# INDEX

# Α

Absolute units of force, 10 Acme thread, 380,625,692 Actual deviation, 64

— size, 63

Addendum, 1025

- angle, 1083
- circle, 1025
- cone diameter, 1083

Adjustable screwed joints, 378

Advantages of chain drives, 760

- cycloidal gears, 1032
- fibre rope drives, 740
- gear drives, 1022
- involute gears, 1031
- rolling contact bearings, 996
- screwed joints, 377
- V-belt drive, 730
- welded joints, 341
- wire ropes, 744

Alloy steel, 31

— cast iron, 24

Allowance, 63

Alternating stresses, 182

Aluminium, 44

- alloys, 45
- bronze, 47

American national standard thread, 379

Angle of articulation, 761

- obliquity, 1022
- thread, 379

Angular bevel gear, 1081

— momentum, 13

Annealing, 42

Application of levers in engineering practice,

559

— Soderberg's equation, 216

Arc of approach, 1027

- contact, 1027
- recess, 1027

Assumptions in designing boiler joints, 296

- Euler's column theory, 602
- hydrodynamic lubricated bearings, 965

Axial brakes, 924

— pitch, 1067, 1103

Axially loaded un-symmetrical welded section, 350

Automobile suspension springs, standard sizes of, 873



В

Babbit metals, 48 Backing, 1083

Back cone, 1083

- distance, 1083
- pitch, 288
- lash, 1026

Ball bearings, standard dimensions and designation of, 999

Barlow's equation, 237

#### Band brake

- simple, 935
- differential, 942
- and block brake, 952

Basic dynamic load rating of rolling contact bearings, 1006

 static load rating of rolling contact bearings, 1003

Basic weld symbols, 345

— size, 63

Basis of limit system, 66

Beam strength of gear teeth, 1037

#### Bearings, 962

- classification of, 962
- characteristic number, 974
- metals, 48
- modulus for journal bearings, 974
- stress, 96

Bell crank lever, 576

Bellevile springs, 822

Belt joints, 681

- speed, 680
- types of, 678

Belt drive with idler pulleys, 684

velocity ratio of, 686

Bending stress in curved beams, 137

straight beams, 128

Beryllium bronze, 47

Bevel gears, 1080

- classification of, 1081
- design of a shaft for, 1088
- determination of pitch angle for, 1084
- factor, 1087
- forces acting on, 1087
- formative or equivalent number of teeth for, 1085
- proportions for, 1084
- strength of, 1086
- terms used in, 1082

Bilateral system of tolerance, 64

Birnie's equation, 237

Blackheart malleable cast iron, 23

Block brake,

- chain,



Boiler joints, design of, 295

— stays, 402

Bolted joints under eccentric loading, 405 Bolts of uniform strength, 404

Brakes, 917

- energy absorbed by, 918
- heat to be dissipated during, 920
- types of, 923

Brass, 46

Breaking stress, 99

British association thread, 379

— standard whitworth thread, 379

Bronze, 47

Buckling of compression springs, 831

- load, 601

Bulk modulus, 112

Butt joint, 286, 353

Bush roller chain, 690

Bushed bearing, 984

— pin flexible coupling, 499

Buttress thread, 381,625

C

Calculation of fundamental deviation for shafts, 73

— for holes, 74

Cap screws, 384

Carriage spring, 822

Case hardening, 44

Cast iron, types of, 21

- effect of impurities on, 25
- pulleys, design of, 716, 720

Casting, 54

— design of, 56

Castle nut, 385

Caulking, 289

Causes of gear tooth failure, 1044

Centre crank shaft, design of, 1162

Centrifugal casting, 56

- clutches, 910
- tension, 695

Chain drives, 759

- advantages and disadvantages, 760
- design procedure of, 772
- factor of safety for, 767
- terms used in, 761
- velocity ratio of, 762

Change in dimensions of thin cylindrical shell,

231

— spherical shell, 233

Chilled cast iron, 21

Characteristics of roller chains, 766

Circular flanged pipe joint, design of, 294

— pitch, 1025

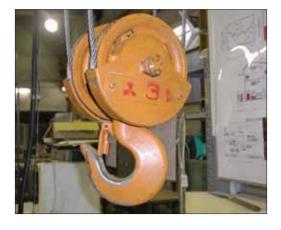
Circumferential lap joint for a boiler, 299

— stress, 226

Clamp or compression coupling, 482

Classification of bearings, 862

- bevel gears, 1081
- chains, 763



- engineering materials, 16
- gears, 1023
- Machine Design, 1
- pressure vessels, 224
- wire ropes, 745

Clavarino's equation, 237

Claw clutch, 886

Clearance, 1026

- bearing, 964
- fit, 65

Closely coiled helical spring, 821

Clutches, types of, 885

- friction, 886
- plate, 888
- positive, 886

Coefficient of friction, 642

- between belt and pulley, 680
- fluctuation of speed, 777
- for journal bearing, 975
- of energy, 981

Cold working, 60

- processes, 60

Collar bearings, 990

Column, failure of, 600

- Johnson's formulae for, 607
- Rankine's formula for, 606

Combined steady and variable stresses, 196

 variable normal stress and variable shear stress, 209

Common types of screw fastening, 383

Comparison between involute and cycloidal gears, 1031

Completely reversed stresses, 1181

Compression springs, terms used in, 825

buckling of, 831

Compressive stress and strain, 89

Compound belt drive, 684

- screws, 671
- cylindrical shells, 241
- stresses in, 241

Concave face worm gear, 1103

Concentric or composite springs, 857

Condition of constant velocity ratio of gears,

1027

for the transmission of maximum power, 697

Cone centre, 1083

- clutches, 902
- distance, 1083
- pulley drive, 685
- worm, 1102

Conical springs, 821

Connecting rod, design of, 612, 1144, 1150

— forces acting on, 614, 1146

Considerations in designing a friction clutch, 887

Construction of flywheels, 812

- leaf springs, 869
- wire ropes, 744

Contact ratio, 1027

Conveyor chains, 763

Copper, 45

- alloys, 46

Core diameter, 378

Cotter joint, types of, 432

- foundation bolt, design of, 453
  - to connect piston rod and cross-head, 450

Couple, 11

Coupler joint, 266

Cover plates, 252

Crank shaft, 1161

- bearing pressures and stresses in,1161
- design procedure for, 1162

Cranked lever, 568

Creep, 19

— of belt, 687



Crest, 379

Critical pressure of journal bearings, 977

- load, 601

Crossed belt drive, 683

length of, 690

Crown bevel gear, 1082

— height, 1083

Cyclic stresses, 181

Cycloidal teeth, 1029

Cylinder, 1031

design of, 1032

Cylinder heads, 252

covers, design of, 395

— liners, 1031

Cylindrical worm, 1102



Dedendum, 1025

- angle, 1083
- circle, 1025
- cone diameter, 1083

Deflection of helical springs of circular wire, 830

— of non-circular wire, 852

Density, 11

— of belt materials, 680

Depth of thread, 379

Derived units, 5

Design of bearing caps and bolts, 986

- boiler joints, 295
- cast iron pulleys, 719
- centrifugal clutch, 910
- chain drives, 772
- circular flanged pipe joint, 271
- circumferential lap joint for a boiler,299
- cone clutch, 903
- connecting rod, 612
- cylinder, 1127
- cylinder covers, 397
- disc or plate clutch, 889
- flange coupling, 487
- flywheel arms, 803

- journal bearings, 978
- levers, 558
- longitudinal butt joint for a boiler, 296
- nut, 405
- oval flanged pipe joint, 274
- pipes, 265
- piston rod, 609
- push rod, 611
- screw jack, 658
- shaft, 511
- shaft for bevel gears, 1088
- sleeve and cotter joint, 440
- socket and spigot cotter joint, 432
- spur gears, 1044
- square flanged pipe joint, 276
- worm gearing, 1112

Detachable fastening, 282

Designation of screw threads, 386

— wire ropes, 745

Determination of pitch angle for bevel gears, 1084

Diagonal pitch, 288

Diametral pitch, 1026

Die casting, 55

Differential band brake, 942

— screw, 669

Direct and bending stresses combined, 160

Disadvantages of chain drives, 760

- gear drives, 1022
- rolling contact bearings, 996
- screwed joints, 377
- V-belt drive, 730
- welded joints, 341

Disc clutches,

— springs, 822

Double block or shoe brake, 930

— enveloping worm, 1102

Duralumin, 45

Dynamic equivalent load for rolling contact bearings, 1007

- load rating for rolling contact bearings under variable loads, 1009
- tooth load, 1040

F

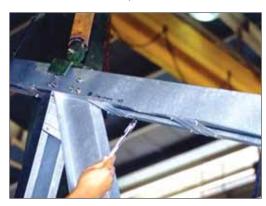
Eccentric loading, 160

- loaded bolted joint, 405,409,419,424
- long column subjected to, 608
- riveted joint, 322
- springs, 831
- welded joint, 361

Eccentricity, 160

Effect of impurities on cast iron, 25

- on steel, 30
- keyways, 487
- loading on endurance limit, 184
- miscellaneous factors, 185
- size, 184
- surface finish, 184



Effective diameter, 398

Efficiency of riveted joint, 292

- self locking screws, 641
- square threaded screws, 635
- worm gearing, 1107

Elastic limit, 98

Electric arc welding, 343

Elements of a welding symbol, 347

— standard location of, 347

End connections for compression helical springs, 826

— tension helical springs, 827

Endurance limit, 182

Energy, 14

- absorbed by a brake, 918
- in helical springs of circular wire, 847

- stored in a flywheel, 781 Equalised stress in spring leaves, 870 Equivalent length of a column, 604
  - number of teeth for bevel gears, 1085
  - for helical gears, 1068

Essential qualities of rivet, 283

Euler's column theory, 601

- assumptions in, 602
- formula, 602
- limitations of, 603

Eutectoid steel, 42

Expansion joints, 267

Externally pressurized lubricated bearings, 965

# F

Face angle, 1083

- of tooth, 1027
- width, 1027
- of helical gears, 1067

Factor of safety, 101

- for chain drives, 767
- for fatigue loading, 186
- for wire ropes, 747
- selection of, 101

Factors to be considered to avoid fatigue failure, 190

Failures of column or strut, 600

- riveted joint, 290

Fast and loose pulley, 718

— drive, 685

Fatigue limit, 182

stress concentration factor, 195

Feather key, 472

Ferrous metals, 17, 20

Fibre ropes, 739

— sheave for, 740

Fillet radius, 1027

— welded joints, special cases of, 351

Fits, 65

— types of, 65

Fitted bearing, 965

Flange coupling, 484

design of, 487

Flanged pipe joint, 268

- circular, design of, 271
- oval, design of, 274
- square, design of, 276

Flank of tooth, 1027

— of thread, 379

Flat belt drives, 677

- types of, 682
- pulleys, 716
- saddle key, 473
- spiral spring, 864

Flexible coupling, 479,498

— bushed pin, 499

Fluctuating stress, 182

Fluctuation of energy, 778

- maximum, 779, 780
- coefficient of, 781

Flywheel, 776

- construction of, 812
- energy stored in, 781
- stresses in, 788

Foot lever, 566

- step bearing, 988

Force, 9

- acting in bevel gears, 1087
- on connecting rod, 614
- on sunk keys, 474
- on worm gears, 1111

Forge welding, 343

Forging, 57

— design of, 58

Form stress concentration factor, 187 Formative number of teeth for bevel gears, 1085

— for helical gears, 1068

Forms of teeth, 1029



Free cutting steel, 31

— length, 837

Friction clutches, 886

- types of, 887
- wheels, 1021

Full annealing, 42

Fullering, 289

Fundamental deviation, 64

— units, 5

Fusion welding, 342

# G

Gas welding, 343

Gears

- classification of, 1023
- materials, 1034
- terms used in, 1024
- tooth failure, causes of, 1044

General considerations in Machine Design, 2

- procedure in, 4

Gerber method for combination of stresses, 197

Gib and cotter joint, 443

- design of, 444,447
- head key, 471

Goodman method for combination of stresses, 197

Gravitational units of force, 10

Grey cast iron, 21

Grooved nut, 385

Guest's theory, 193

Gun metal, 48

Haigh's theory, 154

Hand levers, 565

Hardening, 43

Hauling chains, 763

Heat resisting steel, 37

- generated in a journal bearing, 977
- to be dissipated during braking, 920
- treatment of steel, 42

Helical gears, 1066

- face width of, 1067
- formative or equivalent number of teeth for, 1068
- proportions of, 1068
- strength of, 1069
- springs, 821
- material for, 823
- subjected to fatigue loading, 853
- terms used in, 1067
- torsion spring, 863

Helix angle, 1105

Hencky and Von Mises theory, 154

High speed tool steel, 39

Hindalium, 45

Hobed straight face worm gear, 1102

Hoisting chains, 763

Hole basis system, 66

Hollow saddle key, 473

Hooke's coupling, 504

Hoop stress, 226

Hot working, 58

- processes, 59

Hydraulic pipe joint, 269

— for high pressures, 270

Hydrodynamic lubricated bearings, 965

- assumptions in, 965
- terms used in, 973

Hyper-eutectoid steel, 42

Hypo-eutectoid steel, 42



Iconel, 50

Important factors for the formation of thick oil film in hydrodynamic lubricated bearing, 965

- terms used in riveted joints, 288
- screw threads, 378

Indian standard designation of low and medium alloy steels, 33

- high alloy steels, 39
- high speed tool steels, 40
- system of limits and fits, 67

#### Inertia, 9

— bending forces, 616

Initial stresses due to screwing up forces, 389

— tension in a belt, 705

Inside cone diameter, 1083

Interchangeability, 62

Interference fit, 66

— in involute gears, 1033

Internal bevel gear, 1082

— expanding brake, 955

International system of units, 5

Involute teeth, 1030

Inverted tooth chain, 765

J

Jam nut, 385 Jaw clutch, 886 Johnson's formulae for columns, 607 Joints of uniform strength, 313



#### Journal bearing

- coefficient of friction for, 975
- critical pressure of, 977
- design procedure of, 978
- heat generated in, 977
- solid, 984
- squeeze film, 967
- wedge film, 966

# K

Keys, types of, 470

Keyways, effect of, 477

Kilogram, 6

Kinetic energy, 15

Knuckle joint, 455

- design procedure of, 459
- dimensions of various parts of, 456
- method of failure of, 457
- thread, 381

L

Lame's equation, 234

Laminated spring, 822

Lap joint, 286, 344

circumferential, 299

Lateral strain, 111

Law of conservation of energy, 15

— of motion, 9

Lead, 48, 379, 1104

— angle, 1104

Leaf spring, 822, 866

- construction of, 869
- equalised stress in, 870
- material for, 874

Length of crossed belt, 690

- chain and centre distance, 762
- path of contact, 1027
- open belt, 688
- leaf spring leaves, 872

Levers, 559

- application of, 559
- bell crank, 576

- cranked, 568
- design of, 559
- foot, 556
- hand, 565
- for lever safety valve, 572
- miscellaneous, 589

Lewis equation, 1037

Life of a bearing, 1005

Liquid lubricants, 970

Limit system, 63

- basis of, 66
- terms used in, 63

Limits of sizes, 63

Limitations of Euler's formula, 603

Linear strain, 111

Load, 87

— factor, 184

Location of screwed joints, 382

Lock nut, 385

Locking devices, 385

- with pin, 386
- with plate, 386

Long columns subjected to eccentric loading, 608

Longitudinal stress, 227

— butt joint for boiler, 296

Lonzenge joint, 313

Lower deviation, 64

Lubricants, 970

— properties of, 970

Lubrication of ball and roller bearings, 1018

#### M

Machine Design, classifications of, 2

- general considerations in, 2
- general procedure in, 4
- screws, 384
- shafts, 510

Magnalium, 45

Major diameter, 378

Malleable cast iron, 22

Manufacturing processes, 53

Manufacture of ball and roller bearings, 1018

- rivets, 283
- shafts, 510

Margin or marginal pitch, 288

Marine type flange coupling, 484

Mass, 8

- density, 11
- moment of inertia, 12

Material for belts, 679

- ball and roller bearings, 1018
- brake lining, 922
- friction surfaces, 886
- helical springs, 823
- leaf springs, 874
- rivets, 283
- shafts, 510
- sliding contact bearing, 968

Maximum fluctuation of energy, 780

- distortion energy method, 154
- efficiency of square threaded screws,
  635
- permissible working stresses for transmission shafts, 511
- principal stress theory, 152
- principal strain theory, 153
- shear stress theory, 153
- speed for chains, 770
- strain energy theory, 154
- tension in belt, 697





Mean deviation, 64

Mechanical properties of metals, 18

— working of metals, 58

Metre, 6

Metric thread, 381

Methods of riveting, 282

reducing stress concentration, 188
 Minimum number of teeth on the pinion to avoid interference, 1034

Minor diameter, 378

Mitre gears, 1081

Module, 1026

Modular ratio, 103

Modulus of elasticity, 89

- resilience, 115
- rigidity, 94

Moment of a force, 10

Monel metal, 49

Mottled cast iron, 22

Mounting height, 1083

Muff coupling, 480

Multiple disc clutch, 891

— threads, 632

# N

Nickel base alloys, 49 Nichrome, 50 Nimonic, 50 Nipple joint, 266

Nipping, 870

Nodular cast iron, 23

Nominal size, 63

Non-ferrous metals, 17, 44

— metallic materials, 50

Normal cone, 1083

— pitch, 1105

Normalising, 42

Notch sensitivity, 195

Normal pitch, 1105

Number of teeth on the smaller or driving sprocket or pinion, 769

Nut, design of, 405



Oil grooves, 987

Oldham coupling, 503

Open belt drive, 683

- length of, 688
- coiled helical spring, 821

Outside cone diameter, 1083

Oval flanged pipe joint, design of, 274

Overhauling screw, 640

Overhung crankshaft, 1170



Parallel sunk key, 471

Paper pulleys, 718

Path of contact, 1027

— length of, 1027

Pearlitic malleable cast iron, 23

Penn nut, 385

Percentage elongation, 99

— reduction in area, 99

Permanent fastening, 282

— mould casting, 54

Permissible working stress for gear teeth in

- Lewis equation, 1038
- speed of smaller sprocket, 767

Phosphor bronze, 47

Physical properties of metals, 17

Pipes, 261

design of, 265

— flanges for steam, 269

- hydraulic, 270

— joints, 266

— stress in, 262

Piston, 1132

— barrel, 1136

— design considerations for a, 1133

— head, 1134

— material for, 1133

- pin, 1138

— rings, 1135

- skirt, 1137

Piston rod, design of, 609

Pitch, 288, 379, 761

— angle, 1083

- circle, 1024

— cone, 1083

— diameter, 378, 1083

— point, 1025

— surface, 1025

— circle diameter, 1025

Pivot bearings, 988

Pivoted block or shoe brake, 926

Plain carbon steel, 26

Plastics, 50

Plate clutches, 888

Plummer block, 985

Poisson's ratio, 111

Polar moment of inertia of welds, 364

Positive clutches, 886

Potential energy, 14

Power, 13

- screws, 624

— transmitted by a belt, 692

— by chains, 768

— transmitting chains, 764

Preferred numbers, 83

Presentation of units, 6

Pressure angle, 1025

— vessels, 224

classifications of, 224

- recommended joints for, 301

Principal parts of an I.C. engine, 1126

- planes, 145

- stresses, 145

dimensions of tooth profile, 771

 for a member subjected to bi-axial stress, 146

— application of, 148

— determination of, 146

Procedure for designing a wire rope, 752

Process annealing, 43

Profile, 1027

Proof resilience, 115

Properties of sliding contact bearing materials,

— of wire ropes, 746

Proportional limit, 98

Proportions of bevel gears

helical gears, 1068

— for worms, 1106

— for worm gear, 1107

Protective type flange coupling, 486

Pulleys, flat belt, 716

Push rods, design of, 611

Q

Quarter turn belt drive, 684

R

Radial ball bearing, selection of, 1012

types of, 997

Radial brakes, 924

Rankine's theory, 152





- formula for columns, 606
- Ratio of driving tensions for flat belts, 693
  - fibre ropes, 740
  - V-belts, 730

Recommended joints for pressure vessels, 301

Rectangular sunk key, 471

Relation between endurance limit and ultimate tensile strength, 186

— pitch and pitch circle diameter, 761

Reliability of a bearing, 1010

Repeated stress, 182

Requirements of a good shaft coupling, 479

Resilience, 115

Reversed stresses, 181

Rigid coupling, 479

Ring nut, 385

Rivet, 282

- essential qualities of, 283
- heads for, 283
- materials of, 283
- manufacture of, 283

#### Riveted joints, 280

- eccentric loaded, 322
- efficiency of, 292
- failures of, 290
- for structural use, 313
- important terms used in, 288
- strength of, 292
- types of, 285

Rocker arm for exhaust valve, 584

Roller bearings, 997

— types of, 1001

Rolling contact bearing, 996

- basic dynamic load of, 1006
- dynamic equivalent load of, 1007
- basic static load rating of, 1003
- static equivalent load of, 1004
- types of, 997

#### Root angle, 1083

- circle, 1025
- diameter, 378

Rope drives, 739

Round keys, 470

Rubber, 50

Rules for S.I. units, 7

# S

Saddle keys, 473

Saint Venant theory, 153

Sand mould casting, 54

Sawn nut, 385

Screw thread, 378

- designation of, 386
- forms of, 379
- fastenings, 383
- important terms used in, 378
- standard dimensions of, 387
- jack, design of, 658

#### Screwed joints, 378

- advantages and disadvantages of, 378
- location of, 382

#### Second, 6

Section modulus of welds, 364

Selection of a belt drive, 678

- factor of safety, 101
- materials for engineering purposes, 17
- radial ball bearings, 1012

Self energizing brake, 926

Self locking brake, 926

— screws, 640

Semi-liquid lubricant, 970

Set screws, 384

Shafts, 509

- types of, 510
- material used for, 510
- design of, 511
- manufacturing of, 510
- stresses in, 511
- subjected to twisting moment only,511
- axial load in addition to combined torsion and bending loads, 544
- bending moment only, 514
- combined twisting moment and bending moment, 516
- fluctuating loads, 530

Shaft basis system, 66

Shaft coupling, 478

— types of, 479

Shafts in series and parallel, 125

Shear modulus, 94

Shear stress and strain, 93

— stresses in beams, 172

Sheave for fibre ropes, 740

S.I. units, 5

— rules for, 7

Side crankshaft, 1170

Silent chains, 765

Silicon bronze, 47

Simple band brake, 935

Single block or shoe brake, 924

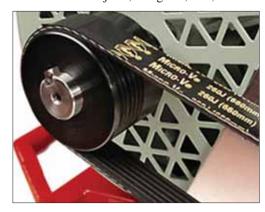
Single disc or plate clutch, 888

design of, 889

Size factor, 185

Sleeve coupling, 480

Sleeve and cotter joint, design of, 439, 440



Slenderness ratio, 603

Sliding contact bearings, 962

- types of, 964
- material used for, 968
- properties of, 967

Slip of belt, 686

Slush casting, 55

Socket joint, 266

- and spigot cotter joint, 432
- design of, 432

Soderberg's method for combination of stresses, 199

— application of, 216

Solid length,

- journal bearing, 984
- lubricants, 970

Sommerfeld number, 977

Special cases of fillet welded joint, 351

— purpose springs, 822

Spheroidal graphite cast iron, 23

Spheroidising, 43

Spigot and socket joint, 267

Splines, 474

Split bearing, 985

Spring lock washer,

- index, 825
- rate, 836
- steels, 40
- types of, 821

Springs in parallel, 856

— series, 856

Spur gears, 1021

- construction of, 1056
- design procedure of, 1044
- design of shaft for, 1058
- design of arms for, 1058

Square flanged pipe joint, design of, 276

- thread, 380, 625
- sunk key, 471

Squeeze film journal bearing, 967

lubrication, 965

Stainless steel, 36

Standard belt thicknesses and widths, 681

— pipe flanges for steam, 269

- pitch lengths of V-belts, 729
- proportions of gear systems, 1032
- size of spring wire, 824
- sizes of transmission shafts, 510
- automobile suspension spring, 873
- dimensions of screw threads, 387
- location of elements of a welding symbol, 347

Static equivalent load for rolling contact bearings, 1004

Static tooth load, 1042

#### Steel, 26

- alloy, 31
- composition, 28
- effect of impurities on, 30
- designation on the basis of chemical
- mechanical properties of, 26
- free cutting, 31
- heat resisting, 37
- stainless, 36
- pulleys, 717

Stepped pulley drive, 685

Straight worm, 1102

Straight face worm gear, 1102

#### Strain, 88

- energy, 14, 115
- volumetric, 112

Strength of a riveted joint, 292

- parallel fillet welded joint, 349
- transverse fillet welded joint, 349
- butt joints, 353
- bevel gears, 1086
- helical gears, 1079
- sunk key, 471
- worm gear teeth, 1109

#### Stress, 88

— strain diagram, 97

Stress concentration, 187

- factor, 187
- due to holes and notches, 187
- for various machine members, 190
- for welded joints, 353
- method of reducing, 188

Stresses in composite bars, 102

- compound cylindrical shells, 241
- due to external forces, 391
- due to change in temperature, 105



- due to combined forces, 394
- in thin cylindrical shell due to internal pressure, 225
- in helical springs of circular wire, 828
- in non-circular wire, 852
- in pipes, 262
- in power screws, 644
- in a flywheel rim, 788
- in flywheel arms, 801
- in screwed fastenings due to static loading, 389
- in shafts, 511
- for welded joint, 353
- in wire ropes, 749

Studs, 383

Sunk keys, 471

- forces acting on, 474
- strength of, 475

Supplementary weld symbols, 347

Surface finish factor, 184

- roughness, 82
- hardening, 44

Surge in springs, 833

System of gear teeth, 1032

— units, 5

#### Т

Tangent keys, 473

Tap bolt, 383

Tempering, 44

Temporary fastening, 282

Tensile stress and strain, 88 Tension helical spring, 821

— end connections for, 827

Thermit welding, 343

Terms used in bevel gears,

- chain drives, 761
- compression springs, 825
- gears, 1024
- helical gears, 1067
- hydrodynamic journal bearing, 973
- limit system, 63

Theories of failure under static load, 152 Thermal rating of worm gears, 1110

- stresses, 105

Thick cylindrical shells, 233

— film bearings, 965

Thin films bearings, 965

— spherical shells, 232

Through bolt, 383

Thrust bearing, 988

— ball bearing, 1001

Tin, 48

Tolerance, 63

— zone, 64

Tooth pressure angle, 1105

- space, 968
- thickness, 1001

Torque, 13

- required to raise load on square threaded screws, 632
- to lower load, 634

Torsion springs, 822

Torsional shear stress, 120

Total depth, 1026



Transition fit, 66

Transmission shafts, 510

- maximum permissible stresses for, 511
- standard sizes of, 510

Trapezoidal threads, 625, 642

Tredgolds' approximation, 1085

Tresca's theory, 153

Turn buckle, 462

design of, 463

Types of belts, 678

- belt drives, 678
- clutches, 885
- cotter joints, 432
- end conditions of columns, 601
- flat belt drive, 682
- friction clutches, 887
- keys, 471
- pulleys for flat belts, 716
- rivet heads, 283
- riveted joints, 283
- rolling contact bearings, 997
- screw threads for power screws, 625
- shafts, 510
- shaft coupling, 479
- sliding contact bearings, 964
- springs, 820
- V-belts and pulleys, 728
- welded joints, 344
- worms, 1102

Twist belt drive, 683



Ultimate stress, 98

Unified standard thread, 380

Unilateral system of tolerance, 63

Union joint, 266

Universal coupling, 504

Unprotective type flange coupling, 485

Upper deviation, 64



Valve gear mechanisms, 1189 Valves, 1190

V-belt drives, 730

- flat drives, 731

Velocity ratio of belt drive, 686

- of chain drives, 762
- of worm gears, 1105

Virtual coefficient of friction, 642 Volumetric strain, 112

Volute springs, 821

# W

Wahl's stress factor, 830

Wear tooth load, 1042

— for worm gear, 1109

Wedge film journal bearing, 966

— lubrication, 965

Weight, 8

Weld symbols

- basic, 345
- supplementary, 347
- standard location of, 347

Welded joints, 341

- advantages and disadvantages of, 342
- eccentrically loaded, 361
- stresses for, 353
- stress concentration factor for, 354
- types of, 344

Welding processes, 342

White cast iron, 21

Whiteheart malleable cast iron, 22

Wire ropes, 744

- advantages of, 744
- construction of, 744
- classification of, 745
- designation of, 745
- properties of, 746
- diameter of wire and area of, 747
- factor of safety for, 747
- fasteners, 749
- procedure for designing, 752
- sheaves and drums for, 747
- stresses in, 749



Work, 13

Working depth,

- stress, 101
- in belts, 680

Woodruff key, 472

Wooden pulleys, 717

Worms, proportions of, 1107

- types of, 1102

Worm gears, design of, 1112

- efficiency of, 1107
- forces acting on, 1111
- proportions of, 1107
- strength of, 1109
- terms used in, 1103
- thermal rating for, 1110
- types of, 1102
- wear tooth load for, 1109

Wrought iron, 25



Y-alloy, 45

Yield point, 98

Young's modulus, 89

7

Zero film bearing, 965

— line, 64

Zinc base alloys, 49