

**THE PRINCIPLES OF MECHANISM AND
MACHINERY OF TRANSMISSION. COMPRISING
THE PRINCIPLES OF MECHANISM, WHEELS
AND PULLEYS, STRENGTH AND PROPORTIONS
OF SHAFTS, COUPLINGS FOR SHAFTS, AND
ENGAGING AND DISENGAGING GEAR**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649679942

The Principles of Mechanism and Machinery of Transmission. Comprising the Principles of Mechanism, Wheels and Pulleys, Strength and Proportions of Shafts, Couplings for Shafts, and Engaging and Disengaging Gear by William Fairbairn

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

www.triestepublishing.com

WILLIAM FAIRBAIRN

**THE PRINCIPLES OF MECHANISM AND
MACHINERY OF TRANSMISSION. COMPRISING
THE PRINCIPLES OF MECHANISM, WHEELS
AND PULLEYS, STRENGTH AND PROPORTIONS
OF SHAFTS, COUPLINGS FOR SHAFTS, AND
ENGAGING AND DISENGAGING GEAR**

THE
PRINCIPLES OF MECHANISM
AND
MACHINERY OF TRANSMISSION.

COMPRISING

THE PRINCIPLES OF MECHANISM, WHEELS AND PULLEYS,
STRENGTH AND PROPORTIONS OF SHAFTS, COUPLINGS FOR
SHAFTS, AND ENGAGING AND DISENGAGING GEAR.

BY

WILLIAM FAIRBAIRN, ESQ., C.E.
LL. D. F.R.S. F.G.S.

CORRESPONDING MEMBER OF THE NATIONAL INSTITUTE OF FRANCE, AND OF THE
ROYAL ACADEMY OF TURIN; CHEVALIER OF THE
LEGION OF HONOUR, ETC., ETC.

PHILADELPHIA:
HENRY CAREY BAIRD,
INDUSTRIAL PUBLISHER,
No. 406 WALNUT STREET.

1869.

R. H.

CONTENTS.



CHAPTER I.

THE PRINCIPLES OF MECHANISM.

	PAGE
GENERAL VIEWS, LINK-WORK, WRAPPING CONNECTORS	
WHEEL-WORK, SLIDING CONTACT:—	
General Views Relating to Machines.....	13
The parts of a Machine.....	18
Elementary Forms of Mechanism.....	27
Link-work.....	22
ELEMENTARY FORMS OF MECHANISM:—	
To construct Watt's parallel motion.....	31
To multiply Oscillations by means of Link-work... ..	34
To produce a Velocity which shall be rapidly retarded by means of Link-work.....	36
To produce a reciprocating intermittent Motion by means of Link-work.....	37
The Ratchet-wheel and Detent.....	39
Intermittent motion produced by Link-work connected with a Ratchet-wheel.....	39
Wrapping Connectors	40
Speed Pulleys.....	44
Guide Pulleys.....	47
To prevent Wrapping Connectors from Slipping..	48
System of Pulleys.....	51
To produce a varying velocity ratio by means of Wrapping Connectors.....	54

	PAGE
Wheel-work producing Motion by rolling Contact..	56
Idle Wheels.....	63
Annular Wheels—Concentric Wheels.....	64
Wheel-work when the axes are not parallel to each other.....	64
Face-wheel and Lantern—Crown-wheels.....	65
To construct Bevel-wheels or Bevel-gear when the axes are in the same plane.....	66
To construct Bevel-gear when the axes are not in the same plane.....	68
Variable motions produced by Wheel-work having rolling contact	69
Intermittent and reciprocating motions produced by Wheel-work having rolling contact.....	71
The Wedge and Movable Inclined Plane.....	74
Sliding Pieces producing motion by sliding contact.	74
The Eccentric Wheel.....	75
Cams, Wipers, and Tappets	76
To find the curve forming the groove of a Camb, so that the velocity ratio of the rod and axes of the Camb may be constant.....	77
The Swash Plate	80
Construction of Screws	82
The Solid Screw and Nut.....	85
The Common Press.....	86
The Compound Screw.....	88
The Endless Screw	89
The Differential Screw.....	90
The Archimedian Screw Creeper.....	91
Mechanism for Cutting Screws.....	92
To produce a changing reciprocating rectilinear motion by a combination of the Camb and Screw.	94
To produce a boring motion by a combination of the Screw and Toothed Wheels:.....	95

CHAPTER II.

ON MACHINERY OF TRANSMISSION.

	PAGE
ON WHEELS AND PULLERS :—	
Wrapping Connections.....	99
Where employed.....	100
Advantages and Disadvantages of.....	101
Material employed in the Construction of.....	101
Strength of.....	102
Table of approximate Widths of Leather Straps, in Inches, necessary to transmit any required Number of Horses' Power.....	103
TOOTHED WHEELS :—	
Introduction of.....	104
Construction of Mortise Wheels.....	105
Smeaton's Introduction of Cast-iron as a Material for Spur Wheels.....	107
Rennie's use of Cast-iron in all the details of Millwork, as exemplified in the Construction of the Albion Mills.....	107
True Principle of Construction.....	108
Tooth-cutting Machine.....	112
SPUR GEARING :—	
Definitions.....	114
PITCH OF WHEELS :—	
Rules for finding the Pitch and Diameter of Wheels.....	117
Table of Constants for Wheel-work.....	118
Rules for finding the Pitch, Diameter, and Number of Teeth.....	119
Professor Willis's Method of graduating the sizes of Wheels.....	121
Table showing the relation of Pitch, Diameter, and Number of Teeth.....	122, 123

	PAGE
TEETH OF WHEELS :—	
The Principles which determine the proper Form..	124
Formation of Epicycloidal and Hypocycloidal Curves	125
Construction of Epicycloidal Teeth	129
Construction of Involute Teeth.....	135
Professor Willis's Method of striking the Teeth of Wheels.....	140
Odontograph.....	142
General Form and Proportions of Teeth of Wheels.	145
Table of Proportions of Teeth of Wheels for aver- age Practice	154
Table giving the Proportions of the Teeth of Wheels in Inches and Thirty-seconds of an Inch	156
BEVEL WHEELS :—	
Examination of the Curves.....	157
Formation and Form of Teeth.....	159
SKEW BEVELS :—	
Definitions and Method of setting out the Teeth...	160
THE WORN AND WHEEL :	
Description of Construction.....	163
STRENGTH OF THE TEETH IN WHEELS :—	
Rules to be observed in Calculations.....	165
Line of greatest Strain.....	167
Table of Thickness, Breadth, and Pitch of Teeth of Wheels.....	168
Table of Relation of Horses' Power transmitted and Velocity at the Pitch Circle to Pressure on Teeth	172
Table showing the Pitch and Thickness of Teeth to transmit a given Number of Horses' Power at different Velocities.....	173

	PAGE
Table showing the Breadth of Teeth required to transmit different Amounts of Force at a uniform Pressure of 400 lbs. per inch.....	174

CHAPTER III.

ON THE STRENGTH AND PROPORTIONS OF SHAFTS :—

The Factory System necessitates the use of long Ranges of Shafts.....	175
---	-----

DIVISION I. :—

The Material of which Shafting is constructed	177
--	-----

DIVISION II. TRANSVERSE STRAIN :—

Resistance to Rupture.....	179
----------------------------	-----

Rules for the Strength of Shafts.....	183
---------------------------------------	-----

Table of Resistance to Flexure. Weights producing a Deflection of $\frac{1}{1200}$ of the Length in Cast-iron Cylindrical Shafts.....	187
---	-----

Table of Resistance to Flexure. Weights producing a Deflection of $\frac{1}{1250}$ th of the length in Wrought-iron Cylindrical Shafts.....	188
---	-----

Table of Deflection of Cast-iron Cylindrical Shafts, arising from the Weight of the Shaft.....	189
--	-----

Table of Deflection of Wrought-iron Cylindrical Shafts, arising from the Weight of the Shaft....	190
--	-----

DIVISION III. TORSION :—

Coulomb's Deductions and Formula.....	191
---------------------------------------	-----

Bevan's Values of Modulus of Torsion	192
--	-----

Wertheim's Formulæ for Cylindrical Bodies.....	193
--	-----

Résumé of Experiments on Cylinders of Circular Section.....	196
---	-----

Résumé of Experiments on the Torsion of Hollow Cylinders of Copper.....	197
---	-----

Résumé of Experiments on the Torsion of Elliptical Bars.....	197
--	-----

	PAGE
Table of the safe Working Torsion for Cast-iron Shafts.....	200
Table of the safe Working Torsion for Wrought-iron Shafts.....	201
DIVISION IV. :—	
Velocity of Shafts.....	204
Table of the Diameter of Wrought-iron Shafting necessary to transmit with safety various Amounts of Force.....	205
DIVISION V. ON JOURNALS :—	
Length of Journals.....	207
Ultimate Pressure per Square Inch on Journal....	208
Form of Journals.....	208
DIVISION VI. FRICTION :—	
Laws of.....	209
Rennie's Table of Coefficients of Friction under Pressures increased continually up to Limits of Abrasion.....	212
DIVISION VII. LUBRICATION :—	
Lubricants.....	213
Method of effecting complete Lubrication.....	215

CHAPTER IV.

ON COUPLINGS FOR SHAFTS AND ENGAGING AND DISENGAGING GEAR.

COUPLINGS :—

Primitive Cast-iron square Coupling-box.....	216
The Claw Coupling.....	217
Mr. Hewe's Coupling.....	218
The Disc Coupling.....	219
The Circular Half-lap Coupling.....	219