

CONTENTS.

SECTION I.

THE MECHANICAL POWERS.

WEIGHT, RESOLUTION OF FORCES, PRESSURES, LEVERS, PULLEYS, TACKLE.

The Resolution of Suspension—Lever Paradox—The Lever and Its Power—The Inclined Plane—The Wedge—The Screw—Worm Gear or Endless Screw—Chinese Wheel—Tackle Blocks—Chinese Windlass—Chinese Shaft Derrick—Compound Weight Motor—Rope Twist Lever—Spanish Windlass—Rope Grip Hook—Guy Rope Clip and Thimble—Rope End—Hemp Rope End... 17 to 28

SECTION II.

TRANSMISSION OF POWER.

ROPES, BELTS, FRICTION GEAR, SPUR, BEVEL, AND SCREW GEAR.

Alternating Circular Motion—Circular Motion—Eccentric Crank—Capstan, or Vertical Windlass—Steering Gear—Jumping Motion—Rope Sprocket Wheel—V-Grooved Rope Pulley—Rope Transmission—Vibratory Motion—Transmission by Rope—Transmission by Rope to a Portable Drill or Swing Saw—Horizontal Rope Transmission—Rope Transmission—Rope Transmission to a Movable Shaft—Vertical Tension Carriage—Belt Lacing—Novel Belt Lacing—Over-and-Over Lacing—Interlocking Belt Lacing—Cross Lacing—Sectional Belt Lacing—Quarter Twist Belt—Full Twist Belt—Full Twist or Cross Belt—Belting to a Shaft at any Angle—Quarter Twist Return Belt—Change Speed Step Pulleys—Cone Pulleys—Curved Cone Pulleys—Shifting Device for Cone Pulleys—Belt Transmission—Belt Transmission of Power—Variable Transmission of Motion—Stop, Driving, and Reversing Motion—Two Speed Pulleys and Belts—Pulleys, Combined with a Differential Gear—Transmission of Two Speeds—Two-Speed Gear—Variable Speed or Cone Gearing—Transmission of Power—Frictional Rectilinear Motion—Variable Rotary Motion—Variable Motion—Friction Gear—Transmission of Variable Speed—Variable Speed Gear—Transmission of Rotary Motion—Combination of Friction Gear—Grooved Friction Gearing—Variable Motion—Transmission of Circular Motion—Three Crank Link—Sprocket Wheel and Chain—Link Belt and Pulley—Toothed Link Chain and Pulley—Step Gear—V-Toothed Gearing—Oblique Tooth Gear—V-Toothed Gear—Split Spur Gear—Star Wheel Gear—Elastic Spur Gear—Internal Spur Gear and Pinion—Bevel Gears—Crown Wheel—Spiral Gearing—Oblique, Spur, and Bevel Gear—Oblique Bevel Gear—Gear Train—Worm Gear—Skew Worm and Wheel Gear—Uniform Intermittent Motion—Variable Speed Bevel Gear.

SECTION III.

MEASUREMENT OF POWER.

SPEED, PRESSURE, WEIGHT, NUMBERS, QUANTITIES, AND APPLIANCES.

Prony Brake—The Prony Brake Rule—"Webber" Dynamometer—Measurement of Power—"Tatham's" Dynamometer—Bell-Crank Dynamometer—"Neer's" Rotary Transmitting Dynamometer—"Van Winkle's" Power Meter—Traction Recording Dynamometer—Friction Machine—Torsion Dynamometer—Tensile Testing Machine—Bourdon Pressure Gauge—Corrugated Tube-Pressure Gauge—Recording Pressure Gauge—Parallel Motion of the Indicator—Parallel Motion for the Indicator—"Amsler" Planimeter—"Lippincott" Planimeter—Centrifugal Speed Indicator—Speed Indicator—Meter Dial—Automatic Tipping Scale—Double Link Balanced Scale—Differential Weighing Beam—Engine Counter—Operation of a Counter—Intermittent Rotary Motion—Tire Measure Counter, 47 to 56

SECTION IV.

STEAM POWER.

BOILERS AND ADJUNCTS, ENGINES, VALVES AND VALVE GEAR, PARALLEL MOTION GEAR, GOVERNORS AND ENGINE DEVICES, ROTARY ENGINES, OSCILLATING ENGINES.

"Stevens" Boiler—Plain Cylindrical Boilers—Hanging Water Drum Cylindrical Boiler—Cylindrical Double Flue Boiler—Internally Fired Flue Boiler—Horizontal Tubular Boiler—Locomotive Boiler—Marine Boiler—"Eclipse" Return Tubular Marine Boiler—"Galloway" Boiler—Internal Fired Cylindrical Tubular Boiler—"Dion" Vehicle Boiler—"Babcock and Wilcox" Water Tube Boiler—"Harrison" Boiler—Submerged Head Vertical Boiler—"Hérreshoff" Boiler—"Thornycroft" Boiler—"See" Water Tube Boiler—"Yarrow" Water Tube Boiler—"Boyer's" Water Tube Boiler—"Hazelton" Boiler—"Climax" Boiler—"Moyes" Water Tube Boiler—"Wheeler" Vertical Tube Boiler—"Cahall" Vertical Water Tube Boiler—Vertical Water Tube Boiler—Boiler of the "Serpellet" Tricycle—"Serpellet's" Steam Generator—"Serves" Boiler Tube—Shaking and Tipping Furnace Grate—Shaking Grate for a Boiler Furnace—Furnace Grate with Dumping Sections—"Columbia" Stoker—"Playford" Mechanical Stoker—"American" Boiler Stoker—Mechanical Stoker—"Jones" Model of a Mechanical Stoker—"Meissner" Model of a Mechanical Stoker for a Furnace—Feed Worm and Air Blast—Petroleum Burner—Pop Safety Valve—Differential Seat Safety Valve—Safety Valve—Original Form of the Æolipile or Hero's Steam Engine—Steeple Engine—Vertical Engine, with Bell-Crank Lever—Inclined Paddle-Wheel Engine—Diagonal Twin-Screw Engine—Twin-Screw Vertical Cylinder Engine—Trunk Engine—Oscillating Engine—Compound Oscillating Engine—Oscillating Hoisting Engine—Three-Cylinder Engine—Tandem Compound Vertical Engine—Compound Engines—Compound Yacht Engine—High-Speed Tandem Compound Engine—Modern High-Speed Engine—Single D Slide Valve—Balanced Slide Valve—Double-Ported Slide Valve—

"Meyer" Cut-off Valve—Single D Slide Valve—Gridiron Slide Valve—Rotary Valves—Steam Engine Valve Chest—Balanced Slide Valve—Balanced Slide Valve (Buchanan & Richter's Patent)—"Richardson-Allen" Balanced Slide Valve—Balanced Throttle Valve—Wing Throttle Valve—Multiple Port Piston Throttle Valve—"Corliss" Valve Gear—Locomotive Link-Motion Valve Gear—Walschaert's Valve Gear—Reversing Link Motion—Valve Gear—"Joy's" Valve Gear—"Bremme" Valve Gear—Single Eccentric Valve Gear—Cam-Bar Valve Movement—Valve Gear of a Cornish Engine—Variable Expansion Gear—Single Eccentric Variable Valve Throw—"Allen" Valve Lift or Toe—Tappet Lever Valve Motion—Starting Lever—Simple Unhooking Device—Simple Reversing Gear—"Joy's" Hydraulic Shifting Eccentric—Shifting Eccentric—Valve Motion Eccentric—"Peaucellier's" Parallel Motion—Parallel Motion—"Cartwright's" Parallel Motion—Cross-Head Slide—Rack Gear Parallel Motion—"Watt" Governor—Compensating Governor—Gravity Centrifugal Governor—Engine Governor—Centrifugal Ball Governor—Inverted Governor—Direct-Acting Centrifugal Governor—Spring Balanced Centrifugal Governor—Parabolic Governor—"Anderson's" Gyroscope Governor—Horizontal Centrifugal Governor—Vane or Wing Governor—Governor for a Steam Engine—Differential Governor—"Huntoon" Governor—"Proell" Governor—"Porter" Governor—"Richardson" Governor—Principle of the "Pickering" Governor—"Pickering" Governor—Pulley or Fly-Wheel Governor—Crank-Shaft Governor—Fly-Wheel or Pulley Governor—Slotted Cross-Head—Trammel Crank—Crank-Pin Lubricator—Centrifugal Crank-Pin Oiler—Centrifugal Lubricating Device—"Cochrane" Rotary Engine—"Franchot" Rotary Engine—Double Slide Piston Rotary Engine—"Lamb" Rotary Engine—"Cochrane" Rotary Engine—Rotary Engine—"Napier" Rotary Engine—Roller Piston Rotary Engine—"Cochrane" Rotary Engine—"Boardman" Rotary Engine—"Smith" Rotary Engine—"Berrenburg" Rotary Engine—"Fletcher's" Rotary Condensing Engine—"Bartrum and Powell" Rotary Engine—"Ritter" Rotary Engine—"Holly" Rotary Engine—"Stocker" Rotary Engine—"Forrester" Rotary Engine—"Kipp" Rotary Piston Engine—"Ruth's" Rotary Engine—"Almond" Engine—Rotating Cylinder Engine—Rotary Multicylinder Engine—"Bates" Compound Vibrating Engine—"Davies'" Disc Engine—"Reuleaux" Engine or Pump—"Link" Vibratory Engine—Oscillating Piston Engine—Vibrating Piston Engine—"Knickerbocker" Four Piston Rotary Engine—"Root's" Double Quadrant Engine—"Root's" Square Piston Engine—"Dake" Square Piston Engine—"Wilkinson's" Steam Turbine—"Dow" Steam Turbine—"De Laval" Steam Turbine—"Parsons'" Steam Turbine.

57 to 102

SECTION V.

STEAM APPLIANCES.

INJECTORS, STEAM PUMPS, CONDENSERS, SEPARATORS, TRAPS, AND VALVES

"Peerless" Injector—"Shaeffer and Budenberg" Injector—"National" Automatic Injector—"Metropolitan" Injector—"Lunkenheimer" Injector—"Eberman" Injector—"Nathan" Injector—"Little Giant" Injector—"Penberthy" Special Injector—"Park" Injector—"Sellers'" Restarting Injector

—“Little Giant” Locomotive Injector—“Metropolitan” Double-Tube Injector—“Brownley” Injector—“Leader” Injector—“Excelsior” Injector—“Korting” Injector—“Hancock” Inspirator—Ball-Valve Injector—“Hancock” Locomotive Inspirator—“Standard” Injector—“Sellers” Self-Adjusting Injector—Steam Pump—“Misch’s” Valve Tappet—Independent Jet Condenser Pump—Ejector Condenser—Exhaust Jet Condenser—Balanced Reducing Valve—Pressure Reducing Valve—“Foster” Pressure Reducing Valve—“Hotchkiss” Boiler Cleaner—Feed-Water Heater—Steam Separator—Filter for Boiler—Return Steam Trap—Spring Steam Trap—Steam Trap—“Bundy” Steam Trap—Steam Trap with Valve—“Heintz” Steam Trap—“Moran’s” Flexible Steam Joint—Corrugated Expansion Coupling—Flanged Expansion Joint—Automatic Relief Valve—Horizontal Swing Check Valve—Globe Valve—Exhaust Steam Head—Centrifugal Exhaust Head..... 103 to 116

SECTION VI.

MOTIVE POWER.

GAS AND GASOLINE ENGINES, VALVE GEAR AND APPLIANCES, CONNECTING RODS AND HEADS.

Gasoline Engine—Sectional Plan of a Gasoline Engine—Simple Gas or Gasoline Engine—Gasoline Engine Valve Gear—“Union” Model Gas Engine—Gasoline Carriage Motor—Vertical Gasoline Engine—Vertical Kerosene Oil Engine—“Diesel” Motor—Vertical Gas Engine—Street Railway Gas Motor Passenger Car—Gasoline Motor Car—Valve Gear—Double-Grooved Eccentric Valve Gear for a Four-cycle Gas Engine—Plumb-Bob Governor—Inertia Governor—Pendulum Governor—Differential Cam Throw—Governor and Variable Cam—Inlet Valve—Gas Engine Valve Gear—Gasoline Vaporizer—Carburetter—Automatic Oiler—Uniform Automatic Oiler—Crank-Rod Head Adjustment—Trunk Piston Rod—Connecting Rod Head—Connecting Rod End—Solid Strap End—Steel Ball Adjustment—Solid End Connecting Rod—Forked End Connecting Rod—Adjustable Link—Link or Connecting Rod..... 117 to 130

SECTION VII.

HYDRAULIC POWER AND DEVICES.

WATER WHEELS, TURBINES, GOVERNORS, IMPACT WHEELS, PUMPS, ROTARY PUMPS, SIPHONS, WATER LIFTS, EJECTORS, WATER RAMS, METERS, INDICATORS, PRESSURE REGULATORS, VALVES, PIPE JOINTS, FILTERS.

Overshot Water Wheel—Iron Overshot Wheel—Undershot Water Wheel—Saw-Mill Water Wheel—Breast Water Wheel—Flutter Wheel—Barker Wheel—Current Motor—Current Water Wheel—Fixed Bucket Water-Raising Current Wheel—Bucketed Water-Raising Current Wheel—Current Wheel Water Lift—Drainage Wheel—Persian Wheel—Ancient Water Lift—“Archimedian” Screw Water Lift—Volute Turbine—High-Pressure Turbine—“Leffel” Double-Runner Turbine—“Jonval” Turbine—Turbine and Gate—“Lancaster” Turbine—“Munson” Double Turbine—“Camden” Turbine—“Model” Turbine

—“Swain” Turbine—“Wairen” Central Discharge Turbine—“Fourneron” Turbine—Belt Water-Wheel Governor—Water Wheel Governor—Impact Water Wheel—Pelton Water Wheel—Buckets of a Pelton Water Wheel—Power of Water—Compound Beam Pumping Engine—“Dean” Steam Pump—Worthington Duplex Pump—Half-Yoke Connection—Yoke Connection—Reversing Movement—Double-Acting Lift and Force Pump—Double-Acting Differential Pump—Lift and Force Pump—Tramp Pumping Device—Lift Pump—Double Lantern Bellows Pump or Blower—Diaphragm Pump—“Fairburn” Bailing Scoop—Pendulum Water Lift—Chain Pump—Reciprocating Motion—Well Pulley and Buckets—Swape, or New Engine Sweep—Parallel Motion—“Golding” Centrifugal Pump—“Quimby” Screw Pump—Rotary Pump—“Pappenheim” Rotary Pump—“Repsold” Rotary Pump—Tri-Axial Rotary Pump—Rotary Pump or Motor—“Cary” Rotary Pump—Vacuum Jet Condenser and Rotary Pump—“Ramelli” Rotary Pump—“Heppel” Rotary Pump—“Emeru” Rotary Pump—“Knott” Rotary Pump—“Pattison” Rotary Pump—“Cochrane” Rotary Pump—Hydraulic Transmission of Power—Siphon—Ejector or Jet Pump—Automatic Water Ejector—Automatic Sprinkler—Hydraulic Ram—“Pearsall’s” Hydraulic Ram and Air Compressor—Silent Hydraulic Ram—Double-Piston Reaction Hydraulic Ram—Water Meter—Disc Water Meter—Water Velocity Indicator and Register—Anchored Ferry Boat—“Mueller” Water-Pressure Regulator—“Mason” Water-Pressure Regulator—Pump Water-Pressure Regulating Valve—Hydraulic Press—Hydrostatic Press—Hydraulic Intensifier—Portable Hydraulic Riveter—Hydraulic Rail Bender—Hydraulic Rail Punch—Hydraulic Elevator Lift—Horizontal Hydraulic Elevator Lift—Hydraulic Pulling Jack—Water Purifying Filter—Reversible Filter—Filtering Cistern—Upward Flow Filter—Domestic Filter—Porous Water Filter—Stoneware Filter—“Ward” Flexible Pipe Joint—Flexible Ball Joint—Flexible Pipe Joints—Universal Pipe Joint—Toggle Clip Pipe Joint—Bibb—Disc Valve and Guard—Double-Beat Disc Valve—Hydraulic Valve—Multiple Ball Valve—Multiple Ring Valve—Double-Beat Pump Valve—Vibrating Motion—Variable Compensating Weights—Sand Auger—Driven Well—Automatic Flush Sewer Tank—Atomizer—Ball and Jet Nozzle—Spray Jet Nozzle—Hero’s Fountain—“Chapman” Aspirator or Vacuum Pump—Hydraulic Lift..... 131 to 164

SECTION VIII.

AIR POWER APPLIANCES.

WINDMILLS, BELLOWS, BLOWERS, AIR COMPRESSORS, COMPRESSED AIR TOOLS, MOTORS, AIR WATER LIFTS, BLOWPIPES.

Aneroid Barometer, Box Kite—Curved Vane Windmill or Motor—Feathering Windmill—Hemispherical Cup Windmill—Windmill of our Grandfathers—Windmill and Steel Tower—Modern Windmill—Ancient Windmill—Electric Windmill Plant—Smith’s Circular Bellows—Double Organ-Blowing Bellows—Three-Throw Bellows—Foot Bellows—Fan Blower—“Hodges” Compound Blower—“Wedding” Rotary Blower—“Fabry” Rotary Blower—“Root” Rotary Blower—Hydraulic Air Compressor—Piston Hydraulic Air Compressor—Tromp or Hydraulic Air Blast—Air Compressor—Hydraulic Air Compressor

—Automatic Air Compressor—Water-Jet Air Compressor—Trunk Air Compressor—Duplex Steam-Actuated Air Compressor—Compound Air Compressor—Duplex Air Compressor—Togg^l. Joint Duplex Air Compressor—Air Compressor Cylinder—Piston and Valves—Air-Compressing Cylinder—Air Compressor Governor—Air-Cooling Receiver—Single Valve Air Pump—Crank Equalizing Angle—Crank Equalizing Angle in Air Compression—Direct Air Pressure Pump—Compressed Air Water Elevator—Raising Sunken Vessels—Compressed Air Lift System—Compressed Air Power—Compound Pneumatic Locomotive—Pneumatic Paint Sprayer—Portable Fire Extinguisher—Fire Extinguisher—Compressed Air Lift—Duplex Pneumatic Riveter—Pneumatic Hammer—“Hotchkiss” Atmospheric Hammer—“Grimshaw” Compressed Air Hammer—Compressed Air Sheepshearing Machine—Portable Riveter—Pneumatic Portable Riveter—Pneumatic Breast Drill—Pneumatic Motor Drill Stock—Air and Gasoline Torch—Torch Soldering Copper—Air and Gasoline Vapor Brazer—Air and Gasoline Brazing Apparatus—Double Cone Ventilator—Spiral Vane or Cowl—Wind Instruments. 165 to 188

SECTION IX.

ELECTRIC POWER AND CONSTRUCTION.

GENERATORS, MOTORS, WIRING, CONTROLLING AND MEASURING, LIGHTING, ELECTRIC FURNACES, FANS, SEARCHLIGHT, AND ELECTRIC APPLIANCES.

Series Wound Motor or Generator—Electric Generator Construction—Single-Pole Shunt Generator—Four-Pole Ring Armature—Ring Armature—Two-Pole or Shuttle Spool Armature—Shuttle Armature—Multiple Brush Commutator—Bipolar Shunt Generator—Four-Pole Compound Generator—Electric Generator Construction—Consequent-Pole Compound Generator—Triple-Expansion Engine and Multipolar Dynamo—Direct-Connected Vertical Compound Engine—Flexible Coupling—Car Truck Motors—Electric Fusible Cut-Out—Rheostat or Resistance Coils—Trolley Car—Sectional Feeder System—Street Railway Single Motor—Electric Car Brake—Electric Street-Car Brake—Electric Igniter—Sparking Dynamo—Magneto-Electric Machine—Electric Thermostat—Telephone Transmitter—Telephone Receiver—Electric Gas Lighter—Pocket Electric Light—Arc Light and Regulating Gear—Luminous Fountain—Electric Heater—Electric Soldering Copper—Electric Sad Iron—Electric Searchlight—Electric Furnace—Open-top Electric Furnace—“Siemens” Electric Gas Furnace—“Cowles” Electric Furnace—Electric Welding Plant—Portable Electric Motor Drill Plant—Electric Perforating Pen—Electric Hoist—Electric Brake—Electric Rock Drill—Electric Fan—Electric-Driven Fan. 189 to 204

SECTION X.

NAVIGATION AND ROADS.

VESSELS, SAILS, ROPE KNOTS, PADDLE WHEELS, PROPELLERS, ROAD SCRAPERS AND ROLLERS, VEHICLES, MOTOR CARRIAGES, TRICYCLES, BICYCLES, AND MOTOR ADJUNCTS.

Leg-of-Mutton Sail—Skip Jack—Square or Lug Sail—Lateen Rig—Split Lug or Square Sail—Two-Masted or Dipping Lug—Newport Cat-Boat—Sloop—

Lateen-Rigged Felucca—Pirogue—Three-Quarter Lug Rig—"Sliding Gunter"
 —Skiff Yawl Rig—Sloop Yawl—Jib Topsail Sloop—The Cutter—Schooner
 Rig—Full Schooner Rig—Topsail Schooner—Club Topsail Rig—Hermaphro-
 dite Brig—A Brigantine—A Barkentine—Full-Rigged Brig—A Bark—Full-
 Rigged Ship—Ice Boat—Rope Knots and Hitches—Clove Hitch—Half Hitch
 —Timber Hitch—Square or Reef Knot—Stevedore Knot—Slip Knot—Flem-
 ing Loop—Bowline Knot—Carrick Bend—Sheet Bend and Toggle—Sheet
 Bend—Overhand Knot—Figure Eight Knot—Double Knot—Blackwall Tackle
 Hitch—Fisherman's Bend Hitch—Round Turn and Half Hitch—Chain Stop
 —Disengaging Hook—Slip Hook—Releasing Hook—Boat-Detaching Hook—
 Swinging Oar-lock—Pivoted Steps—Screw Anchor—Floating Lighthouse—
 Stone Dry-Dock—Floating Dry-Dock—Feathering Paddle Wheel or Water
 Motor—Vertical Bucket Paddle Wheel—Feathering Paddle Wheel—Outward
 Thrust Propeller Wheel—Screw Propeller—Reversing Propeller—Reversing
 Screw Propeller—Screw Propulsion—Thrust Bearing—"Silver's" Marine Gov-
 ernor—Deep-Sea Sounding Ball—Sounding Weight Release—Sampler Sounding
 Weight—Submarine Lamp—Road Builders' Level—Road Machine—Reversible
 Road Roller—Road Roller—Single Eccentric Reversing Gear—Elastic Wheel
 —Spring Wheel—Application of Trace Springs—"Serpollet's" Steam Tricycle
 —Steam Fire Engine—Jacketless Gasoline Carriage Motor—Gasoline Motor
 Carriage—Light Electric Carriage—Electric Phaeton—Electric Brougham—
 Differential Gear—Baby-Carrier Tricycle—Electric Tricycle—Ice Bicycle—
 Bicycle Gear—Bicycle Crank—Swinging Ball-Bearing Bicycle Pedal—A. F.
 Haven's Planetary Crank Gear—Detachable Link Chain—Ball-Bearing Problem
 —Acetylene Bicycle Lamp—Bicycle Lamp. 205 to 228

SECTION XI.

GEARING.

RACKS AND PINIONS; SPIRAL, ELLIPTICAL AND WORM GEAR; DIFFERENTIAL
 AND STOP-MOTION GEAR; EPICYCLICAL AND PLANETARY TRAINS; "FER-
 GUSON'S" PARADOX.

Ordinary Rack and Pinion—Doubling the Length of a Crank Stroke—Sawmill
 Feed—Rack Motion—Air-Pump Movement—Circular Rack—Rectilinear
 Vibrating Motion—Vertical Drop Hammer—Sector Pinion and Double Rack
 —Reciprocating Motions—Crank Substitute—Alternate Circular Motion—
 Quick Back Motion—Alternate Rectilinear Motion—Reciprocating Rectilinear
 Motion—Mangle Rack—Mangle Wheel—Mangle Wheel Gear—Continuous
 Rotary Motion—Mangle Machine Gear—Worm Screw Rack—Rotary Motion
 —Adjustable Feed Rolls—Saw-Tooth Worm Gear—Right- and Left-Hand
 Worm Gear—Three-Part Worm Screw—Traversing Motion—Globoid Spiral
 Gear Wheels—Internal Worm-Gear Wheel—Worm-Gear Pinion—Anti-Fric-
 tion Worm Gear—Release Rotary Motion—Release Cam—Hunting Tooth
 Worm Gear—Differential Screw and Gear Movement—Complex Alternating
 Reciprocal Motion—Two-Toothed Pinion—Pin Wheel and Slotted Pinion—
 Variable Rotary Motion—Scroll Gear—Spiral Hoop Gear—Accelerated Cir-
 cular Motion—Roller-Bearing Gear Teeth—Ball Gear—Spiral Gearing—Ex-

panding Pulley—Concentric Differential Speed—Differential Motions—Differential Gear—Doubling the Number of Revolutions on One Shaft—Multiple Gear Speed—Variable Throw Traversing Bar—Revolution of a Pinion—Differential Speed—Capstan Gear—Slow Forward and Quick Back Circular Motion—Geared Grip Tongs—Variable Circular Motion—Elliptical Spur Gear—Elliptical Gear Wheel—Irregular Circular Motion—Variable Reciprocating Motion—Alternating Rectilinear Motion—Intermittent Motion of Spur Gear—Spiral Stop-Motion Gear—Fast and Slow Motion Spur Gear—Intermittent Gears—Intermittent Rotary Motion—Irregular Vibratory Motion—Variable Vibrating Motion—Motion by Rolling Contact—Variable Sectional Motion—Uniform Speed of Sectional Spur Gear—Scroll Gearing—Intermittent Rotary Motion—Stop Roller Motion—Change Gear Motion—Differential Driving Gear—Equalizing Pulley—Equalizing Gear—Doubling a Revolution on Same Shaft—Continuous Shaft Motion—Alternating Motion—Eccentric Wheel Train—Epicyclic Gear—Epicyclic Train—Automatic Clutch Motion for Reversing—Eccentric Gear—Sun and Planet Crank Motion—High-Speed Epicyclic Train—Sun and Planet Winding Gear—Epicyclic Gear Train—Compound Epicyclic Train—Planetary Motion—Planetary Gear Train—"Ferguson's" Mechanical Paradox. 229 to 252

SECTION XII.

MOTION AND DEVICES CONTROLLING MOTION.

RATCHETS AND PAWLS, CAMS, CRANKS, INTERMITTENT AND STOP MOTIONS, WIPERS, VOLUTE CAMS, VARIABLE CRANKS, UNIVERSAL SHAFT COUPLINGS, GYROSCOPE.

Ratchet Bar Lift—Ratchet Lift—Ratchet Governor—Rotary Motion—Intermittent Circular Motion—Intermittent Rotary Motion—Double Pawl Ratchet—Continuous Feed of a Ratchet—Double-Pawl Ratchet Wheel—Intermittent Rotary Motion—Intermittent Circular Motion—Ratchet Intermittent Motion—Pawl Lift—Oscillating Motion—Continuous Rotary Motion—Intermittent Motion—Windlass Grip Pawl—Ratchet and Level Pawl—Internal Multiple Cam—Ratchet Head—Reciprocal Circular Motion—Ball Socket Ratchet—Continuous Motion Ratchet—Stops of Various Forms—Stops for a Spur Gear—Stops for a Lantern Wheel—Safety Centrifugal Hooks—Crank Motion—Centrifugal Safety Catch for Hoisting Drums—Stop Motion—Variable Reciprocating Motion—Irregular Rocking Motion—Rocking Arm—Yoke Strap—Triangular Curved Eccentric—Triangular Eccentric—Reciprocating Motion—Uniform Reciprocating Motion—Needle-Bar Slot Cam—Slotted Yoke—Crank Motion—Trammel Gear—Slotted Lever Motion—Intermittent Reciprocating Motion—Variable Crank Throw—Variable Adjustment—Four-Bolt Cam—Equalizing Tension Spring and Lever—Alternating Rectilinear Motion—Traverse Bar—Rectilinear Motion—Intermittent Rotary Motion—Vibrating Toothed Wheel—"Lazy Tongs" Movement—Quadrangular Rectilinear Motion—Parallel Motion—Intermittent Motion—Rocking Escapement—Rotary and Longitudinal Motion—Reciprocating Feed Ratchet—Friction Rod Feed Ratchet—Friction Hauling Ratchet—Cam-Lever Grip—Lever Toggle Joint—Single Toggle Arm Letter-Press—Toggle-Joint Cam Movement—Double-Screw

Toggle Press—Screw Stamping Press—Multiple Return Grooved Cylinder—Reciprocating Rectilinear Motion—Rectilinear Motion—Six Radial Grooved Trammel—Rectilinear Reciprocating Motion—Rocking Motion—Pair of Toe Levers—Wiper Cam for Stamp Mills—Angular Wipers—Equalizing Levers or Toes—Variable Crank Motion—Spiral-Grooved Face Plate—Lever—Cam Sectors—Gear-Disengaging Cam Lever—Oblique Disc Motion—Grooved Cylinder Cam—Traverse Motion—Four-Motion Feed, of Wheeler and Wilson and other Sewing-machines—Reciprocating Rectilinear Motion—Quick Reciprocating Rectilinear Motion—Cylindrical Cam—Cam-Operated Shears—Irregular Cam Motion—Vibrating Rectilinear Motion—Irregular Vibrating Circular Motion—Clover-Leaf Cam—Power Escapement—Rotary Motion—Irregular Reciprocating Motion—Bevelled Disc Cam—Grooved Heart Cam—Heart-Shaped Groove—Laying out a Heart Cam—Cam Motion—Double Cam Motion—Pivoted Follower—Reciprocating Motion—Ovoid Curve—Variable Power Transmitted from a Crank—Elliptical Crank—Curvilinear Motion—Spring Lathe-Wheel Crank—"Brownell" Crank Motion—Ordinary Crank Motion—Eccentric and Straps for Valve Motion—Reciprocating Motion—Variable Circular Motion—Irregular Motion—Variable Power Vibrating Movement—Variable Crank Pin—Variable Rectilinear Motion—Variable Crank Throw—Variable Radius Lever—Combination Crank-Motion Curves—Flexible Angular Coupling—Sliding Contact—Shaft Coupling—Rectilinear Motion—Angular Shaft Coupling—Universal Joint—Double Link Universal Joint—Universal Angle Coupling—"Almond" Angular Shaft Coupling—"Hooke's" Angular Shaft Coupling—Rack and Pinion Movement—Gyroscope—Globe Gyroscope—Tension Helico-Volute Spring—Double Helico-Volute Spring—Compression Helical Spring—Single Volute Helix Spring—Compound Disc Spring.....253 to 282

SECTION XIII.

HOROLOGICAL.

CLOCK AND WATCH MOVEMENTS AND DEVICES.

Cycloidal Pendulum Movement—Compensating Pendulum Bob—Compound Compensating Pendulum—Centrifugal Pendulum—Antique Clock Escapement—Crown Tooth Escapement—Double Ratchet-Wheel Escapement—Star-Wheel Escapement—Anchor Escapement—Recoil Escapement—Pendulum Escapement—Stud Escapement—Lantern-Wheel Escapement—Pin-Wheel Escapement—Hook-Tooth Escapement—Single-Pin Pendulum Escapement—Three-Toothed Escapement—Detached Pendulum Escapement—Mudge Gravity Escapement—Tri-Toothed Pendulum Escapement—"Harrison" Winding Device—Double Tri-Toothed Pendulum Escapement—"Bloxam's" Gravity Escapement—Dead-Beat Clock Escapement—Endless Cord-Winding Device for Clocks—Clock Train—Compensation Watch Balance—Watch Regulator—Antique Watch Escapement—Verge Escapement—Cylinder Escapement—Duplex Escapement—Jewelled Detached Lever Escapement—"Guernsey" Escapement—Anchor and Lever Escapement—Lever Escapement—Lever Chronometer Escapement—"Arnold" Chronometer Escapement—Fusee

Chain and Spring Drum—Chronometer Escapement—"Geneva" Stop—Geared Watch Stop—Watch Stop—Stem-Winding Movement—Pin-Geared Watch Stop—Watch Train.....283 to 296

SECTION XIV.

MINING.

QUARRYING, VENTILATION, HOISTING, CONVEYING, PULVERIZING, SEPARATING, ROASTING, EXCAVATING, AND DREDGING.

Diamond Prospecting Drill—Rock Drill—Diamond Well-Boring Machine—Portable Diamond Drill—Arc Tappet Valve Motion—Tappet Valve, for a Rock Drill—Rock Drill—Rock Drill with Balanced Piston Valve—Coal-Cutting Machine—Link Chain Cutter—Drill for Curved Holes—Box-Wing Blower—Multiplex Butterfly Valve—Steam-Driven Ventilating Fan—Miner's Safety Lamp—Horse-Power Hoisting Drum—Steam Hoisting Engine—Strap Brake—Elevator Tower—Horizontal Boom Tower—Mast and Gaff Hoist—Coal-Loading Tiptle—"Otis Stop" for Elevator Cars—Elevator Dumping Head—Mining Buckets and Skip—Belt Conveyer—Chain Scraper Conveyer—Cable Conveyer—Driving Mechanism—Log Conveyer—Rope Tramway—Automatic Dumping Car—Toggle Joint—Stone Crusher—"Buchanan" Rock Crusher—Roller Coal Crusher—Eight-Stamp Ore Mill—Rolling Crusher—"Arastra" Ore Mill—"Chili" Mill—Pulverizing Ball and Pan Mill—Revolving Pulverizing Mill—Hydraulic Balanced Giant Nozzle—Coal Dust Press—Klondike Mining Machine—Gold Separator—Centrifugal Separator—Magnetic Ore Separator—Iron Ore Separator—Railway Steam Shovel—Magnetic Ore Separators (Hoffman-Edison Types)—Ore Roasting Furnace—Railway Excavator—Railway Steam Shovel—Continuous Ditching Dredge—Clam-Shell Bucket—Revolving Hoisting Dredge—Floating Dredge—Marine Dredge.....297 to 312

SECTION XV.

MILL AND FACTORY APPLIANCES.

HANGERS, SHAFT BEARINGS, BALL BEARINGS, STEPS, COUPLINGS, UNIVERSAL AND FLEXIBLE COUPLINGS, CLUTCHES, SPEED GEAR, SHOP TOOLS, SCREW THREADS, HOISTS, MACHINES, TEXTILE APPLIANCES.

Adjustable Bracket Hanger—Adjustable Floor Bearing—Adjustable Post Hanger—Adjustable Floor Stand—Continuous Traversing Roller—Roller Wheel Anti-Friction Bearing—Ball Bearings—Adjustable Hanger for Shafting—Screw Traversing Ball Bearing—Hanging Shaft—Suspended Shaft—Curved Step Bearing—Conical Pivot Bearing—Lubrication of a Hanging Bearing—Vertical Shaft Step—Shaft Step Adjustment—Adjustable Step Bearing—Collar Bearing and Step—Oil Circulating Step—Lenticular Bearing—Spherical Step Bearing—Angle Coupling—"Oldham" Coupling—Flexible Link Coupling—Flexible Shaft Coupling—Angle Shaft Coupling—Universal Joint—"Hooke's" Universal Joint—"Goubet's" Universal Shaft Coupling—Ball Socket Universal Joints—Right-Angle Shaft Coupling—Right-Angle Shaft Coupling ("Hobson"

Patent)—Eccentric Line Coupling—Simple Friction Pulley—Friction Clutch—V-Grooved Face Clutch—Clutch and Gear—Cone Clutch—Multiple Plate Friction Clutch—Pin Clutch—Friction Pin Clutch—Friction Clutch Bevel Gear—Spring Friction Clutch—Double Toggle-Joint Friction Clutch—Adjustable Friction Clutch—Double Conic Rope Drum—Variable Speed Device—Expanding Pulley—Variable Speed Transmitting Device—Belt Holder—Jointed Radial Arm—Drilling Machine Clamp—Screw Bench Clamp—Automatic Bench Clamp—Wood-Bending Clamp and Formers—Boiler Tube Expander—Roller Tube Expander—Revolving Tool Head—Collapsing Tap—Wabble Saw—Automatic Screw-Cutting Die—Universal Chuck—Compound Lever Shears—Disc Shears—Gig Saw—Band Saw—Toggle-Joint Lever Press or Punch—Power Stamping Press—Hand Drilling Machine—Portable Drill—Multiple Drilling Machine—Stamp Mill Cam Motion—Blacksmith's Helper—Revolving Rapid-Blow Hammer—Helve Trip Hammer—Friction Drop Hammer—Beam Trip Hammer—Spring Hammer—Tire Shrinker—Combined Tire Upsetting and Punching Machine—Plate Sawing Machine—Combined Punch and Shears—Suspended Swing Treadle—Power Rumbling Mill—Centrifugal Separator—Closure of Rollers—Vibrating Lift—Differential Pitch Movement—Feed Wheel—Combined Ratchet and Hand-Feed Gear—Gear Train—Quick Return Movement—Reversing Gear—Flexible Universal Steam Joint—Bye Pass Cock or Valve—Sight-Feed Lubricator—Screw Movement—Centering Tool—Vernier Caliper—Expansion Bit—Double-Acting Screwdriver—Pump Drill Stock—Reciprocating Drill Stock—Compound Lever Cutting Pliers—Ball Socket—Screw Threads—Continual Barrel Elevator—Telescopic Hydraulic Elevator—Traveller Hoist—Travelling Crane—I-Bar Travelling Tramway—Swing Bracket Crane—Adjustable Universal Sheave—"Harrington" Chain Hoist—"Yale" Duplex Hoist—Safety Tackle—Differential Chain-Pulley Block—Double Screw-Gear Hoist—Taper Tube Rolls—"Yale-Weston" Differential Gear Hoist—Tube-Rolling Machine—Seamless Tube Making—Wire-Bending Machine—Hopper and Bell—"Bessemer" Steel Converter—Lense-Grinding Machine—Grinding Mill—"Bogardus" Mill—Circulating Screw Propeller and Mixing Tank—Double Cylinder Planer—Double Toggle-Joint Screw Press—Steam Cotton Press—Toggle-Bar Press—Sector Press—Bark or Cob Mill—Drawing and Throstle Twisting, Rolls and Bobbin Winder—Cop Winder—Bobbin Winder—Cloth Dresser—Knitting Machine.....313 to 348

SECTION XVI.

CONSTRUCTION AND DEVICES.

MIXING, TESTING, STUMP AND PILE PULLING, TACKLE HOOKS, PILE DRIVING, DUMPING CARS, STONE GRIPS, DERRICKS, CONVEYER, TIMBER SPLICING, ROOF AND BRIDGE TRUSSES, SUSPENSION BRIDGES.

Post Augur—Pug Mill—Conical Pug Mill—Conical Mixing Barrel—Concrete Mixer—Cement-Testing Machine—Hydraulic Sand Ejector—Toggle Stump Puller—Right and Left Hand Turnbuckle—Swivel Shackle Slip Hook—Trip Hook—Balanced Riveting Machine—Releasing Grip—Automatic Disengaging Grip—Swivelling Dumping Car—Square Box Side-Dumping Car—Lever Grip

Tongs—Adjustable Grip Tongs—Pneumatic Dumping Car—Lewis Wedge for Lifting Stone—Stone Grinding and Polishing Machine—Four-Guy Mast Derrick—Shears with Winch or Tackle Block—Swinging Derrick Crane—Portable Steam Derrick—Swing-Boom Crane—Cable Hoist and Conveyer—Cantilever Hoisting and Conveying Machine—Timber Splicing—Timber Cords and Arches—Truss Roof—Queen Post Roof Truss—Wooden Road Bridge Truss—Deck Bridge Trusses—Bridge Truss—Arched Deck Truss Bridge—Bridge Trusses—Arch Truss Bridge—Swing Bridge—Cantilever Bridge—Suspension Bridges.....349 to 362

SECTION XVII.

DRAUGHTING DEVICES.

PARALLEL RULES, CURVE DELINEATORS, TRAMMELS, ELLIPSOGRAPHS, PANTOGRAPHS.

Proportional Compasses—Roller Parallel Ruler—Slotted Parallel Ruler—Three Part Parallel Ruler—Spring Cyclograph—Flexible Curve Scriber—Helicograph—Great Curve Delineator—Conchoid Delineator—Cyclograph—Trammel for Drawing Ellipses—Ellipsograph—Parabola Scriber—Geared Ellipsograph—Hyperbola Scriber—Pantograph—Lazy-Tongs Pantograph—Perspective Centrolinead—Spherometer.....363 to 370

SECTION XVIII.

MISCELLANEOUS DEVICES.

ANIMAL POWER, SHEEP SHEARS, MOVEMENTS AND DEVICES, ELEVATORS, CRANES, SEWING, TYPEWRITING, AND PRINTING MACHINES, RAILWAY DEVICES, TRUCKS, BRAKES, TURNTABLES, LOCOMOTIVES, GAS, GAS FURNACES, ACETYLENE GENERATORS, GASOLINE MANTLE LAMP, FIREARMS.

Human Treadmill—Horse-Power Tread Wheel—Horse-Power Machine—Dog-Power Machine—Geared Horse-Power—Multiple Bladed Sheep Shears—Horse Clipper—Machine Sheep Shears—"Almond's" Flexible Metallic Tube—Evolution of a Wood Screw—Artificial Leg and Foot—Mean Time Sun Dial—Door Push Check—Folding Ladder Simple Combination Lock—Tripod—Double Spherical Socket—Disc Slicer—Micrometer Screw Adjustment—Correct Principle in Setting a Hot-Water House Boiler—Under-Feed Heating Furnace—Harvester or Mowing Machine—Bell Clapper Movement—Piano Key and Action—Lapidary or Lithological Lathe—Wire-Drawing Machine—Wire-Covering Machine—Stirring Machine for Grain Mash—Sector Wheel Baling Press—Wood Compression Carving Machine—Belt-Driven Elevator—Safety Catch for Elevators—Elevator Safety Gear—Swing Derrick—Package Elevator—Post Crane—Wharf Crane—Automatic Balance Crane—Sewing-Machine Shuttle—Sewing-Machine Feed Bar—Sewing-Machine Hook and Bobbin—Hook of the "Wheeler and Wilson" Sewing-Machine—Sewing-Machine—Spring Motor for Sewing-Machine—Tinplate Lacquering Machine—Single Cylinder Printing Press—Typewriting Machine—"Gordon" Printing Press—Rack and Pawl—

Ball-Bearing Screw Jack—Hydraulic Transfer Jack—Rail-Cutting Saw—Prouty-Noble Automatic or Self-Winding Brake—Street-Car Sand Box—Friction Brake for Street Railway Cars—Car Truck for Street Railways—Street-Car Truck—Car Truck—Trolley-Car Truck—Freight-Car Truck—Cable Railway Grip—Cable Grip for Street Railways—Linked Hinges—Endless Cable Grip Car—Street Railway Sweeping Car—Equalizing Lever—Novel Car Brake—Wooden Frame Turn-Table—Iron Frame Turn-Table—Single-Cylinder Locomotive—Modern Locomotive and Tender—Passenger Locomotive, Eight-Wheel Model—Ten-Wheel Freight Locomotive—Freight Locomotive—Centre Valve for a Gas House—Disc Valve for Large Gas Pipes—Centre Guide Gas Holder—Counter-Weighted Gas Holder—Expanding Pipe Stopper—Lantern Bellows Dry Gas Meter—Wet Gas Meter—Dry Gas Meter—Gas Pressure Regulator—Fuel Gas Burner—Gas Furnace—Gas-Heated Incubator—Acetylene Gas Generator—Automatic Gasoline and Mantle Lamp—Acetylene Generator and Gas Holder—Acetylene Burner—Bayonet Joint—Gun Lock—Co-Cylinder Revolving Device for Firearms—Magazine Rifle, "Lee-Metford" Model—"Martini-Henry" Rifle—Chassepot Gun—Remington Rifle—"Remington" Magazine Gun—"Hotchkiss" Magazine Gun—"Lebel" Rifle—"Mauser" Rifle—"Winchester" Magazine Rifle—Disappearing Gun, "Moncrief Model", 371 to 396

ADDITIONS TO

THE FOURTEENTH EDITION.*

SECTION I.—Lever Safety Trip—Lever Sector—Lever and Ratchet—Lever Movement—Lever Action—Straight line Linkage—Lever and its Office Inclined Plane.

SECTION II.—Parallel Pliers—Transmission Circular Motion—Reversing Lever—Transmission, Reciprocating—Link Transmission—Gyrating Lever Transmission—Transmission by Bell Crank—Gambrel Joint Linkage—Two Revolutions for One Stroke—Equalizing Thrust—Speed Changing Pulley—Helping Crank Over Center—Reverse Motion Drive—Intermittent Transmission—Registering Dynamometer.

SECTION III.—St. John's Steam Meter—Belt Shipper—Three Horse Whiffletrees—Anemometer.

SECTION IV.—Crude Petroleum Burners—Petroleum Furnace—Automobile Boiler—Feeding Pulverized Fuel—Roney Stoker—Sterling Boiler—Worthington Boiler—Compound Locomotive Cylinders.

SECTION V.—Pulsometer Steam Pump—Edwards Air Pump—Steam Soot Sucker—Air Cooling Tower—Flexible Metallic Hose and Tubing.

SECTION VI.—Stake Puller—Stalk Puller—Valve Gear—Gasoline Atomizers—Ignition Plug—Jump Spark Coil—Caloric Engine—Four Cylinder Motor.

*Section numbers below refer back to additions to each original section already cited on pages 3-15, except for Section XIX ("Straight Line Movements") that is an entirely new section added on pages 397 to 402 as of the fourteenth edition.

- SECTION VII.—Hydraulic Sprinkler Head—Milk Cooler—Hydraulic Irrigation Engine—Four Stage Centrifugal Pump—Current Meter.
- SECTION VIII.—Wind Instruments—Ventilator—Wind Gauge—Compound Pohle Air Lift—Prairie Wind Mill—Gas Crucible Furnace—Oil Burning Melting Furnace—Mechanical Flyer.
- SECTION IX.—Non-Arcing Lightning Arrester—Ampere Meter—Recording Watt-hour Meter—Electric Escapement—Pneumatic Emergency Brake—Solenoid Electric Fan—Alternating Current Transformer—Electro Magnetic Ratchet Driver.
- SECTION X.—Air Ship—Railroad Gates—Railway Pneumatic Signal—Self-Registering Tide Gauge—Novel Steering Gear—Ship's Steering Gear—Street Cleaning Machine—Spring Wheel—Automobile Horn.
- SECTION XI.—Link Chain Hoist—Bicycle Signal Bell—Multiple Speed Gear—Changeable Motion Gear—Pneumatic Grain Elevator—Flying Machine.
- SECTION XII.—Hydro-Extractor—Reversible Pulley—Four Speed Change Gear—Heddle Cam—Ferris Wheel—Wave Motions—Sewing Machine Hook—Positive Shuttle Motion—A Curious Padlock.
- SECTION XIII.—Equated Sun Dial—Universal Sun Dial—Electric Balance Wheel Clock—Compensating Pendulum—Electro-Magnetic Clock Pendulum—Electric Time Clock—Electric Winding Device.
- SECTION XIV.—Disintegrator—Ore Crusher—Hand Power Rock Drill—Free Running Axle—Garbage Furnace—Automatic Ore Dump—Air Blast for Moving Coal—Rope Drive for Mine Haulage.
- SECTION XV.—Traveling Derrick—Modern Cotton Gin—Spool Winding Machine—Conical Roller Thrust Bearing—Steam Vulcanizers—Right Angle Shaft Transmission—Take-up and Let-off Motion for Looms.
- SECTION XVI.—Expansion or Anchor Bolts—Rolling Lift Bridge—Concrete Bridge—Melan Bridge—Steel Arched Concrete Bridge—Hydraulic Pile Driver—Log Sawing Machine.
- SECTION XVII.—Ellipsograph Turntable—Ellipsographs—Omni-Telemeter Odontograph, Section Liner—Dotting Instrument—Eidograph—Tracing Bar—Reflecting Drawing Board—Self-Registering Barometer—Spirograph.
- SECTION XVIII.—Railway Water Lift—Two Speed Gear.
- SECTION XIX.—Two Lever and One Link Straight Line Motion—Two Lever and Three Link Straight Line Motion—Two Lever and One Link Straight Line Motion—One Lever and Sliding Link Straight Line Motion—One Lever and Two Link Straight Line Motion—Three Lever Two Link Straight Line Motion—Two Lever, One Link Straight Line Motion—Three Lever, Two Link Straight Line Motion in Opposite Directions—Two Link, One Lever Straight Line Motion—Oil Switch Movement with Three Levers and Two Links—Oil Switch Movement with Two Levers and One Link—Oil Switch Movement with Two Levers and One Link—Oil Switch Movement with Two Levers and One Link—Oil Switch Movement with Three Levers and Three Links.