

GENERAL TABLE OF CONTENTS.

		PAGE
PREFACE.....		iii
Synoptical Table		xxi
General Table of Contents		xxii
Contents of the separate Articles		xxiii
List of Technical and New Terms		xxviii
Notes to pages 301 and 361		xxx
Introduction.....	Intro.	1
On Trains of Mechanism in general	} Part I. Chap. 1	} 14
Elementary Combinations :		
Class A. { Directional Relation Constant { Velocity Ratio Constant		
Division A. Communication of Motion by Rolling Contact	Chap. 2	31
B	Chap. 3	62
C	Chap. 4	168
D	Chap. 5	185
E	Chap. 6	196
Trains of Elementary Combinations (Class-A)	Chap. 7	202
Class B. { Directional Relation Constant } { Velocity Ratio varying..... }	Chap. 8	239
Division A. Communication of Motion by Rolling Contact		239
B		264
C		269
D		271
E		284
Class C. Directional Relation Changing	Chap. 9	286
Division A. Communication of Motion by Rolling Contact		287
D		295
B		316
C		330
On Mechanical Notation.....	Chap. 10	332
On Aggregate Combinations	Part II.	
General Principles	Chap. 1	346
Combinations for producing Aggregate Velocity.....	Chap. 2	352
..... Paths	Chap. 3	394
On Adjustments	Part III	
General Principles	Chap. 1	417
To alter the Velocity-Ratio by Determinate Changes	Chap. 2	419
..... Gradual Changes	Chap. 3	438

CONTENTS OF THE SEPARATE ARTICLES.

INTRODUCTION.

Arts. 1—7. General Principles. 8. Rest. Motion. 9. Path. Direction. Velocity. 10. Uniform Motion. 11. Angular Velocity. Period. Synchronal Rotations. 12. Varying Velocity. 13. Graphic representations, first method by time and velocity. 14. Second method by time and space. 15, 16. Comparison of these methods. 17. Periodic Motion. Cycle. Phase.

PART THE FIRST.

ON TRAINS OF MECHANISM IN GENERAL.

Art. 18. Mechanism defined. Combinations are single or aggregate. 19. System based upon proportions and relations, not upon actual motions. 20. Velocity-ratio. 21. Directional relation. 22. Three Classes. 23. Cycles. 24. Trains. 25. Connexion of pieces. 26. Driver. Follower. 27. Communication of Motion; 28. by Contact; 29. by Intermediate pieces; 30. by Reduplication. 31. Five Divisions. 32. Velocity Ratio in Link-work; 33 in Contact Motions. 34. Quantity of sliding in Contact Motions. 35. Rolling Contact. 36. Corollary. 37. Velocity Ratio in wrapping connexions. 38. Line of action. 39. Path may always be a circle; 40. may be limited or unlimited.

CLASS A. $\left\{ \begin{array}{l} \text{DIRECTIONAL RELATION CONSTANT.} \\ \text{VELOCITY RATIO CONSTANT.} \end{array} \right\}$ DIVISION A. BY ROLLING CONTACT.

By pure Rolling Contact.

Art. 41. General Principles. 42. Axes parallel. Cylinders. 43, 44. Axes meeting, Cones. 45—47. Axes neither parallel nor meeting. Hyperboloids. 48. Poncelet's Cones.

To apply these Solutions to practice.

Art. 49. Rolling surfaces. 50—57. Toothed-wheels in general. 58. Annular wheels. 59. Rack. 60. Sector. 61—63. Face gearing. 64. Crown-wheel. 65, 66. Bevil-wheels. 67. Skew-bevils. 68. Hooke's gearing, (vide Art. 148). 69—74. Pitch.

CLASS A. DIVISION B. BY SLIDING CONTACT.

Axes Parallel.

Art. 75. General principles. 76. First solution. Epicycloid and pin. 77. Second solution. Epicycloid and Radial-line. 78. Third solu-

XXIV CONTENTS OF THE SEPARATE ARTICLES.

tion. Epicycloid and Hypocycloid. 79—81. Fourth solution. Involutés. 82—85. Fifth or general solution.

Teeth of Wheels, derived from the First solution.

Arts. 87—90. Pin-wheels. 91. Racks. 92. Annular wheels. 93—97. To find least number of teeth.

Teeth of Wheels, from the Second solution.

Arts. 98, 99. Spur-wheels. 100—105. To find the least number of teeth. 106. Racks. 107—112. Length of teeth, and Addendum.

Teeth of Wheels, from the Third solution.

Arts. 113—116. Spur-wheels. 117—120. Length of teeth, and Addendum. 121. Least number of teeth. 122. Racks.

Teeth of Wheels, from the Fourth solution.

Arts. 123—128. Involute wheels. 129. Involute racks.

Teeth of Wheels, from Arcs of Circles.

Arts. 130—132. General principles. 133—136. Constructions and formulæ. 137, 138. Single arc. 139, 140. Double arc. 141—144. Odontograph. 145. Cutters. 146. Length of teeth. 147. Unsymmetrical teeth. 148. Hooke's gearing.

Axes not parallel.

Arts. 149—153. Bevil-wheel teeth. 154.—157. Face-wheel gearing. 158. Skew-bevils. 159. Involutés.

On Cams and Screws.

Arts. 160—165. Cams. 166—169. Screws. 170—173. Endless screws and wheels. 174. Hindley's screw. 175. Many-threaded screws. 176. Oldham's coupling.

CLASS A. DIVISION C. BY WRAPPING CONNECTORS.

Arts. 177, 178. Bands in general. 179. Material of bands. 180. Form of pully. 181. Cone-pully. 182. Crossed belt. 183. Acting radius of pully. 184. Band shifted by the advancing side. 185. Arrangement of belt when axes are not parallel. 186, 187. Guide-pullies. 188. Stretching pullies. 189. Geering chains. 190—194. Limited rotations.

CLASS A. DIVISION D. BY LINK-WORK.

Arts. 195, 196. General principles, (vide Art. 326). Dead points. 197. First method of passing the link over the dead points. 198. Second method. 199. Cranks. 200. Third method. 201, 202. Small motions. 203—207. Bell-cranks.

CONTENTS OF THE SEPARATE ARTICLES. XXV

CLASS A. DIVISION E. BY REDUPLICATION.

Arts. 208—210. General principles. 211—214. Tackles. 215, 216.
 Tackles in trains.

TRAINS OF ELEMENTARY COMBINATIONS. (CLASS A.)

Arts. 217—222. General formulæ. 223. Idle-wheel. 224. Marlborough wheel. 225. Bevil-wheels. 226. Cannon-wheels. 227, 228. Hunting cogs. 229—242. Calculation of numbers and arrangement of trains. 233, 234. Notation. 237. Young's theorem. 243—256. Calculation of numbers by approximation.

CLASS B. $\left\{ \begin{array}{l} \text{DIRECTIONAL RELATION CONSTANT.} \\ \text{VELOCITY RATIO VARYING.} \end{array} \right\}$ DIVISION A.
 BY ROLLING CONTACT.

Arts. 258—270. Theory of rolling curves. 271—273. Practical applications. 274. Forms of teeth. 275, 276. Cometarium. 277. Excentric wheels. 278, 279. Swing-frame. 280. Roëmer's wheels. 281, 282. Excentric crown-wheel. 283. Unequal pitch. 284—287. Intermitted teeth. 288. Rolling-curve levers.

CLASS B. DIVISION B. BY SLIDING CONTACT.

Art. 290. Pin and Slit-lever. (vide Art. 364.) 291. Endless screw and wheel. 292—294. Intermittent motions. Geneva stop. 295, 296. Cams, (vide Art. 352).

CLASS B. DIVISION C. BY WRAPPING CONNECTORS.

Art. 297. Unlimited Rotations. 298, 299. Limited Rotations. Fuseses.

CLASS B. DIVISION D. BY LINK-WORK.

Art. 300. General solution. (vide Art. 325.) 301—307. Hooke's joint. 308. Sundial machine. 309, 310. Joints of Flexure. 311. Crabs-claw.

CLASS B. DIVISION E. BY REDUPLICATION.

Art. 312. Reduplication of unparallel cords.

CLASS C. DIRECTIONAL RELATION CHANGING.

Arts. 313, 314. General principles.

CLASS C. DIVISION A. BY ROLLING CONTACT.

Arts. 315—319. Mangle-wheels. 320, 321. Mangle-racks. 322, 323. Escaping geerings. 324. Curvilinear toothed-wheel on swing frame.

CLASS C. DIVISION D. BY LINK-WORK.

Arts. 325—329. Formulæ. 330. Excentric. 331. Trains of Link-work. 332. To correct the crank. 333. To equalize velocity. 334. To retard

XXVI CONTENTS OF THE SEPARATE ARTICLES.

velocity. 335. To multiply oscillations. 336. Alternate intermission. 337. Graphic representation of motion. (vide Arts. 13—16.) 339—350. Clicks, ratchet-wheels and detents. 342, 343. Lever of Lagarousse. 346—348. Forms of detent and teeth of ratchet. 349. Yielding tooth. 350. Silent click. 351. Intermittent link-work.

CLASS C. DIVISION B. BY SLIDING CONTACT.

Arts. 352—358. Cams. 359. Swash-plate. 360—362. Cylindrical cams. Screw-cams. 363. Solid cam. 364. Pin and slit-lever, (vide Art. 290.) Eccentric cam. 365. Cam with equidistant opposite tangents. 366—374. Escapements. 370. Crown-wheel escapement. 371. Anchor escapement.

CLASS C. DIVISION C. BY WRAPPING CONNECTORS.

375. Curvilinear Pully.

ON MECHANICAL NOTATION. (Arts. 376—385.)

PART THE SECOND.

ON AGGREGATE COMBINATIONS.

Arts. 386—389. General principles.

To connect a Driver and Follower, the relative position of whose paths is variable.

Arts. 390, 391. Long screw, long pinion, &c. 392. Travelling pully frame. 393. Link-work.

ON COMBINATIONS FOR PRODUCING AGGREGATE VELOCITY.

By Link-work.

Art. 395. Bar. 396. Compound Bar.

By Wrapping Connectors.

Arts. 397, 398. Sliding pully. 399. Lever and pully. 400, 401. Chinese windlass.

By Sliding Contact.

Art. 402. Differential screw. 403. White's differential nut and screw. 404. Wollaston's Odometer. 405. Thick pinion driving two wheels.

By Epicyclic Trains.

Art. 406. General Forms. 407—413. Formulæ. 414, 415. Uses of Epicyclic trains.

Examples of the first use. Art. 416. Ferguson's Paradox. 417. Sun and Planet-wheels. 418. Planetary mechanism. 419. Pearson's Planctarium.

CONTENTS OF THE SEPARATE ARTICLES. xxvii

Examples of the second use. Arts. 420—424. *Francœur's method.*
Examples of the third use. Arts. 425—428. *Differential wheel-work.*
Examples of the fourth use. Arts. 429—431. *Equation clocks.*

ON COMBINATIONS FOR PRODUCING AGGREGATE PATHS.

Art. 432. Rectangular co-ordinates. 433. Polar co-ordinates. 434. Example. 435. General principles. 436. Screw-cutting and boring motions. 437. Trammel. 438. Suardi's pen. 439. Parallel motions.

On parallel Motions.

Art. 440. Definition. 441—443. First simple form. 444, 445. Calculation of error. 446. Second simple form. 447—449. Compound parallel motion of steam engine. 450. Of marine engine. 451. Roberts' parallel motion. 452. Third simple form. 453. Parallel motions by toothed wheels. 454. White's. 455. By two spur-wheels.

PART THE THIRD.

ON ADJUSTMENTS.

Arts. 456—458. General principles.

To alter the Velocity Ratio by determinate changes.

Art. 459. Change-wheels; 460. fixed to the axes; 461. with idle-wheels. 462—465. Speed-pullies. 466. Formula. 467. Screw-cutting lathe. 468, 469. Turning lathe. 470. Large lathe. 471. General principles. 472. Link-work.

To alter the Velocity Ratio by gradual changes.

Art. 473. General principles. 474—477. Solid pullies. 478. Expanding riggers. 479. Disk and roller. 480. Equitangential conoid. 481. Solid cam, (vide Art. 363.) 482, 483. Link-work.