, 529, 531, 548, 549, 552, 578, 605; I 3, 37, 53, 61; J 16; L 2; Q 1; S 43, 46

Japanese

D 96, 262, 307, 342, 446; J 8; S 32; T 10, 20, 26

Others

D 246, 255, 278, 311, 321, 359, 393, 405, 447, 556; I 13; V 8

AUTHOR INDEX

Abrams, H.	J38	Balcar, G.	C45
Ackley, W. A.	D545	Barbican, T. P.	D65
Adams, J. B.	C2	Barker, A. A.	S38
Agler, W. B.	G35	Barker, A. M.	D503
Allen, A. H.	D12	Barbkiewicz, B.	I7,28;J45;V28
Allen, R.	D584	Barton, H. K.	U9
Allison, C. R.	U31	Barton, L. C.	D156;U9
Ambos, E.	V31	Baumgarten, R.	U39
Anders, H.	I17;J39	Beaudet, E. C.	D66
Anderson, E. F.	C9, 10	Beaver, H. L.	D13,17,24,32,67, 81,106
Anderson, R. D.	D297	Beisel, W.	V33
Anderson, R. H.	D39	Beletskii, D. G.	C31
Andrews, C.	U11	Bell, C. L.	T6
Arensten, S.	D80, 89	Bennie, A. J. O.	H6
Arnold, O. M.	C29;V12	Benninghoff, H.	R30
Arzt, P.	U25	Bernards, A.	C17
Ashmead, G. B.	D64	Bertorelle, E.	D220
Ashmore, J.	D188	Bessagnet, M.	D329,399
Astrop, A. W.	D298	Biebel, W. A.	D97-100,144
Aufuldish, W.	D252, 253	Biegel, J. G.	T4
Babichev, A. P.	D299,367-369, 398, 432	Bigony, F.	I40
Bacquias, G.	D300,541;I27	Birney, C. G.	D433
Bahgn, W. R.	C13	Black, T. W.	D128,221,254,330

Blagodeteleva, E. S.	L2	Burr, J.	D227
Blake, H. F.	D331	Burris, F.	D542
Blount, E. A.	D46,157	Bussack, V.	I29;J46
Blundell, B. F.	D370,434;J33;K10	Byrov, A. M.	D334,372
Bogue, D.	I51	Castle, C.H.	D18,25,160,259,373, 457,564
Bonn, C. A.	D400	Chadwick, R. F.	N2
Bonnemaier, E.	D255	Charleson, J. F.	D33
Borch, E. A.	D301;C40	Charvat, V. K.	G10,22
Botsford, R. L.	E12	Chase, H.	D19,20,26,34,41, 47-49,82,90;S14
Boyle, S. C.	I8;J18,23,27	Chih, L. C.	U18
Brandt, J. N.	D597,600	Christenson, J. D.	I2
Brandt, W. E.	D56,107,108,129,130, 158,159,222-225,256- 258,302-304,332,333, 371,401-403,435-438, 457,473-476,504-512, 560,561	Clark, T.	U33
		Clarke, P. K.	D514
		Colegate, G. T.	D57
Braski, D. N.	D439	Collens, J. L.	S8
Bredin, H. W.	J12	Coller, M.	D404
Bregman, A.	D40	Collins, C. C.	D440,441
Brody, J.	D513	Compton, W. A.	C44
Brookes, K. J. A.	R35	Cope, S. R.	U5-7
Brosheer, B. C.	C13	Crane, E. V.	U2
Brown, M. E.	D226	Cross, J.	I18
Bryan, J. H.	R4	Curti, T. H.	J40
Buhler, H.	T18,21	Darch, A. E.	S34
Burkart, W.	D189,477	Davenport, W. H.	D543

Davidson, L. R.	D305	Enyedy, R.	D91,131,162,192-194,337,338
Debarr, A. E.	I30	Erofeev, N. A.	D524,549
Degroat, G.	D374,478;M4	Eshelman, R. H.	D339;S19,23
Denny, C.	D260,335	Evans, D. M.	C29;V12
Depastina, R.	D68,69;G13	Eyre, R. E.	G13
Depauw, A.	S48	Farrell, J. F.	C4
Derigs, H.	D145	Faust, C. L.	J19,29,70
Desemery, P. P.	D228,405;V7	Feinberg, D.	D481,515
deVere, W. G. D.	D229	Fernley, R. C.	G56
Dexter, H. B.	D489	Field, M.	D516
Dietiker, A.	D479	Finkelburg, H. H.	D442,517
Diez, H.	D480	Fisher, E. H.	V32
Draper, C. R.	D189	Fisher, E. P.	G29
Dreher, M.	D161,261,336,544,562, V13	Fisher, T. A.	D375
Dulaney, F.	D449,457	Fishlock, D. J.	D163,231;J13
Dusek, J.	I59	Fitch, R. W.	D132
D'yachenko, V. I.	D299,367-369,432	Fleming, C. M.	T29
Earl, R. E.	D190,191	Foertmeyer, E. E.	U17
Eda, H.	T25	Ford, G.	D584
Eggum, J. R.	C14	Forrester, J. J.	D195
Elliott, B. W.	D230	Fortune, L. L.	D545
Engel, E.	D42	Francis, H. T.	U38
Engel, W.	V16	Frey	V5
Enke, C. G.	V34	Funabashii, W.	D262,306,307

Funke, P.	T22	Gurnham, C. F.	D133
Furbish, C. O.	D58	Gustafson, E. L.	D340,341,483,567
Furgeson, R.	C14	Gutsche, D.	V17
Gardos, M. N.	C46	Habel, A.	E10
Garner, J. G.	V20	Hach, R.	I51
Gazan, G.	S41	Hagelucken, B.	D264
Gent, W. E.	165	Haggerty, W. A.	T5
Gettelman, K. M.	I41;S42	Hagiuda, Y.	D342,381,445,447
Gill, W.	D440,441	Hahmann, G.	I28;J45
Gillespie, L. K.	T24,30-34;D563,6C1; F10;G59;R32	Hall, F. T.	D120,146
Ginnever, B. J.	K14	Hamm, J.	D519
Glasrud, C. J.	D109	Hanley, E.	C45
Glemming, F.	V17	Harlamov, I. P.	J20
Goldman, H. M.	D263,564	Harper, J. F.	D164
Gollnick, H.	V4	Hauri, H.	F6;R33
Goodman, H. A.	D376	Hauschild, E. R.	I19
Gormly, M. W.	D377	Hawkins, W. A.	I31,43
Gosger, P.	I42,60	Hazlet, R. N.	D484
Gould, E. N.	D196	Heger, G.	D92,265
Grant, D. M.	P2	Herb, C. O.	D546
Gray, A. G.	D50,59	Hendey, J. C.	D266
Green, R. E.	R13	Heyer, G.	D271,272,315
Gubin, V. I.	D482	Heyes, J.	J47
Gulden, M. E.	C44	Higgins, K. D.	D110
Gurklis, J. A.	U21	Hignett, J. B.	D308,343,344

Hikl, O.	V21,22	Jacques, M. E.	N1
Hinz, H. E.	D602;L3;R36	Johnson, K.	D520
Hiroshi, A.	D518	Johnson, W. L.	C29;V12
Hishaw, R. J.	R37	Jones, J. R.	C46
Hobday	D70	Jumer, J. F.	J7
Hodges, F. D.	D232	Kaftol, P.	D134
Holiga, L. A.	T7	Kaharl, D. J.	D61,62
Holmes, R. E.	T4	Kamo, S.	T10
Holsinger, E.	D443	Kartyshev, B. N.	D309
Hopewell, L. H.	D83	Kearsley, B.	T6
Horn, H.	J55	Keck, B. T. K.	I66
Horton, K. W.	D196	Keener, D. E.	R8
Hovis, H. L.	D93	Kellard, C. J. A.	D94,165
Howe, R. E.	U26	Keller, H. L.	D268;G36
Hubbard, F.	D60	Kellner, H. L.	G53
Hugo, H. R.	T23	Kenney, V. W.	D352-356
Hurst, T.	D547	Keogh, C. J.	D444
Hylar, J. E.	D7,84;R3	Kern, J. E.	04,5,10
Ingulli, C. N.	C32	Kharlamov, I. P.	I3
Inove, K.	M5	Khodosh, B. B.	D369,605
Inukai, T.	D518	Khol, R.	D234,310
Iredale, R.	D267	Kincaid, C. E.	D111,112
Irving, R. R.	D233	Kinoshita, N.	D96
Ivanov, B. G.	Q1	Kirilin, E. N.	D578

Kishi, K.	T25	Kurafuii, H.	D96
Kittreoge, J. B.	D521,522	Kurko, M. C.	N1,2
Klein, J.	I44	Kurz, W. W.	C33
Kobayash, H.	D406	Lane, R. O.	D380
Kohler, A. S.	D51,135,197	Lapshina, S. K.	D372
Kohlhase, H.	J9	Larson, H. C.	D71
Kohls, J.	D516	Larson, J.	D587
Kolesnik, N. V.	D269,345	Laughner, V. H.	D21
Kollner, S. V.	I3	Laurenzen, A.	U38
Kollosch, A. W.	D95	Laux, L. E.	D113
Kolner, S. V.	J20	Lavalley, D. R.	D579
Kolpakova, L. D.	D334	Law, D. A.	U34;S49
Korshunov, B. S.	K15	LeClair, M.	D198
Koster, W. P.	D516,603	Lederhausen, J.	V14
Kowu, Y.	U18	Letner, H. R.	D167
Kramer, C.	D147,166	Liebman, R. C.	D168
Kramer, R. M.	D378,568-572,585,586, 598,604;U35b	Linsley, H. E.	G8;S9
Krickau, O.	J48	Loeschbart, H.	D573
Krupp, R.	D587	Loll, T.	D170
Krydsby, P.	D311	Lord, G. W.	U14
Kudryautseva, A. V.	D432	Lord, R. M.	D14,15,22,23,35
Kulakov, Y. M.	D548	Loschy, B.	D599
Kulikov, V. M.	I61	Luebbert, L. H.	F10
Kulikovskikh, V.A.	G41	Lucius, F.	V23
Kulischenko, W.	C38	Lutes, F.	D523
Kunz, P.	D379	Lyalikov, N. T.	D524,549

Lydick, C.	06	Meisel, R. C.	D450;R24
Mable, L.	D43,85	Melamed, Z. O.	I53
MacNair, R.	D8	Melnik, V. A.	D529
Magnusson, F.	D198	Merwin, M.	D235
Manning, E. J.	I47	Meslink, M. C.	I45
Maranchik, J.	D516	Messenger, R. G.	D136
Marciniak, M.	D588	Michaels, G. J.	I20
Marhan, H.	D525,574	Michaels, G. T.	I32,46
Massad, R. B.	M1;U23,29	Michaelson, G.	D348
Masuda, K.	T19	Michalek, J.	D485
Matarese, F. R.	D312,314,346;S35	Mickelson, H.	D114
Mathewson, C.	D148	Millan, W. H.	U40
Matsunaga, M.	D270,342,347,381,406, 445-448,575	Miller, B. S.	A1;R23;D382
Maund, W. J.	G11	Miller, H. R.	D554;L4-6
Mauz,	I52,62,63	Miller, J. F.	I67
Maynes, M. M.	D35,86,169	Millhiser, R. G.	C29
McAleer, H. J.	G1	Mitchell, R. W.	D3,4
McBride, J. N.	T16	Mizusawa, S.	T20
McCandless, W. E.	D449,457	Molinelli, J.	I20
McCormick, W. A.	D407	Mondon, R.	J5, 24
McKee, R. L.	D313,408;C27;G48;R20	Moroz, I. I.	I3
McMullen, H. L.	C22	Moroz, I. J.	J20
Mead, H. A.	S38	Mosher, D.	D170,171,409,410,526
Meier, G.	D451	Moushey, D. C.	D236

Movich, R. C.	I33	Pavlidis, C.	T22
Mowry, T.	D452	Pedroj, A. F.	D116
Mueller, H. W.	R5	Pedrosa, F.	C12
Murphy, J. A.	D576;G54	Pettigrew, D. W.	D317
Naito, T.	D342	Peter, H.	J25
Nann, H.	D265,271,272,315,349	Peterson, R. O.	G3,12
Narnichi, A.	J8	Petrich, G.	V15
Narins, R.	A2	Phillips, J. L.	D453
Naruse, M.	J8	Pickrell, A. L.	G37;S31
Nicholson, J. E.	J34	Pikovskii, S. A.	D482
Nunn, W. P.	D115,237,273,350-356	Pimishofer, H.	D201
Odgers, M.	L1	Pinke, K. G. O.	D72
Ogawa, M.	T20	Piorko, I.	T22
Oliver, D. A.	I30	Plaster, H. J.	C49
Olson, G. E.	D114,238	Pohlman, R.	J41
Orlando, J.	D550	Poll, G. H.	01; D318
Owens, G.	I20	Pollmer, F.	T18,21
Parlapanski, M.	J61	Polucha, A.	D117,239,240,383 411,412,454,527,551
Parry, W. P.	D274	Pontzer, J.	D413
Parthey, W.	D316	Porter, C.	D528
Passmore, L. W.	G45	Post, B. F.	D486
Passow, L. J.	V29	Povidailo, V. A.	D552
Patterson, M. M.	D172,199;R14	Powers, R. W.	J30
Patterson, W. C.	D577	Prince, C. A.	P1
Patton, W. G.	C8	Proskuryakov, Y. G.	G41;S43

Purdon, W.	09	Royster, R. M.	D489
Pushkarev, V. F.	D529	Rub, F.	I54,55
Radtke, S. F.	D530	Rundfeldt, H.	V1
Rakestraw, A.	D275,319	Ryan, R. R.	D415
Rampe, J. F.	D455	Sachs, K.	Li;L4-6
Rano, H. B.	D565,567	Safranek, W. H.	D554
Ranschoff, N.	D9	Saga, T.	T20
Ratmansky, S. C.	I21	Saito, Y.	T20
Reed, J. G.	D73	Sandford, J. E.	D357,384,457
Reinhold, R.	I22,23	Sasena, R. E.	G10
Reynolds, W.	R25	Sato, K.	T20
Rhoades, C. R.	F4	Saver, E.	V15
Rhoades, L.	F9	Savishchenko, V. M.	S43
Roadarmer, K. W.	D487,553,589	Saxby, G.	R16,17,21
Robbins, G. V.	D414	Schaaf, H. A.	I69
Rogers, J. W.	U40	Schaefer, F.	D590
Rohre, T.	D456,457	Schaft, E.	D488
Roll, F.	R15	Schekulin, K.	I14
Rolstein, R. F.	I47	Schilling	V10
Romais, J. E.	D118,119	Schmidt, J.	I48
Rose, A.	T18	Schmolz, K.	D591
Rowland, G. O.	G2	Schnell, G.	V30
Royster, D. M.	D439	Schoffler, I. G.	I4

Schreur, N.	D358	Smeltzer, C. E.	C44
Schroeder, E. G.	C41	Smith, F. E.	D109
Schubert, M.	V17	Smith, R. A.	S20
Schulze, A. P.	D27	Snider, R.	D516
Schulze-Berge, K.	J49	Soper, F.	D170
Schwenz, C. W.	D416	Spears, V. C.	R8
Scotten, F. M.	D16	Spencer, L. F.	D555;C34,47;R9
Seabright, L. H.	J35	Springborn, R. K.	R26
Seidel, J. R.	T8	Springford, J. L. H.	D200
Seidenberg, H.	T9	Squibb, G. R.	D120
Setzler, P. H.	D320	Stampeli, W. D.	C13
Shaefer, C. B.	D136	Stauch, K.	D349,417
Shainskii, M. E.	D385,458	Stedman, G. E.	D10
Shchigolev, P. V.	J62	Stein, B. A.	D489
Shipley, M. S.	D97-100	Stevens, L. D.	D173
Shneider, Y. G.	D359	Stevens, L. O.	R6
Shoemaker, W. G.	D459	Stockl, E.	J6
Shriver, G. L.	J2	Stone, W.	D74
Sidorov, A. I.	D578	Strasser, F.	T3
Siegel, B.	I11,56,68;J42,43,50-52,56,57,63-65,71-73;R31	Striegler, C.	J15
Silin, R. I.	D552	Strom, J. R.	D579
Silman, H.	D189	Sukegawa, M.	S32
Simmons, A. L.	D28	Swain, J. D.	J66,67
Sivak, J. C.	D276,277	Szyrle, W.	D490,556
Sizelove, R.	D5	Taraman, K.	T17
		Tarasov, L. D.	D174,491;R27

Tarpy, J.	D360	Weaver, D. J.	S16
Thomsch, W.	V24	Weihrich, O.	D280
Tiranskaya, S. M.	J16	Weiner, R.	J22;R18
Tomas, E.	D278,321	Weiss, H.	D35,37,38
Totskly, A. N.	D334,372	Welborn, W. W.	D545
Trott, L. L.	U18a	Whited, H.	D494
Tschrittor, R.	I64	Wick, C. H.	E8;I10;N3
Tucker, R. J.	D279	Wightman, J. C.	U15
Tuvek, C. G.	D175,176,418,419,452	Williams, K. J.	D122
Uhlig, W.	D532,533	Williams, L. A.	I12,15
Ulrich, W.	D201	Wilson, F. W.	U8
Van Horn, K. R.	J44	Wilson, J. C.	U22
Veit, P. L.	D52	Wingate, J.	D29
Vernon, I. R.	D493	Winship, J. T.	D592
Von der Linden, A.	D121	Winter, E.	V25
Wagner, H.	V18	Wise, R. L.	D421
Wakefield, B. D.	G55	Wolfhart, D.	D590
Walker, W. F.	D420	Wood, N.	D281
Waller, J.	S24	Wright, F.	D523
Walmsley, A.	D202	Wright, J. P.	K1
Wang, K. K.	T17	Wright, S.	G23
Waschull, H.	D534	Wrigley, A.	C50;N4
Watkins, N. L.	D177	Wu, S. M.	T17
Watson, F. D.	C28	Wukusik, C. S.	T1
Way, K.	D557	Wulhorst	J14