

CONTENTS

	PAGE
PREFACE TO THE SECOND EDITION	v
PREFACE TO THE FIRST EDITION	vii

THE DRILLING MACHINE

CHAPTER I

DRILL-PRESS CONSTRUCTION

1. Introduction	1
2. The Drilling Machine	2
3. The Standard Drill Press.	4
4. The Sensitive Drill Press.	5
5. The Radial Drill.	6
6. The Gang Drill	6
7. The Multiple Spindle Drill	8
8. Parts of the Drill Press.	9
9. The Drill-press Drive	9
10. The Feeding Mechanism	11
11. The Quick-change Gearbox.	14
12. Sliding Gears for Feeds.	14
13. Reversing Mechanism or "Tapping Attachment"	14
14. Superservice Drill Presses.	15

CHAPTER II

DRILLS AND DRILLING

15. Drilling-machine Operations	21
16. How the Cutting Tools Are Held	22
17. Sockets and Sleeves	23
18. Drill Chucks	25
19. The Twist Drill.	25
20. The Straight-fluted Drill	27
21. The Flat Drill.	27
22. The Three-fluted Drill	28

23.	Oil-tube Drills.	
24.	Drill-grinding Machine.	
25.	Principles of Sharpening a Drill.	
26.	Operation of Sharpening a Drill.	
27.	Drill Points for Different Materials	
28.	Thinning the Point of a Drill	
29.	Speeds and Feeds of Twist Drills	
30.	Calculations for R. P. M. of Drills.	
31.	The Use of Cutting Oils	
32.	High-duty Upright Drills with Coolant System	
33.	Drill Jigs.	
34.	Laying Out for Drilling.	
35.	Example of Laying Out.	
36.	The Use of Clamps and Stops.	
37.	Bolts.	
38.	Clamps.	
39.	Clamping Blocks	
40.	Shims	
41.	Hints on Clamping.	
42.	Examples of Drilling Setups	
43.	Hints on Drilling	
44.	Drilling the Hole	
45.	Drilling Large Holes.	

CHAPTER III

OTHER DRILL-PRESS TOOLS AND OPERATIONS

46.	Introduction	
47.	Chucking or Machine Reamers	
48.	Shell Reamers.	
49.	Hand Reamers	
50.	Adjustable Reamers	
51.	The Expansion Reamer.	
52.	Taper Reamers	
53.	High-speed Reamers	
54.	Emergency Reamers.	
55.	To Avoid Chattering of Reamers	
56.	Hints on Reaming.	
57.	The Operation of Reaming	
58.	Duplicating a Drilled or Reamed Part	
59.	The Counterbore	
60.	The Countersink	
61.	Boring in a Drill Press.	
62.	Taps and Tapping.	

CONTENTS

	xi
	PAGE
63. Tap-size Drills	69
64. Advantages of Tapping by Power	70
65. Tapping Attachments	70
66. Auxiliary Tapping Attachments.	71
67. Tapping in a Drill Press	73
68. Using a Piece Already Drilled as a Template	74

THE SHAPER

CHAPTER IV

SHAPER CONSTRUCTION

69. Introduction	76
70. The Value of the Shaper	77
71. Parts of the Shaper	78
72. Crank Shaper Driving Mechanism.	79
73. Adjustment for Length of Stroke	81
74. Adjustment for Position of Stroke.	83
75. Quick Return.	84
76. Speeds of the Shaper.	85
77. The Worktable	86
78. The Feeding Mechanism	88
79. Cam-operated Feed Action	90
80. Toolhead. Vertical and Angular Downfeed	95

CHAPTER V

SHAPER WORK

81. Shaper Cutting Tools	98
82. Clearance Angles	98
83. Rake Angle.	99
84. Right-hand and Left-hand Tools	99
85. Toolholders	102
86. Speeds and Feeds	103
87. Depth of Cut and Feed.	104
88. Cutting-speed Calculations.	105
89. Holding the Work.	107
90. The Shaper Vise.	107
91. Angle Plates	109
92. Shaper Centers	110
93. Parallels	110
94. Degree Parallels.	111
95. Hold-downs or Grippers	111
96. Inaccurate Vise or Vise Settings.	

97. To Test the Work Seat. 7
98. To Test the Solid Jaw
99. To Set the Vise Parallel with Direction of Stroke
100. To Set the Vise Square with Direction of Stroke.
101. Chips and Burrs as a Cause of Inaccurate Work.
102. Preliminary Hints on Shaper Work
103. The Horizontal Cut
104. To Sharpen a Square-nose Tool for Finishing Cast Iron
105. Setting the Head for Vertical and Angular Cuts.
106. Planing Vertical and Angular Cuts.
107. To Plane a Rectangular Block or Similar Piece
108. The Adjacent Surface
109. Squaring the Ends.
110. Planing an Irregular Cut.
111. Planing Tongues and Grooves.
112. The Horizontal Surfaces of Tongues and Grooves
113. The Vertical Surfaces
114. Planing the Groove
115. Taper Parallels or Adjustable Parallels.
116. Planing Slots, Keyways, Etc
117. Taking Cuts Which End in the Metal
118. Planing Keyways
119. Planing Dovetails
120. Measuring Dovetails.
121. The Vertical Shaper

THE PLANER

CHAPTER VI

PLANER CONSTRUCTION

122. Introduction to Planer.
123. Parts of the Planer
124. Size of Planer.
125. Openside Planer.
126. Modern Planers.
127. The Planer Bed.
128. The Planer Platen.
129. The Crossrail.
130. The Toolhead
131. Planer-driving Mechanism
132. Quiet-running Qualities of the Planer.
133. Reversing Mechanism
134. Planer Speeds.

CONTENTS

xiii

PAGE

135. Speed Variator	154
136. Feeding Mechanism	155
137. The Feed Friction.	158

CHAPTER VII

PLANER WORK

138. Introduction	161
139. Methods of Holding Work	162
140. The Planer Vise.	163
141. The Planer Centers	164
142. Holding Work on the Platen	165
143. Bolts.	165
144. Clamps.	166
145. Clamping Blocks	167
146. Shims	167
147. Planer Jacks	167
148. Braces.	168
149. Planer Poppets, Stops, Toedogs	168
150. Planer Strips, V blocks, Angle Plates.	169
151. Internal Stresses.	171
152. External Stresses	171
153. Placing the Clamps and Stops.	172
154. Clamping Hints.	174
155. Leveling	175
156. Laying Out.	176
157. Measuring and Gauging	178
158. Planer Cutting Tools.	179
159. Setting the Tool.	180
160. Cutting Speed, Depth of Cut and Feed.	182
161. Starting the Cut—General Precautions.	183
162. The Roughing Cut.	184
163. The Finishing Cut.	184
164. A Typical Elementary Planer Job.	185
165. Similarity of Shaper Work and Planer Work	187
166. Memoranda.	187
167. Planing T slots	187

THE MILLING MACHINE

CHAPTER VIII

MILLING-MACHINE CONSTRUCTION

168- Introduction	190
169- Types of Milling Machines	193

CHAPTER XI

TYPICAL MILLING SETUPS AND ELEMENTARY OPERATIONS

206. Various Methods of Holding Work.	248
207. Milling-machine Fixtures.	249
208. Clamping Work to the Table	250
209. Holding in a Vise	250
210. Aligning and Squaring the Holding Tools and Work	252
211. Special Vise Jaws	254
212. The Milling-machine Setup—Introduction	255
213. Setup of the Work.	256
214. Selecting the Cutter	257
215. Setting the Cutter.	257
216. Setting the Speed and Feed.	258
217. Setting the Feed Trip	258
218. Concerning an Undercut	259
219. Other Uses of the Positive Stop.	260
220. Milling a Rectangular Piece.	260
221. Squaring the Ends.	261
222. Face Milling	262
223. Cutting a Keyway or Similar Groove.	262
224. Locating the Cutter Central.	263
225. Adjusting for Depth of Cut.	264
226. Whitney Keys.	264

CHAPTER XII

THE INDEX HEAD AND INDEXING OPERATIONS

227. Introduction	270
228. The Index Head.	270
229. The Footstock	272
230. Simple Indexing.	272
231. Index-plate and Sector.	273
232. Indexing in Degrees	276
233. Direct Indexing.	277
234. Differential Indexing.	278
235. Wide-range Divider	284
236. Milling a Square or a Hexagon	285
237. To Cut a Spur Gear.	290
238. Fluting Reamers and Taps	292
239. The Cut-and-try Method.	293
240. The Layout Method.	295
241. Unequal Spacing or Increment Cut	296
242. Fluting Taper Reamers.	297
243. Drilling and Boring in a Milling Machine.	299
244. Feeding with the Index Handle	300

CHAPTER XIII

SPIRAL MILLING

245. Introduction
246. The Spiral
247. The Lead of the Spiral.
248. Five Features of Spiral Milling
249. The Gears Necessary for Spiral Milling.
250. Spiral-head Gearing
251. The Index Head with Bevel Gears.
252. The Index Head with Spiral Gears.
253. Change Gears for Spiral Milling.
254. Calculating the Gears for Spiral Milling
255. The Angle of the Helix or Spiral.
256. Milling Steep Spirals.
257. To Use the Card Furnished with the Machine.
258. Cutting a Spiral.
259. Reason for Double-angle Cutter
260. Use of Right-hand and Left-hand Double-angle Cutters
261. Setting the Cutter for Spiral Milling.
262. The Operation of Setting the Double-angle Cutter.
263. A Typical Spiral-milling Job, Step by Step

THE GRINDING MACHINE

CHAPTER XIV

GRINDING-MACHINE CONSTRUCTION

264. Introduction
265. The Plain Grinding Machine
266. The Internal Grinding Machine.
267. The Surface Grinding Machine
268. The Cutter and Tool Grinding Machine
269. The Universal Grinding Machine
270. Parts of the Universal Grinding Machine
271. The Bed
272. The Sliding Table.
273. The Swivel Table
274. The Table-feeding Mechanism.
275. The Table-feed Reverse
276. The Headstock
277. The Tailstock.
278. The Wheel Head
279. The Cross-feed Mechanism.
280. The Automatic Cross-feed Mechanism
281. The Overhead Works

CHAPTER XV

GRINDING WHEELS

282.	Introduction	353
283.	The Manufacturer of Grinding Wheels	355
284.	Abrasives	355
285.	Natural Abrasives	355
286.	Artificial Abrasives	355
287.	Silicon Carbide Abrasives	356
288.	Aluminum Oxide Abrasives	357
289.	Grain	357
290.	Bonds	358
291.	Vitrified Wheels	359
292.	Silicate Wheels	359
293.	Rubber- and Shellac-bonded Wheels	360
294.	Resinoid- (Bakelite-)bonded Wheels	360
295.	Grade	360
296.	Structure	361
297.	Grading or Classification	361
298.	Shapes and Sizes of Grinding Wheels	362
299.	Final Operations in Making a Grinding Wheel	364
300.	Diamond Wheels	366

CHAPTER XVI

GRINDING PRINCIPLES AND PRACTICE

301.	Introduction	368
302.	Kinds of Grinding	369
303.	Factors in Successful Grinding	370
304.	The Kind of Wheel (Bond) to Use	371
305.	Material to Be Ground	372
306.	Arc and Area of Contact	373
307.	Finish	374
308.	Grade of Wheel	374
309.	Grain of Wheel	375
310.	Structure of Wheel	375
311.	Mounting the Wheel	376
312.	Truing and Dressing the Wheel	377
313.	Types of Wheel Dressers	378
314.	The Diamond Dressing Tool	378
315.	Directions for Using the Diamond Tool	379
316.	Grinding Practice—Setting the Work	380
317.	Setting the Wheel Speed	380
318.	Setting the Work Speed	381
319.	Setting the Table Feed	382
320.	Setting the Depth of Cut	383

321.	Causes of Inaccurate Work.	
322.	Causes of Wheel Wearing Too Rapidly.	
323.	Causes of Wheel Glazing.	
324.	Causes of Wheel Getting Loaded	
325.	The Advantage of Using Dead Centers.	
326.	The Use of Back Rests.	
327.	Roughing and Finishing Cuts.	
328.	The Use of Cutting Lubricant.	
329.	Grinding Operations—A Few Suggestions.	
330.	Operations in Grinding a Cylinder.	
331.	Grinding a Shouldered Piece	
332.	Grinding a Taper	
333.	Grinding an Angle.	
334.	Face Grinding.	
335.	Internal Grinding Fixture.	
336.	Internal Grinding	
337.	Grinding Taper Holes	
338.	Surface Grinding	
339.	The Centerless Grinding Machine	
340.	Features of the Centerless Grinding Machine	
341.	Laps and Lapping.	

HYDRAULICS

CHAPTER XVII

HYDRAULIC POWER TRANSMISSION

342.	Introduction	
343.	Advantages of Hydraulic Power.	
344.	Hydraulic Units.	
345.	Pumps.	
346.	The Gear Pump.	
347.	The Vane Pump.	
348.	The Plunger Pump	
349.	Value of the Variable-displacement Pump	
350.	Valves.	
351.	Plunger or Piston-type Valves.	
352.	The Control Valve.	
353.	A Modern Control Valve.	
354.	The Resistance (Foot) Valve	
355.	Driven Units	
356.	Cross-feed Mechanism	
357.	A 35-ton Hydraulic Press	
358.	Rapid-traverse and Feed Circuit.	
359.	Automatic Control.	

CONTENTS

xix

PAGE

GEARS

CHAPTER XVIII

SPUR GEARS AND BEVEL GEARS

360.	Introduction	439
361.	Reason for Gears	439
362.	The Pitch Circle.	440
363.	Tooth Parts.	441
364.	Circular Pitch.	442
365.	Diametral-pitch Idea.	442
366.	The Diametral Pitch.	443
367.	The Module	443
368.	Gearing Nomenclature.	444
369.	Definitions and Rules	445
370.	Rules and Formulas	448
371.	Shape of Gear Teeth.	449
372.	The Base Circle and the Pressure Angle	451
373.	Gear Cutters	452
374.	Full-depth Involute Gear.	453
375.	The 20-degree Stub Tooth	454
376.	Values Not Standard.	455
377.	Metric Gears	456
378.	Bevel Gears, Introduction	457
379.	Pitch Cylinders and Pitch Cones	458
380.	Pitch Cones.	459
381.	Pitch Angle.	459
382.	Pitch Diameter	460
383.	Face Width of Bevel Gear	460
384.	Cone Distance, Tooth Size and Shape	460
385.	Laying Out Bevel Gears, Shafts at Right Angles.	461
386.	Laying Out Bevel Gears, Shafts Not at Right Angles	461
387.	Calculations for Bevel Gears	463
388.	Definitions and Rules	464
389.	Example Showing Calculations for Miter Gear	466
390.	Cutting a Bevel Gear in a Milling Machine.	467
391.	Selecting the Cutter	468
392.	Order of Operations	469

APPENDIX

INDEX OF TABLES	475
TABLES 1 TO 20	476 to 502
INDEX	503