

INDEX TO THE TWO VOLUMES.

A

Absolute steam pressure, ii, 411.
 Accidents to locomotives, ii, 402.
 Accurate standards, i, 341.
 Admission of steam to indicator, ii, 414.
 point of, ii, 376.
 Adjustable centre rest, ii, 14.
 chucks for true work, i, 235.
 cutters, i, 448.
 with half-round bit, i, 281.
 die stock, i, 448.
 drivers for bolt-heads, i, 224.
 end measurement gauges, i, 377.
 or jamb dies, i, 98.
 planes, ii, 269.
 reamers, i, 189, 284, ii, 99.
 shell reamers, i, 284.
 tap wrenches, i, 110.
 taps, i, 104.
 wrenches, various forms of, i, 125.
 Adjusting connecting rod brasses, ii, 385.
 length of connecting rods, ii, 126.
 main bearings, ii, 386.
 parts of a locomotive, ii, 404.
 Adjustment of band saws, ii, 309.
 by differential screw, i, 119.
 Advantages of face cutters, i, 108.
 of involute gear teeth, i, 34.
 Air brake for locomotives, ii, 398.
 Air chambers, ii, 388, 441.
 Air pumps, ii, 441.
 Aligning connecting rods, ii, 119, 124.
 Alignment in crank pins, errors, ii, 169.
 of cranks, testing the, ii, 167.
 of lathe tail stocks, i, 145.
 Allen valve, ii, 377.
 Allowance, for contraction fits, i, 366.
 for hydraulic fits, i, 365.
 Alteration of shape of threads from the
 wear of tools, i, 89.
 Angle irons, welding of, ii, 236.
 of clearance in lathe tools, i, 257.
 plate chucking, examples of, i, 251.
 plates for planer tables, i, 418.
 valve patterns, ii, 283, 284.
 Angles for the facets of scrapers, ii, 97.
 of cutting edges of chisels, ii, 74.
 of thread cutting tools, i, 91.
 Angular advance of eccentrics, ii, 380.
 cutters, ii, 19.
 cutters for groove cutting, ii, 27.
 or helical teeth, i, 69.
 teeth, and thrust of, i, 69.
 herring-bone, i, 69.
 velocity of gear-wheels, i, 6.
 Angularity of connecting rods, ii, 375.
 Annular emery wheels, ii, 47.
 wheels, i, 1.
 compared with spur, i, 32.
 Anvils, ii, 230.
 Apparatus for oiling, ii, 439, 440.
 Appliances for bending timber, ii, 265.
 for tapping standard work, i, 111.
 Aprons, lathe, feed motion for, i, 168.
 Apron tools for planers, i, 411.
 Arbors, adjustable, i, 227.
 cutter, ii, 25.
 emery wheel, construction of, i, 198.
 expanding, i, 227.
 for eccentric work, i, 229.
 shell reamers, i, 283.
 threaded work, i, 228.
 lathe, i, 227.
 Arc of approach of gear wheels, i, 13, 16.
 of contact of gear-wheels, i, 17, 25.
 of recess of gear-wheels, i, 13, 16, 20.
 Area of the indicator diagram, ii, 419.
 Arms for pulleys, ii, 279.
 pivoted, for tooth templates, i, 44.
 Atmosphere, influence of, on oils, ii, 153.
 Auger bit, i, 453.
 Augers for end-grain wood, i, 454.
 Augers for wood boring, ii, 342.
 Automatic air brake, ii, 398.
 cut-off engines, ii, 423.
 engine, high speed, ii, 427.
 engine, straight line, ii, 428.
 wheel governors, ii, 427.
 feed motions, i, 408; ii, 8.
 gear cutter, ii, 54.
 nut tapping machine socket, ii, 475.
 grindstone traversing device, ii, 53.
 Auxiliary valve, ii, 438, 439.
 Ax handle lathes, i, 210.
 Axle boxes, hot, ii, 403.
 locomotive, ii, 248.
 brasses, testing, i, 366.
 Axles, crank, lathes for turning, i, 152.
 forging, ii, 259.

B

Babbitting boxes, methods of, ii, 155.
 Babbitt metal-lined boxes, ii, 155.

Back-gear of lathe, i, 135, 145.
 throwing in and out, i, 165.
 treble, i, 143.
 Back-knife gauge lathe, i, 211.
 Back rest, i, 233.
 Balanced valves, ii, 377.
 Balancing cutter heads, ii, 324, 326.
 emery wheels, ii, 39.
 pulleys, ii, 202.
 Ball turning, i, 325.
 Banking fires, ii, 401.
 Band saw machines, ii, 308, 311, 312.
 Band saw guides, ii, 311.
 teeth, ii, 308-310.
 pitch of, ii, 309.
 tension, ii, 310, 311.
 Bar cutters, boring, i, 289.
 the shapes of, i, 291.
 Bar iron, straightening, i, 395.
 Barometer, graduation of, ii, 416.
 construction of, ii, 415.
 Bars, boring, i, 289.
 boring, with fixed heads, i, 290.
 Bar steel, forms of, for chisels, ii, 73.
 Beading bits, ii, 270, 271.
 Bearings, adjusting, ii, 386.
 for lead screw, i, 139.
 of engine lathes, i, 134.
 of line shafting, ii, 166.
 surfaces of keys, i, 126.
 thrust of, ii, 445.
 various forms of, ii, 147.
 wear of, i, 158.
 Beating and pounding, causes of, ii, 168.
 Bedding brasses in their boxes, ii, 132.
 Beds, planer, flat guideways for, i, 414.
 planer, oiling devices for, i, 415.
 Belt stretching clamps, ii, 210.
 lacings, covers for, ii, 215.
 forms of, ii, 214.
 Belt pumps, ii, 388.
 shifting mechanism, i, 406, 407.
 Belts, bevelled joints for, ii, 215.
 changing or shipping, ii, 217.
 driving power of, ii, 28-225.
 friction, coefficient of, ii, 222.
 grain side, weak, ii, 208.
 to pulley, ii, 209.
 guide pulleys for, ii, 211.
 lap joints for, ii, 215.
 length of, ii, 209.
 line of motion of, ii, 217.
 parts of hide used for, ii, 207.
 pegged, ii, 215.
 single and double, ii, 208.
 stretch of, parts of hide, ii, 208.
 the creep of, ii, 222.
 length of, ii, 209.
 sag of, ii, 210.
 tension of, ii, 211, 224.
 torsional moment, ii, 223.
 V or angular, ii, 217.
 Bench lathes, i, 130.
 Bending appliances, ii, 226, 265.
 block for wood, ii, 265, 266.
 iron, ii, 226, 240.
 timber, ii, 265, 266.
 wood, modern methods, ii, 265.
 Bent files, use of, ii, 93.
 Bevel gear teeth, originating, i, 22.
 pinion, drawings for, i, 59.
 protractors, i, 380.
 squares, i, 380.
 wheel, body pattern, i, 59.
 Bevel wheels, i, 1, 21, 61.
 formation of the teeth of, i, 22.
 testing the angle of, i, 60.
 Bilge injection marine engines, ii, 441.
 Billiard cues, steady rest for, i, 233.
 Birmingham wire gauge for gold and
 silver, i, 387.
 Bit, half round, 281.
 Bits for wood working, ii, 342.
 Blacksmith's anvils, ii, 230.
 drilling levers, i, 456.
 fire, side blast for, ii, 228.
 forges, ii, 228, 229.
 swages, ii, 230, 231.
 temper, ii, 460.
 tools, ii, 229, 230.
 work, swaging, ii, 232.
 Blade, form of, necessary to produce a
 given shape of moulding, ii, 77.
 Block planes, ii, 269.
 Blocks for filing pins, ii, 104.
 pillow for shafting, ii, 194.
 or pillar, patterns for, ii, 277.
 swage, ii, 232.
 Blotting paper, oil test, ii, 154.
 Blowing down boilers, ii, 370.
 Blows upon plates, effects of, ii, 69.
 Blow through valve, ii, 440.
 Boiler fitting joints, ii, 140.
 Boilermakers, drilling machine, i, 435.
 drilling machine, feed motion, i, 436.

Boilermakers' turning machine, i, 435.
 Boiler, blowing down, ii, 370.
 cleaning, ii, 370.
 evaporative efficiency of, ii, 366.
 examining, ii, 458.
 factors of safety of, ii, 355.
 feed water, ii, 370.
 feeding, instruction upon, ii, 370.
 fire cleaning, ii, 369.
 cleaning tools, ii, 369.
 for stationary engine, ii, 350.
 gauge cocks, ii, 368.
 grate bars, ii, 369.
 bars, shaking, ii, 369.
 horizontal, return tubes, ii, 361.
 lighting the fire under, ii, 368.
 internally fired, ii, 358.
 plate, the strength of, ii, 351.
 settings, ii, 364-366.
 seams, diameter of rivets, ii, 356.
 treble riveted, ii, 353.
 shells, drilling machines for, i, 436.
 the strains on, ii, 351.
 the strength of, ii, 350.
 strains on, ii, 355.
 the care and management of, ii, 368.
 tubes, for fire engines, ii, 431.
 vertical, ii, 359.
 external uptakes, ii, 361.
 water gauge glass of, ii, 368.
 with Field tubes, ii, 359.
 Boilers, low water in, ii, 370.
 of marine engines, ii, 436, 437.
 of steam fire engines, ii, 431.
 priming in, ii, 370.
 Bolt-cutting machine, head of, i, 466.
 dies, i, 473.
 rapid, i, 467.
 the construction of dies for, i, 473.
 with automatic stop motion, i, 466.
 back gear, i, 467.
 Bolt-forging, ii, 238.
 Bolt-threading machinery, i, 468.
 capacity of, i, 471.
 construction of, i, 468-472.
 Bolted connecting-rod straps, ii, 116.
 Bolt-heads, adjustable drivers for, i, 224.
 bedding, i, 117.
 filing, ii, 105.
 Bolt-holes, classification of, i, 112.
 Bolts and nuts, table for, i, 114.
 Bolts, classification of, i, 112.
 countersunk, i, 112.
 devices for forging, ii, 238.
 for foundations, forms of, i, 113.
 planer tables, forms of, i, 417.
 quick removal, i, 116.
 forms of drivers for, i, 224.
 hook, i, 113.
 not passing through the work, i, 117.
 rapid construction of, i, 468.
 removing corroded, i, 122.
 self-locking, i, 117.
 Bore gauge, i, 387.
 Boring and turning mill or lathe, i, 211.
 bar, centres for, i, 293.
 cutters, ii, 289.
 cutters, shapes of, i, 291.
 bars, i, 289.
 for taper work, forms of, i, 292.
 three or four cutters for, i, 290.
 with fixed heads, i, 290.
 with sliding heads, i, 290.
 double-coned work, i, 293.
 end grain wood, augers for, i, 453.
 head with nut feed, i, 291.
 heads, i, 288.
 lathe for engine cylinders, i, 219.
 with double heads, i, 220.
 with traversing spindle, i, 218.
 mill, i, 211.
 purposes, chucking lathe for, i, 152.
 tool holders, i, 287.
 tools for brass, lathe, and small
 work, i, 285-287.
 octagon, holders for, i, 175.
 the spring of, i, 286.
 Boring-machine, i, 431.
 for car wheels, i, 438.
 wood, ii, 342.
 horizontal, i, 433.
 pulley, i, 438.
 the feed motion of, i, 432.
 Box wrenches, i, 124.
 body chucks, i, 237.
 tools for screw machines, i, 208.
 Brace drill, i, 455.
 with multiplying gear, i, 456.
 ratchet motion, i, 456.
 Bradawl, i, 452.
 Brake for lathe pulley, i, 149.
 for pattern lathe, i, 149.
 lathe, i, 151.
 Branch pipe core boxes, ii, 286.
 Brasses, fitting to their journals, ii, 145.

Brasses, for connecting rods, adjusting,
 ii, 120-127, 130-132.
 lead lined, ii, 148.
 oil cavities for, ii, 150.
 open, ii, 149.
 various forms of, ii, 127, 147.
 Brass work, boring tools for, i, 286.
 front tools for, i, 264.
 hand tool for roughing out, i, 332.
 side tools for, i, 264.
 special lathes for, i, 217.
 Breast drill with double gear, i, 456.
 Broaches, construction of, i, 479.
 Broaching press, i, 478.
 Broken frames, repairing, ii, 178.
 Brush wheels, for polishing, ii, 50.
 speed of, ii, 50.
 Built-up gear wheels, i, 61.
 Burnishing lathe work, i, 311.
 Butt joints, boiler, ii, 352.
 Butt welds, ii, 236.
 Buzz planer, ii, 315.
 By-pass valve, ii, 438.

C

Calculating the horse power of engines,
 ii, 407, 419.
 revolutions of, and power transmit-
 ted by, gear wheels, i, 5.
 speeds of pulleys, ii, 204.
 strength of gear teeth, i, 65.
 strength of riveted seams, ii, 354.
 horse power by indicator diagrams,
 ii, 418, 419.
 Calculations, safety-valve, ii, 409.
 Calendar roll lathe, i, 195, 215.
 Caliper, the micrometer, i, 354.
 Calipers, compass, i, 378.
 holding and using, i, 361, 362.
 inside, i, 360.
 spring, i, 360.
 with locking devices, i, 360.
 Cam chuck for irregular work, i, 328.
 motion for an engine slide-valve
 without steam lap, i, 83.
 motions, applications of, i, 327.
 for engines, i, 83.
 return or backing, i, 82.
 Cams, finding the pitch line of, i, 80.
 finding the working face of, i, 80.
 originating in the lathe, i, 326.
 return, finding the shapes of, i, 82.
 Capacity of pumps, ii, 388.
 of thread cutting machine, i, 471.
 Cape chisels or cross-cut chisels, ii, 74.
 Car axle lathe, i, 147.
 the feed motions of, i, 148.
 Carpenter's chisel, ii, 77.
 Carriages, lathe, testing, ii, 182.
 for lathes, i, 137, 145.
 Carriers, lathe, i, 222.
 Car wheels, boring machine for, i, 438.
 Case-hardening, ii, 128, 442.
 finished work, ii, 129.
 preparing work for, ii, 129.
 Casting pillow blocks, ii, 277.
 Cast gear, contact of the teeth of, i, 67.
 iron, internal strains, i, 306.
 teeth, contact of, i, 67.
 scale for curves of, i, 51.
 side clearance, i, 53.
 Cat head, i, 233.
 steady rest, i, 233.
 Caulking tools, ii, 141.
 Cement chuck, i, 242.
 Cements used in the manufacture of
 emery wheels, ii, 38.
 Centre bit, i, 454.
 dead, methods of removing, i, 159.
 drill and countersink, i, 300.
 chuck, i, 302.
 drilling lathe attachment, i, 300.
 chucks for, i, 303.
 machine, i, 300.
 live, removing, i, 159.
 of rough work, i, 301.
 planer, i, 408.
 punch, i, 300.
 guide, i, 301.
 Centres for boring bars, i, 293.
 for hollow work, i, 226.
 lathe, i, 296.
 shaping machines, i, 397.
 taper work, i, 226.
 live, tapers for, i, 159.
 Centring devices for crank axles, i, 230.
 square, i, 300.
 work with the scribing block, i, 301.
 Chain riveted joints, ii, 352.
 Chambering or gumming, ii, 200.
 Change gears, arrangement of, i, 319.
 gears, compounded, i, 321.
 table for finding, for screw
 cutting, i, 180.

- Change gears, hanging, i, 158.
wheels, pitches of teeth, i, 182, 321.
- Changing or slipping belts, ii, 217.
- Chasers, errors in applying, i, 336.
forms of, i, 268.
holders, i, 268.
improved form of, i, 90.
outside and inside, i, 335.
setting, i, 268.
- Check valves, ii, 388.
- Chisels, angle of presentation, ii, 77.
angles of cutting edges, ii, 74.
blacksmith's, ii, 230.
cape or cross-cut, ii, 74.
carpenter's, ii, 77.
cow-mouthed, ii, 75.
curved or oil groove, ii, 76.
cutting ends of, ii, 74.
diamond point, ii, 74.
dimensions of, ii, 74.
for wood, ii, 271.
handles for, ii, 271.
holders, ii, 74.
machinist's application of, ii, 76.
round-nosed, ii, 76.
shapes of cutting edges, ii, 74.
the use of, ii, 76.
- Chucking device for pulleys, i, 318.
devices for planer tables, i, 408.
errors in, i, 250.
lathe for boring purposes, i, 152.
machine beds, on a planer, i, 421.
on angle plates, i, 251.
reamers, for true work, i, 283.
the halves of large pulleys on a planer, i, 422.
- Chucks and chucking, i, 234.
- Chucks, box body, i, 237.
cement, i, 242.
combination, i, 237.
cone, i, 232.
contracting, for lathes, i, 188.
drill, i, 446.
drill-holding, construction of, ii, 41.
expanding, i, 188.
for centre-drilling and countersinking, i, 303.
large planing machines, i, 422.
milling machines, ii, 31.
screw machine, i, 205.
straightening wire, i, 395.
true work adjustable, i, 235.
wood-working lathes, i, 242.
- Independent, i, 238.
planer, for curved work, i, 420.
planer, for grooved work, i, 419.
reversible jawed, i, 237.
special forms of, i, 234-241.
swivelling, i, 395.
tailstock for drilled work, i, 279.
the wear of, i, 240.
three and four-jawed, i, 237.
two-jawed, i, 236.
universal, i, 238.
various forms of, i, 394.
vise, for vise work, i, 396.
vise, holding taper work in, i, 394.
vise, rapid motion, i, 396.
- Circle, dividing the, i, 348.
- Circular cutters, for change gears, i, 16.
rolling, for change gears, i, 16.
- Circular cutters, i, 272; ii, 22.
cutters, tool holders for, i, 272.
cutting tools, i, 267.
plane, ii, 268.
saw gauges, ii, 287.
inserting teeth, ii, 290, 291.
machine, roll feed, ii, 298, 300.
mandrel hole, size of, ii, 287.
segmental, ii, 300.
stretching by heat, ii, 288.
tension, ii, 288.
- Circular slide valves, ii, 377.
- Circulating pumps, ii, 440.
- Circumferential seam strength, ii, 356.
grindstone speed, ii, 52.
- Clamp couplings, ii, 197.
- Clamping work on face plates, i, 245.
- Clamps, belt, ii, 210.
chucking, i, 245.
for steady rests, i, 233.
polishing for lathe-work, i, 311.
steady rest, i, 233.
vise, various forms of, ii, 64.
- Classification of bolts, i, 112.
of bolt heads, i, 112.
of lathes, i, 129.
of measuring tools, i, 354.
- Cleaning boilers, ii, 370.
files, ii, 94.
- Clearance in cast gear teeth, i, 53.
of front tools, i, 254.
of planer tools, i, 424.
of taps, i, 102.
of tools for square threads, i, 269.
of twist drills, i, 274, 275.
on cutter, ii, 35.
- Clements driver, i, 223.
- Clinker hook, ii, 369.
- Clip-ended connecting-rod, ii, 115.
- Clock wheels, i, 21.
- Clutches, friction, ii, 192.
- Cocks and plugs, grinding, ii, 144.
leaky, ii, 145.
- Cogged gear-wheels, i, 63.
- Cogs, durability of, i, 66.
strength of, i, 66.
thickness of, i, 66.
methods of fastening, i, 63.
- Cold-rolled shafting, ii, 187.
- Collapsing tap, screw machine, i, 107.
taps, tapping machine, i, 107.
- Collar gauges and standard plug, i, 356.
for threads, i, 91.
testing, i, 356.
- Collars for shafting, ii, 189.
- Color tempering, ii, 460.
- Combination chucks, i, 237.
- Combination planes, ii, 269, 270.
- Combined centre-drill and countersink, i, 300.
cutting off tools and holders, i, 273.
drilling machine and lathe, i, 433.
- Compass planes, ii, 268, 269.
- Compasses, i, 377.
- Compound engines, ii, 434, 435.
slide rest, i, 140.
tool holders for, i, 174.
- Compounded gears, i, 320.
- Compounds for welding, ii, 234.
- Compression curve of engines, ii, 422.
- Compression curve, ii, 415.
line, ii, 415.
the point of, ii, 376.
- Concave saw, ii, 287, 283.
- Condenser, total pressure in, ii, 444.
- Condensing engine diagram, ii, 415.
- Cone chuck, i, 232.
- Connecting-rods, adjusting the length of, ii, 126.
angularity of, ii, 375.
brasses, adjusting, ii, 385.
joint faces of, ii, 122.
lining up, ii, 126.
double gibbed, ii, 116.
ends, tapered, ii, 117.
fitting up, ii, 118.
keys, ii, 375.
keyways, filing out, ii, 120.
locomotive, ii, 115.
length of, ii, 123.
marine engine, ii, 116.
marking length of, ii, 123.
repairing, ii, 125.
setting up keys of, ii, 126.
solid-ended, ii, 114.
strap-ended, ii, 115.
straps, ii, 120.
bolted, ii, 116.
stepped, ii, 117.
trammelling the length of, ii, 122.
various forms of, ii, 117.
welding up stub ends of, ii, 119.
- Construction of gland patterns, ii, 276.
of groove cams, i, 84.
of lathe carriages, i, 137.
of emery wheel arbors, i, 108.
of tailstock of engine lathe, i, 135.
of reciprocating cross-cut saw, ii, 312.
of scroll sawing machines, ii, 306, 307.
of the barometer, ii, 415.
- Contact of cast teeth, i, 67.
- Contracting chucks for lathes, i, 188.
- Contraction or shrinking fits, i, 366.
- Convection, ii, 472.
- Conversion of heat into work, ii, 411.
- Cope cutters, ii, 344.
- Cope boxes for branch pipes, ii, 286.
- Core box plane, i, 269.
- Core work, drivers for, i, 225.
- Corliss engine, ii, 423, 424.
valve, lap of, ii, 426, 427.
valve gear, ii, 424, 425.
- Correcting the errors of, of thread pitch caused by hardening, i, 109.
- Corroded bolts, removing, i, 122.
nuts, removing, i, 122.
- Cotter or keyway drilling machine, i, 438.
drills, i, 446.
- Counterbore and drill, i, 449.
- Countershafts, ii, 191.
- Countersink cutters, i, 449.
- Countersink, for hardened work, i, 303.
for lathe work, i, 301.
with adjustable drill, i, 300.
- Countersinking, chucks for, i, 303.
- Countersinks, i, 285.
- Countersunk bolt heads, i, 112.
- Coupling for light shafting, ii, 198.
plate, ii, 196.
universal, ii, 199.
- Couplings, clamp, ii, 197.
for line shafting, ii, 194.
for split sleeves, ii, 195.
self-adjusting, ii, 196.
- Covers for belt facings, ii, 215.
- Cow mouthed chisel, ii, 75.
- Crank, application of slide-rest, i, 152.
axles, centring devices, i, 230.
axles, lathe for turning, i, 152.
drill, i, 457.
lathe for turning, i, 154.
motion for shaping machines, i, 401.
simple, i, 173.
placing at right angles, ii, 156.
- Crank-pin aligning, errors, ii, 158, 170.
remedying errors of, ii, 171.
riveting, ii, 73.
- Crank-pins, hot, ii, 386.
- Crank position, engine starting, ii, 384.
- Crank-shaft, forging, ii, 248, 249.
setting eccentrics on, ii, 174.
- Cranks, placing at right angles, ii, 156.
special lathe chuck for, i, 248.
testing the alignment of, ii, 167.
- Creep of belts, ii, 211.
- Crossing gauge, ii, 266.
- Cross-bar, construction of, i, 409.
- Cross-cut, or cape chisels, ii, 74.
saws, ii, 272, 273, 312.
- Cross-cutting or gaining machine, ii, 305.
- Cross-feed motion, construction of, i, 138.
- Cross-files, ii, 91.
- Crossfling, ii, 92, 93.
- Cross-head chucking, i, 251, 253.
- Cross-heads of steam engines, ii, 375.
- Crowning of cutters, to avoid, ii, 27.
- Crowned pulleys, ii, 200.
- Crowns of brasses, shapes of, ii, 127.
- Crown wheels, i, 1.
- Curve of expansion of indicator diagrams, ii, 174.
of gear wheel teeth, variation of, i, 12.
Curved or oil groove chisel, ii, 76.
work, planer chuck for, i, 410.
work, turning, i, 314, 315.
- Curves, compression, ii, 415.
marking, by hand, i, 45.
of gear teeth for bevel gear, i, 22.
templates for, i, 384.
- Cushioned hammers, ii, 252, 253.
- Cut, and kinds of rasps, ii, 87.
of files, ii, 86.
gear-wheel teeth, strength of, i, 65.
- Cut-off engines, ii, 423.
the point of, ii, 376.
valves, ii, 378.
- Cutter, adjustable, i, 448.
adjustable on half-round bit, i, 281.
angle for worm wheels, i, 43.
angle of, for spiral grooves, ii, 29.
arbors, ii, 25.
boring-bar, the shapes of, i, 291.
clearance of, ii, 35.
grinding taper, thin edge, ii, 33.
heads, ii, 337.
heads for planing machines, ii, 320.
revolving, for gear teeth, i, 37.
- Cutters, angular, ii, 18.
angular, grooving, setting of, ii, 28.
circular, ii, 22.
countersink, i, 449.
crowding, to avoid, ii, 27.
face, ii, 17.
fly, ii, 21.
for drilling machines, i, 442.
edge moulding, ii, 341.
friezing machines, ii, 340.
moulding machines, ii, 340.
mouldings, ii, 336, 337.
standard shapes, i, 111.
gang or composite, ii, 23.
holders for fly, ii, 22.
matched, ii, 21.
milling, ii, 73.
milling, errors in grinding, ii, 32.
parallel, fixture for grinding, ii, 32.
right and left-hand, ii, 18.
rotary, for all kinds of work, ii, 341.
shank, ii, 19.
sizes of, ii, 17.
slide of gear-cutter, operating, ii, 55.
sliding, grinding teeth of, ii, 36.
tube-plate, i, 448.
twin, ii, 18.
with inserted teeth, ii, 24.
with spiral teeth, ii, 47.
- Cutting cams in the lathe, i, 326.
coarse pitch square threads, i, 269.
double threads, i, 322.
edge of chisels, angles of, ii, 74.
of chisels, shapes of, ii, 74.
on drills, clearance, ii, 43, 44.
edges for dies, number of, i, 471.
for taps, number of, i, 105.
ends of chisels, ii, 74.
feeds for wrought iron, i, 294.
files, ii, 101.
gauge, ii, 274.
grooves in cylindrical work, ii, 27.
helical teeth in the lathe, i, 69.
iron when hot, ii, 263.
keyways by hand, ii, 108.
left-hand threads, i, 322.
out keyways by drifts, ii, 109.
steam ports, i, 267.
right and left-hand grooves, ii, 29.
right or left-hand thread, single, double, or treble, with same dies, i, 99.
screws by the metric system, i, 322.
screw thread by hand, i, 62.
speeds, examples of, i, 295.
for threading dies, i, 474.
for wrought iron, i, 294.
taper threads, i, 338.
threads, multiple, i, 322.
on taper work, i, 324.
tools, circular, i, 267.
producing gauges for, i, 92.
power required to drive, i, 273.
the utmost duty of, i, 258.
wheels, angle of cutter for, i, 43.
wood slips, ii, 271.
worm-wheel teeth in the lathe, i, 42.
- Cutting-off machine, i, 193.
tool for screw machines, i, 208.
tools, i, 262, 273.
- Cycloidal curves for gear teeth, i, 8.
- Cylinder boring lathe with facing slide rests, i, 219.
cover joints, ii, 137.
cover, turning a, i, 318.
ends, scraping out, ii, 161.
- Cylinder heads, knocking out, ii, 402.
- Cylinders, bores of, ii, 372.
clearance in, ii, 372.
counterbore of, ii, 372.
for steam engines, ii, 372.
jacketed, ii, 374.
lagging, ii, 374.
lubricating, ii, 373.
reboring in place, ii, 160.
relief valves for, ii, 373.
steam, ports of, ii, 373.
waste water cocks of, ii, 373.
wear of, ii, 372.
- Cylindrical work, cutting grooves, ii, 27.

D

- Dancing governors, ii, 384.
- Dead-centre, finding the, ii, 174.
methods of removing, ii, 139.
of the crank, finding the, ii, 172.
- Deflection of surface plates, ii, 135.
- Depth of gear wheel teeth, i, 42.
- Designing slide valves, ii, 380.
- Detachable slide rest, i, 143.
- Determining the pitches of the teeth for change wheels, i, 182.
- Diagram, theoretical, ii, 414.
the uses of, ii, 413.
- Diagrams for condensing engine, ii, 415.
indicator, ii, 414.
defective, ii, 421.
- Diameter at the roots of threads, i, 269.
of circle for generating curves of gear teeth, i, 10.
of the pitch circle of wheels, i, 1.
Diameters of line shafting, ii, 180.
- Diametral clearance of twist drills, i, 274.
- Diamond point chisel, ii, 76.
- Diamond pointed tool for lathe work, i, 254.
- Dictionary of work-shop terms, ii, 473.
- Die stock for pipe-threading by hand, i, 463.
by power, i, 463.
Dies, adjustable, i, 68.
for finishing square threads, i, 269.
for forging eye-bars, ii, 260.
for gas and steam pipes, i, 101.
or chasers in the heads of bolt-cutting machines, i, 463.
the wear of, ii, 189.
with four cutting edges, i, 100.
- Differential threads for locking, i, 119.
- Displacement of pumps, ii, 387.
- Distance between bearings of line-shafting, ii, 186.
- Dividers, i, 377.
Dividing device for circle, i, 352.
engine, i, 349.
mechanism for gear cutting, ii, 57.
- Division of the circle, i, 348.
- Dog-head hammer, ii, 69.
- Dogs, lathe, various kinds of, i, 222.
movable for face-plate work, i, 250.
- Donkey engines, ii, 442.
- Double bevel valves, ii, 443.
eye, filing up a, ii, 103.
forging of, ii, 240.
eyes, fitting pins in, i, 127.
gibbed connecting rod, ii, 115.
head panel raiser and sticker, ii, 335.
heads for planing machines, i, 404.
ported slide valves, ii, 377.
rapid bolt threading machine, i, 467.
riveted lap joint, ii, 352.
saw machine, ii, 294, 295.
spindle milling machine, ii, 16.
threads, cutting, ii, 322.
tool holder for slide rest, i, 169.
wheel sanding machines, ii, 348.
- Double-coned work, boring, i, 293.
- Dovetail joint, ii, 275.
- Drifting of keys, i, 127.
- Draw filing, ii, 93.
- Drawing the temper, ii, 462.
- Drawings for bevel pinion, i, 59.
for gear wheels, i, 59.
- Drifts, forms of, ii, 109.
methods of using, ii, 160.
- Drill, and counter-bore, i, 449.
brace, i, 445.
universal joint for, i, 456.
with multiplying gear, i, 456.
with ratchet motion, i, 456.
chucks, i, 446; ii, 41.
cranks, i, 457.
for stone, i, 454.
for wood work, i, 449.
grinding, varied for diameter, ii, 41.
conditions for all diameters, ii, 41.
holders, flat, for lathe work, i, 281.
holders, twist, i, 274.
machine, grinding, ii, 41.
position, for all drills, ii, 41.
shanks, i, 445.
shank, improved form of, i, 446.
sockets, i, 445.
with cord, i, 455.
with spring motion, i, 455.
- Drilled work, tailstock chucks for, i, 279.
- Drilling and boring machine, i, 431.
feed motion of, i, 432.
device for lock work, i, 459.
engine cylinders, jigs for, i, 440, 441.
hard metal, i, 445.

- Drilling holes true to location with flat drills, i, 442.
 levers for blacksmith, i, 457.
 square holes, device for, i, 450.
 taper holes, i, 451.
 and turning machine for boiler makers, i, 435.
 machine, and lathe combined, i, 433.
 cotter or keyway, i, 438.
 feed motion of, i, 432.
 feed motions of, i, 436.
 for boiler shells, i, 436.
 four-spindle, i, 434.
 hand, i, 459.
 lever feed, i, 428.
 power, i, 428.
 three-spindle, i, 434.
 with automatic motions, i, 428.
 with quick return, i, 428.
 machines, counterbores for, i, 449.
 cutters for, i, 447.
 drills for, i, 442.
 fixtures for, i, 439.
 flat drills for, i, 442.
 jigs for, i, 439.
 radial, i, 439, 431.
 stocks for, i, 447.
 Drills and cutters, i, 442, 447.
 cotter or keyway, i, 446.
 flat, errors in grinding, i, 443.
 flat, for drilling machines, i, 442.
 flat, for lathe work, i, 280.
 for wood work, i, 279.
 square-shanked, i, 446.
 disadvantages of, i, 446.
 stock, with spiral grooves, i, 445.
 twist, diametral clearance of, i, 274.
 fluting, ii, 29.
 front rake of, i, 275; ii, 44.
 grinding by hand, i, 279.
 large, grinding, ii, 4.
 speeds and feeds for, i, 277.
 Driver, and face plate, i, 223.
 Drivers, equalizing, i, 223.
 for bolt heads, i, 224.
 coned work, i, 225.
 lathe mandrels or arbors, i, 227.
 steady rest work, i, 22.
 threaded work, i, 225.
 wood, i, 225.
 lathe, i, 222.
 the elements, i, 223.
 Driving cones, steps of, i, 159-164.
 drills, flexible shaft for, i, 458.
 gear of universal milling machine, ii, 15.
 gear table, i, 404.
 Drop hammers, ii, 255, 256.
 Duration of a hammer blow, experiments on, ii, 65, 66.
 Duplex slide-rests, i, 143.
- E**
- Eccentrics, fixed and shifting, ii, 378.
 slipping, ii, 403.
 turning in the lathe, i, 317.
 Eccentric work, lathe mandrels for, i, 229.
 Edge tools, oilstoning, ii, 54.
 Effects of hammer blows, ii, 69.
 of speed of a hammer blow, ii, 65.
 Elevating slide rests, i, 168.
 Elliptical gears, tooth curves of, i, 73.
 gear wheels, i, 70.
 gears, the pitch lines of, i, 70.
 taps, in cross section, i, 109.
 Emery belt grinding machine, ii, 47.
 grinder for car axle boxes, ii, 47.
 for engine guide bars, ii, 45.
 machine knives, ii, 46.
 rough work, ii, 46.
 true surfaces, ii, 45.
 with revolving emery wheel, ii, 42.
 machines, grinding, ii, 40.
 charging, polishing wheels, ii, 50.
 paper, use on lathe work, i, 308.
 wheel arbors, i, 198.
 arbors, positions of, ii, 35.
 swing frame for dressing large castings, ii, 46.
 wheels, annular, ii, 48.
 balancing, ii, 39.
 cements used in the manufacture of, ii, 38.
 clearance of, ii, 39.
 coarseness and fineness of, ii, 38.
 positions of, i, 282; ii, 36, 37.
 presenting to work, ii, 47.
 qualifications of, ii, 38.
 recessed, ii, 47.
 speeds of, ii, 39.
 wear of, ii, 48.
 End, face and twin milling, ii, 25.
 grain wood boring, i, 453.
 measurements of lathe work, i, 376.
 milling, advantages of, ii, 25.
 thrust of angular teeth, i, 69.
 Endless screw thread, cutting, i, 62.
 Engine, alignment, errors in, ii, 166.
 calculating the power of, ii, 407.
 connecting rods, ii, 375.
 crank turning, i, 247.
 crossheads, ii, 375.
 crosshead turning, i, 252.
 cylinder covers, turning, i, 318.
 cylinders, bores of, ii, 372.
 boring lathe for, i, 219.
- Engine cylinders, clearance in, ii, 372-404.
 cylinders, counterbore of, ii, 372.
 fitting, ii, 158.
 jacketed, ii, 374.
 lagging, ii, 374.
 lubricating, ii, 373.
 relief valves for, ii, 373.
 steam ports, ii, 373.
 waste water cocks of, ii, 373.
 wear of, ii, 372.
 eccentrics, ii, 378.
 turning a cover, i, 318.
 gear cutting, ii, 56.
 glands, turning, i, 316.
 guide bars, ii, 375.
 setting, ii, 162.
 spring of, ii, 162.
 testing, ii, 163.
 lathe, i, 129, 147.
 construction of carriage, i, 137.
 of the back gear, i, 135.
 of the bearings, i, 134.
 of the head stock, i, 134.
 general construction of, i, 133.
 lead screw and change wheels of, i, 139.
 shears of, i, 134.
 link motion, designing, ii, 389.
 plain slide valve, starting, ii, 384.
 valves, ii, 376-378.
 balanced, ii, 377.
 circular, ii, 377.
 cut-off, ii, 378.
 double ported, ii, 377.
 exhaust lap of, ii, 376.
 lead of, ii, 376.
 point of admission, ii, 376.
 slide and piston, ii, 378.
 slide, designing, ii, 380.
 testing horse power of, ii, 408.
 the Allen, ii, 377.
 the D, ii, 376.
 tracing the action of, ii, 376.
 Webb's, ii, 377.
 Engines, compound, ii, 434, 435.
 donkey, ii, 442.
 heating and knocking of, ii, 164.
 subject to freezing, ii, 386.
 Engineers, test questions for, ii, 467.
 Engraver's plates, polishing, ii, 51.
 Epicycloidal gear teeth, curves, i, 8.
 teeth, the strength of, i, 64.
 filleting the roots of, i, 53.
 Equalizing drivers for lathe work, i, 223.
 Erecting, ii, 137.
 a lathe, ii, 181.
 an iron planer, ii, 179.
 pipe-work, ii, 143.
 the framework of machinery, ii, 176.
 Errors in alignment, determining, ii, 158-167.
 in chucking, i, 250.
 crank pin alignment, ii, 169.
 cutting threads on taper work, i, 324.
 cutting up inside chasers, i, 337.
 drill-grinding machines, ii, 41.
 grinding flat drills, i, 443.
 grinding milling cutters, ii, 32.
 jigs, limits of, i, 439.
 shafting couplings, ii, 196.
 Evaporative efficiency of boilers, ii, 366.
 Examining a boiler, ii, 368.
 a locomotive, ii, 401.
 Excessive lead of engines, ii, 421.
 Exhaust lap, ii, 376.
 Expanding bit, i, 454.
 chucks for lathes, i, 188.
 for ring work, i, 241.
 for large work, i, 228.
 laps, i, 311.
 mandrels, i, 227.
 taps, i, 107.
 Expansion, ii, 376.
 curve of indicator, ii, 417, 418.
 testing of indicator, ii, 417, 418.
 joint, ii, 141.
 line of diagrams, ii, 414, 415.
 of steam, ii, 411.
 pulleys, ii, 200.
 valves, separate, ii, 443.
 Experiments on duration of a blow, ii, 65, 66.
 on the strength of the parts of a hide, ii, 208.
 Extension lathe, i, 151.
 Eye-bar dyes, ii, 260.
 Eyes, hammer, shapes of, ii, 66.
- F**
- Face and taper cutters, fixture, ii, 34.
 cutters, ii, 17.
 advantages of, ii, 18.
 disadvantages of, ii, 18.
 fixtures for, ii, 34.
 milling, advantages of, ii, 26.
 length of feed, ii, 26.
 plate, clamping work on, i, 245.
 clamps, i, 245.
 errors in, and their effects, i, 243.
 for wood-work, i, 247.
 work, examples of, i, 249.
 work, movable dogs for, i, 250.
 Facets of scrapers, angles for, ii, 97.
 Facing and countersink cutters, i, 449.
 cutters, i, 449.
 rests, boring lathe with, i, 220.
 tool with reamer-pin, i, 449.
- Facing tools or knife tools, i, 262.
 Factors of safety, boiler seams, ii, 355.
 Fastening cogs, i, 63.
 pulleys to their shafts, ii, 201.
 Featheredge, removing, ii, 54.
 Feathers and their applications, i, 127.
 methods of securing, ii, 102.
 sinking into shafts, ii, 101.
 Feed, direction, for shank cutters, ii, 20.
 for spiral grooves, ii, 27.
 escape valve, ii, 441.
 gear, i, 197.
 for screw machine, i, 205.
 in cutting spiral grooves, ii, 28.
 length, in face milling, ii, 26.
 motions, automatic, i, 408.
 construction of, i, 390.
 examples of, i, 170.
 for boiler-maker's drilling and turning machine, i, 436.
 for boring machine, i, 432.
 boring mills, i, 215.
 cam turning, i, 326.
 car-axle lathe, i, 148.
 carriage or saddle, i, 137.
 chucking lathe, i, 150.
 drilling machine, i, 432.
 grinding lathe, i, 200.
 lathe aprons, i, 168.
 milling machine, ii, 13.
 planer heads, i, 413.
 reversing traverse, i, 168.
 special lathe, i, 146.
 weighted slide rest, i, 168.
 wood-working, i, 209.
 friction wheels for, i, 78.
 nut, position of, i, 177.
 ratchet, i, 173.
 regulators for screw cutting, i, 171.
 spindle bearings, i, 139.
 spindle for lathe, i, 139.
 spindle, giving motion to, i, 135.
 water, heating, ii, 370.
 Feeds, cutting, for wrought iron, i, 294.
 for roughing cuts, i, 306.
 for twist drills, i, 277.
 Feed-water, ii, 370.
 from natural supply, ii, 387.
 Fiddle drill with feeding device, i, 455.
 Fild tube for boilers, ii, 359.
 Fifth wheel, forging of, ii, 239.
 File cutters' hammers, ii, 71.
 cutting, ii, 201.
 teeth, shapes of, ii, 85.
 Files, ii, 85.
 bent, using, ii, 93.
 cleaning of, ii, 94.
 cross, ii, 91.
 cut of, ii, 86.
 flat sizes and kinds, ii, 86, 87.
 for soft metals, ii, 95.
 Groubet, ii, 87.
 half-round, ii, 90.
 instruction on holding, ii, 92.
 knife, ii, 91.
 names of, ii, 88.
 putting handles on, ii, 92.
 reaper, ii, 91.
 resharping, ii, 95.
 round, ii, 90.
 selection of, ii, 91.
 thin, ii, 93.
 three square, ii, 90.
 tumbler, ii, 91.
 warping, ii, 93.
 Filing bolt heads, ii, 105.
 cross, ii, 93.
 draw, ii, 93.
 fixture for lathes, i, 189.
 lathe work, i, 308.
 nuts, ii, 105.
 out connecting rod keyways, ii, 120.
 out round corners, ii, 95.
 pins, ii, 105.
 pins, blocks for, ii, 104.
 the link slot, template for, ii, 127.
 the teeth of band saws, ii, 309.
 Filleting the roots of gear teeth, i, 53.
 Finishing cast iron with water, i, 307.
 cast iron work, pecks in, i, 307.
 cuts, rates of feeds for, i, 307.
 horseshoes, machines for, ii, 262.
 internal work, laps for, i, 311.
 lathe work, scrapers for, i, 307.
 Fire cleaning, ii, 369.
 cleaning tools, ii, 369.
 engine boiler tubes, ii, 431.
 engine heaters, ii, 432, 433.
 engines, steering gear for, i, 75.
 Firing boilers, ii, 368.
 methods of, ii, 402.
 Firmer chisels, ii, 272.
 Fits, shrinkage or contraction, i, 366.
 Fitting brasses to connecting rod straps, ii, 121.
 brasses to journals, ii, 146.
 engine cylinders, ii, 158.
 keys, ii, 107.
 keys, examples of, ii, 107.
 straps, ii, 120.
 taper pins, i, 122.
 taper work, i, 213.
 the keys and gibs, ii, 120.
 up connecting rods, ii, 118.
 a double eye, ii, 103.
 a fork end connecting rod, ii, 123.
 a lathe, ii, 181.
 a link motion, ii, 127.
- Fixed pins, i, 122.
 Fixture for grinding cutters, ii, 32, 33.
 for grinding taper work, ii, 33.
 Fixtures for drilling machines, ii, 439.
 Flank contact of gear teeth, i, 18.
 Flat drill holders, i, 281.
 drills, drilling with, i, 444.
 errors in grinding, 443, 444.
 for lathe work, i, 280.
 files, sizes and kinds, ii, 86, 87.
 guideways for planer beds, i, 414.
 side lathe shears, i, 183.
 Flexible shaft for driving drills, i, 458.
 Flue boiler, ii, 358.
 Flutes, shapes of taps, i, 105.
 the number of, i, 107.
 Fluting twist drills, ii, 29.
 Fluxes, heating in, ii, 462.
 Fly ball governors, ii, 384.
 cutters, ii, 21.
 holders for, ii, 22.
 making, ii, 21.
 methods of originating, ii, 21.
 Follower rests, i, 234.
 Foot lathe, i, 130.
 Foot-power hammers, ii, 252, 253.
 Foot valves, ii, 388.
 Forges for blacksmiths, ii, 228, 229.
 side blast for, ii, 228.
 Forging bolts, ii, 238.
 crank shafts, ii, 248, 249.
 hydraulic, ii, 260.
 machine thread, ii, 261.
 nails by machinery, ii, 261.
 of bolts, ii, 238.
 press, ii, 260.
 rope sockets, ii, 243, 244.
 rudder frames, ii, 245, 246.
 steel forks, ii, 241.
 threads on rods, ii, 261, 262.
 turn buckles, ii, 239, 240.
 under the hammer, ii, 242, 243.
 under a steam hammer, ii, 241.
 wheels, ii, 244, 245.
 Fork end connecting rod, fitting, ii, 123.
 aligning, ii, 124.
 Fork forging, ii, 241.
 Former of Corliss bevel gear-wheel engine, i, 45.
 Form of lead screw threads, i, 177.
 worm to give a period of rest, i, 74.
 Forms of lathe shears, i, 183.
 of outside calipers, i, 360.
 pin wrenches, i, 126.
 riveted joint, ii, 352.
 taps, i, 102.
 templates for gear teeth, i, 44.
 wrenches, i, 125.
 Foundations for an iron planer, ii, 179.
 Four-jawed chucks, i, 237.
 Four-spindle drilling machine, i, 434.
 Fractional pitch change gears, i, 34.
 Frames for rudders, forging, ii, 245, 246.
 of machinery, erecting, ii, 176.
 Freezing, preventing an engine from, ii, 386.
 French gear-cutting machine, ii, 56-61.
 Friction clutches, ii, 192.
 experiments on, ii, 154.
 of jamb dies, i, 98.
 plane surfaces, ii, 135.
 slide valves, ii, 443.
 taper taps, i, 103.
 tap threads, i, 108.
 wheels, i, 77.
 for feed motion, i, 78.
 materials for, i, 77.
 paper, i, 78.
 to reduce journal strain, i, 79.
 Friezing machines, cutters for, ii, 340.
 or moulding machines, ii, 334, 339.
 Front rake of twist drills, ii, 44.
 tools for brass work, i, 264.
 rake and clearance of, i, 254.
 Fullers, blacksmith's, ii, 230.
 Furnaces for scrap iron, ii, 247.
- G**
- Galvanized iron, gauge for, i, 387.
 Gang edging machines, ii, 301.
 Gang or composite cutters, ii, 23.
 Gap, or break lathe, i, 151.
 Gas pipe dies for, i, 101.
 Gauge cocks for boiler, ii, 368.
 Gauges, i, 356-359.
 adjustable, i, 377.
 cropping, use of, ii, 296.
 cutting, ii, 274.
 for American sheet zinc, i, 387.
 circular saws, ii, 287.
 cutting tools, i, 92.
 galvanized iron, i, 387.
 lathe work, i, 359.
 marking wood, ii, 274.
 music wire, i, 386.
 planer tools, i, 423.
 planing V-guideways, i, 421.
 Russian sheet iron, i, 387.
 setting over taper work, i, 313.
 shrinkage fits, i, 367.
 threading tools, i, 266.
 woodworking machine, ii, 295.
 forms of laps for, i, 310.
 hexagon, i, 381.
 instrument, standard, i, 96.
 mitre, use of, ii, 294.
 mortise, ii, 274.

- Gauges, notch wire, i, 384.
 plug and collar, comparing, i, 356.
 screw thread, producing, i, 92.
 standard for taper work, i, 316.
 standard, comparing, i, 356.
 surface, i, 378.
 vacuum, i, 444.
 wire, i, 387.
- Gauging the pitch of threads, after hardening, i, 108.
- Gear cutter, automatic, ii, 55.
 cutting engine, vertical spindle, ii, 56.
 machine, half-automatic, ii, 56.
 machine, French, ii, 56-61.
 table of index holes for, i, 417.
 racks, i, 77.
- Gear-teeth, i, 73.
 arc of approaching contact, i, 15.
 of receding contact, i, 16.
 pitch of, i, 2.
 calculating strength of, i, 65.
 chord pitch of, i, 2.
 curve of, for bevel gear, i, 22.
 curves, templates for rolling, i, 43.
 cutting by hand, i, 62.
 cutting templates for, i, 35.
 elliptical, i, 70.
 depth or height of, i, 1.
 errors produced by wear, i, 18.
 faces of, i, 1.
 factors of safety for, i, 64.
 flank contact of, i, 18.
 depth or height, i, 1.
 flanks of, i, 1.
 forms of template for, i, 44.
 generating involute curves, i, 31.
 helical, i, 69.
 line of centres of, i, 2.
 pitch line of, i, 2.
 point of, i, 2.
 requirements of curves, i, 7.
 revolving cutters for, i, 37.
 rolling and sliding motion of, i, 16.
 curves for, i, 43.
 strength of, i, 65.
 table of cutters for, i, 41.
 variation of curve, i, 12.
 of shape, i, 16.
- Gear-wheels, i, 1.
 angular velocity of, i, 6.
 bevel, i, 21.
 drawing for built-up, i, 61.
 pinion, drawings for, i, 59.
 calculating revolutions of, i, 5.
 chord pitch, i, 3.
 cogged, i, 63.
 cogs, i, 67.
 durability of, i, 66.
 diameters of pitch circles of, i, 4.
 drawings for, i, 59.
 driver and follower, i, 3.
 for rapid increase of motion, i, 75.
 reciprocating motion, i, 77.
 reversing motion, i, 75.
 steering steam fire engines, i, 75.
 variable motion, i, 74.
 generating curves for, i, 11.
 hunting tooth in, i, 7.
 interchangeable gearing, i, 16.
 internal, compared with spur, i, 25.
 or annular, i, 23 to 27.
 making cogs for, i, 63.
 mortised, i, 63.
 motion at a right angle, i, 69.
 patterns, i, 54-61.
 power of, ii, 406.
 transmitted by, i, 5.
 skew bevel, i, 61.
 spacing teeth on, i, 58.
 stop motion of, i, 7.
 strength of, i, 66.
 table of pitches, i, 3.
 table giving strength of, i, 67.
 thickness of, i, 66.
 tracing path of contact, i, 13.
 value of cutters, table, i, 41.
 various applications of, i, 74.
 velocity of, uniform, i, 16.
 with dovetail teeth, i, 60.
 involute teeth, i, 31-34.
 stepped teeth, i, 69.
- Gear-worm or endless screw, i, 62.
- Gears, for screw cutting, i, 320.
- Generating the involute curve, i, 31.
- German bit, i, 452.
- Gibbed elevating slide-rest, i, 169.
- Gimblet bit, i, 452.
- Gland patterns, ii, 275.
- Globe valve patterns, ii, 281, 282.
- Genzenback's cut-off valve, ii, 378.
- Gouge for wood, ii, 272.
 use of, i, 338.
- Governors, dancing, ii, 384.
 fly ball or throttling, ii, 384.
 for automatic engines, ii, 427, 428.
 for stationary engines, ii, 425, 426.
 isochronal, ii, 384.
 Sawyer's valve for, ii, 384.
 speed of, ii, 384.
 speeders for, ii, 384.
 spring, adjustment of, ii, 386.
- Grate bars, cleaning, ii, 368.
- Grades of emery wheels, ii, 38.
- Graduations of planer heads, i, 412.
- Grain side of leather, weakness of, ii, 208.
- Graver, i, 330.
- Grinder, emery, for axle boxes, ii, 45.
 for engine guide bars, ii, 45.
- Grinder for planing machine cutters, ii, 46.
 for rough work, ii, 46.
 for true surfaces, ii, 45.
- Grinding clamps for lathe work, i, 311.
 cocks and plugs, ii, 145.
 operations, ii, 38.
 taper cutters, ii, 33.
 taper work, i, 313.
 teeth of reamers, i, 282.
 teeth of spiral cutters, ii, 36.
 thin cutters, ii, 33.
 twist drills by hand, i, 279.
 universal, i, 195.
 with elevating rest, i, 194.
 with traversing wheel, ii, 46.
- Grinding-lathes, i, 193.
 for calendar rolls, i, 199.
 construction of tailstock, i, 200.
 special chuck for, i, 196.
- Grinding-machine, drill, ii, 41.
 emery belt, ii, 47.
 for milling cutters, ii, 32.
 errors in construction, ii, 41.
- Grindstones and tool grinding, ii, 51.
 application of work to, ii, 53.
 for saws or iron plates, ii, 52.
 wood-working tools, ii, 52.
 hacking, ii, 53.
 speeds of, ii, 52.
 traversing device for, ii, 53.
 truing device for, ii, 53.
 various kinds of, ii, 51, 52.
- Gripping devices, ii, 227.
- Groove cams, i, 84.
 proper construction of, i, 84.
 wear of, i, 84.
 with double roller, i, 84.
- Groove cutting, angular cutters, ii, 27.
- Grooved friction wheels, wear of, i, 79.
- Grooves, producing different shapes with same cutter, ii, 29, 30.
 right and left-hand, ii, 29.
- Groubet files, ii, 87.
- Ground joint, ii, 137.
- Guide-bars, ii, 375.
 setting by stretched lines, ii, 163.
- Guide pulleys for belts, ii, 211.
- Guide for centre punches, i, 301.
- Guideways, flat, i, 414.
 planing, i, 422.
- Guides for band saws, ii, 311.
- Gumming or gulleting, ii, 290.
- H**
- Hacking grindstones, ii, 53.
- Hack saw, ii, 97.
- Half-round bit for true work, i, 281.
 for wrought iron or steel, i, 281.
 or pod auger, i, 281.
 reamers, ii, 99.
 with adjustable cutter, i, 281.
- Hammer, ii, 64.
 blow, effects of, ii, 65, 69.
 coopers', ii, 71, 72.
 cushioned, ii, 252.
 doghead, ii, 69.
 drop, ii, 255.
 eyes, shapes of, ii, 66.
 foot power, ii, 252.
 forging, methods, ii, 242.
 file cutters', ii, 71.
 handles, putting in, ii, 67.
 machinists' hand, ii, 66.
 paning or pening, ii, 68.
 plate and saw makers', ii, 68.
 power, 252.
 riveters', ii, 71.
 sledge, machinists', ii, 71.
 steam, ii, 256-259.
 trip, ii, 254.
- Hand bolt threading machine, i, 97.
 device to straighten lathe work, i, 305.
 drilling machine, i, 459.
 finishing tool, i, 331.
 hammers, machinists', ii, 66.
 lathe, i, 130.
 watch manufacturers', i, 191.
 milling machine, ii, 1.
 planer, i, 391.
 reamers, ii, 98.
 shaping machine, i, 392.
 side tools, i, 331.
 tools for brass-work, i, 332.
 round nosed, for iron, i, 331.
 screw cutting, i, 96.
 threading machine, head, i, 465.
 turning, i, 330.
 vise, ii, 104.
 work, swages for, ii, 230.
- Handles for chisels, ii, 271.
 of files, putting on, ii, 92.
 of hammers, putting in, ii, 67.
- Hangers, shafting, forms of, ii, 192.
 wall, ii, 194.
- Hardening, case, ii, 128, 442.
 outside, ii, 462.
 saws, ii, 462.
 to resist wear, ii, 460.
 increase elasticity, ii, 460.
 provide a cutting edge, ii, 460.
- Hard metal, drilling, i, 444.
- Head boring, i, 288.
 with nut feed, i, 291.
- Heads, construction of, i, 408.
 double for planing machines, i, 404.
- Heads for match board grooves, ii, 337, 338.
 for tenoning machines, ii, 345.
 of the rapid machines, i, 468.
 planer, feed motions for, i, 414.
 safety devices for, i, 413.
 V-guideways for, i, 414.
- Headstock lathe, construction, i, 153.
 of engine lathes, i, 134.
 grinding lathes, i, 200.
 special lathe, i, 144.
- Heat, ii, 410.
 conversion of, into work, ii, 411.
 latent, ii, 410.
 radiation of, ii, 412.
- Heaters for fire engines, ii, 432, 433.
- Heating and knocking, ii, 164.
 feed-water, ii, 370.
 showing the causes of, ii, 168.
- Heavy oil for hot bearings, ii, 386.
- Heel tool, i, 330.
- Height of lathe tools, ii, 260.
 of vise jaws, i, 62.
- Helical teeth, cutting in the lathe, i, 69.
- Herring-bone gear-teeth, i, 69.
- Hexagon gauge, i, 381.
- Hide, parts of, used for belting, ii, 208.
- High pressure steam engine, ii, 372.
- High speed automatic engines, ii, 427.
- Hobbing dies, methods of, i, 473.
- Hob for threading dies, i, 474.
- Hobs and their uses, i, 335.
 for cutting up dies, i, 99.
 threading dies, i, 474.
- Hoe, ii, 369.
- Holders, for chasers, i, 268.
 for fly cutters, ii, 22.
 octagon boring tools, i, 175.
- Holding chisels, ii, 74.
- Hollow work, centres for, i, 226.
- Hook bolts, i, 113.
- Hooks, belt, ii, 216.
- Horizontal boring machine, i, 433.
- Horse-power, from diagram, ii, 418.
 of an engine, calculating, ii, 407, 419.
 testing, ii, 408.
- Horseshoes, finishing, machine for, ii, 262, 263.
- Horizontal tubular boiler, ii, 361-366.
 saw frame, ii, 312.
- Hydraulic fits, allowance for, i, 365.
 parallel holes and taper plugs for, i, 365.
 forging, ii, 260.
 press, ii, 260.
 pressure, i, 366.
- Hypocycloidal curves, i, 8.
- I**
- Inclination of skew bevel teeth, i, 61.
- Inch plate of milling machine, ii, 7.
- Index wheel, originating, i, 342, 353.
- Indicator, ii, 413.
 attachment of, to engine, ii, 416.
 diagram, area of the, ii, 419.
 diagrams, ii, 414.
 defective, ii, 421.
 expansion curve, ii, 417, 418.
 springs, ii, 417.
 vacuum line, ii, 415.
- Injector, feed, ii, 370.
 for locomotives, ii, 395.
- Inside calipers, i, 360.
 chasers, i, 335.
 errors in cutting up, i, 337.
- Interchangeable gearing, i, 16.
- Intermediate gears, i, 3.
 wheels, i, 319.
 rolling circle, i, 24.
- Internal gear wheels, i, 23-27.
 strains in cast iron work, i, 306.
 threading tools, i, 264.
 wheels, i, 23.
- Involute curves for gear teeth, i, 8.
 teeth, advantages of, i, 34.
- Iron and steel welding, ii, 234.
 bending, ii, 240.
 devices, ii, 240.
 galvanized, gauge for, i, 387.
 planer, erecting an, ii, 179.
 foundation for, ii, 180.
 plates, grindstones for, ii, 52.
 testing, ii, 226.
- Irregular forms, lathes for, i, 210.
 motion, cams for, i, 80.
 work, tugging, i, 326.
- Isochronal governors, ii, 384.
- J**
- Jacketed cylinders, ii, 374.
- Jam dies, i, 98.
 nuts, i, 119.
- Jeweller's rests for lathes, i, 189.
- Jigs, designing, i, 440.
 errors in, limit of, i, 439.
 for cutting out steam ports, i, 441.
 drilling engine cylinders, i, 440.
 drilling machines, i, 439.
 simple work, i, 440.
- Joining machines, ii, 338.
- Joints, boiler fitting, ii, 140.
 butt, boiler, ii, 352.
 cylinder cover, ii, 137.
 dovetail, ii, 275.
 easily removable, ii, 141.
 expansion, ii, 140.
- Joints, for boiler work, ii, 352.
 rough surfaces, ii, 138.
 gauze, ii, 138.
 ground, ii, 137.
 half check, ii, 275.
 lap, boiler, ii, 352.
 mitre, ii, 275.
 mortise, ii, 274.
 open, for wear, ii, 121.
 riveted, proportioning, ii, 355, 356.
 rubber, ii, 139.
 rust or caulked, ii, 141.
 scraped, ii, 137.
 tenon, ii, 274.
 thimble, ii, 141.
 to withstand great heat, ii, 138.
 water, ii, 138.
- Joule's equivalent, ii, 411.
- K**
- Key seats, cutting, ii, 101.
- Keys and gibs, fitting, ii, 120.
 bearing surfaces of, i, 126.
 draught of, i, 127.
 forms of, i, 126.
 for parallel rods, i, 128.
 seating rule, i, 378; ii, 101.
 with set-screws, i, 127.
- Keyway calipers, i, 363.
- Keyways, cutting by hand, ii, 101, 108.
 cutting out by drifts, ii, 109.
- Knife blade rolls, ii, 261.
 files, ii, 91.
- Knives for balanced heads, ii, 324-326.
 for jointing machines, ii, 338.
 moulding machines, ii, 336-340.
 moulding, scale for shapes of, ii, 83.
- Knurling tool, improved forms of, i, 328.
- L**
- Lap joint, boiler, ii, 352.
 of Corliss engine valve, ii, 426.
- Latent heat, ii, 410.
- Lathe, advantages of, i, 129.
 apron, i, 138.
 feed motion for, i, 168.
 back gear, i, 144.
 bench, i, 130.
 boring devices for, i, 288.
 tools, shapes of, i, 285.
 break, i, 151.
 capacity, i, 130.
 carriage, i, 145.
 feed motion for, i, 37.
 testing, ii, 182.
 carriers, i, 222.
 centre drilling attachment, i, 300.
 centres, i, 290.
 removing, i, 159.
 shapes of, i, 299.
 testing, i, 298.
 change wheels for, i, 139.
 chucks for, i, 188.
 chucking for boring purposes, i, 152.
 clamps, i, 223.
 classification of, i, 129.
 cutting fractional threads on, i, 181.
 helical teeth in the, i, 69.
 screws in the, i, 319.
 cutting-off machine, i, 193.
 cylinder boring, i, 219.
 dogs, various kinds of simple, i, 222.
 drivers, i, 222.
 English chucking, i, 149, 150.
 erecting a, ii, 180.
 extension, i, 151.
 face-plates, i, 243.
 chucking, i, 246.
 clamps for, i, 245.
 errors in, i, 143.
 for wood work, i, 247.
 feed-motions, i, 144.
 feed-screw, i, 175.
 feed, spindle for, i, 139.
 filing, fixtures for, i, 189.
 fit of the live spindle of a, i, 157.
 fitting up, ii, 180.
 foot, i, 130.
 for axe handles, i, 210.
 engine cylinders, i, 219.
 irregular forms, i, 210.
 taper turning, i, 142.
 turning crank shafts, i, 152, 154.
 turning wheel hubs, i, 221.
 gap, i, 151.
 grinding, i, 193.
 universal, i, 195.
 with elevating rest, i, 194.
 hand, i, 130.
 headstock, construction of, i, 153.
 importance and advantages of, i, 129.
 jewellers', rest for, i, 189.
 locking spindles of, i, 126.
 lead-screw, i, 175.
 bearings for, i, 139.
 nuts for, i, 140.
 supporting long, i, 176.
 mandrels, drivers for, i, 227.
 expanding, i, 227.
 for eccentric work, i, 229.
 nuts, i, 229.
 threaded work, i, 228.
 tubular work, i, 227.
 forms of, i, 229.

- Lathe mandrels, with expanding cones, i, 228.
with expanding pieces, i, 228.
motions for turning cams, i, 326.
open spindle, tailstocks for, i, 189.
pattern makers', i, 148.
pulley, i, 150.
screws, errors of pitch, i, 79.
screw slotting, i, 192.
self-acting, English, i, 148.
shears, the legs of, i, 184.
various forms of, i, 183.
methods of ribbing, i, 184.
or beds, i, 182.
with flat slides, i, 183.
V and flat slide, i, 183.
V slides, i, 183.
sizes of, i, 130.
slide-rest for, i, 131, 145.
lost motion of, i, 133.
special chucks for, i, 190.
swing frames, i, 158.
tailblock, i, 185.
setting over, for tapers, i, 136.
various methods of testing, i, 187.
wear of the spindles of, i, 185.
with rapid spindle motion, i, 185.
releasing devices, i, 185.
testing, i, 186.
instruments for, ii, 182.
tool-holders for outside work, i, 270.
with clamp, i, 271.
tools, angle of clearance of, i, 257.
height of, i, 260.
shapes of, i, 254.
watchmakers', i, 188.
with compound slide-rest, i, 140-143.
elevating rest, i, 194.
flat chucking surface, i, 143.
rapid spindle motion, i, 185.
sliding heads, i, 290.
variable speed, i, 192.
wooden bed, i, 149.
work, boring tools for, i, 285.
burnishing, i, 311.
chisels for, i, 339.
countersinks for, i, 302.
end measurements of, i, 376.
filing, i, 308.
flat drills for, i, 280.
holders for, i, 281.
forms of countersink for, i, 302.
gauge for, i, 359.
grinding clamps for, i, 311.
holding straps for, i, 244.
mandrels or arbors for, i, 227.
method of polishing, i, 308.
polishing clamps for, i, 311.
side tools for, i, 261.
technical terms used in, i, 296.
use of emery paper on, i, 308.
Lead-lined brasses, ii, 149, 386.
Lead of a valve, adjusting the, ii, 386.
Lead of slide valves, ii, 379.
Lead-screw, bearings for, i, 139.
conveying motion to the, i, 147.
nuts, i, 180.
for lathes, i, 175.
forms of threads of, i, 177.
long supporting, i, 176.
swing frame for, i, 139.
with three threads per inch, i, 177.
five threads per inch, i, 178.
Leather, grain side, weak, ii, 208.
Left-hand threads, cutting, i, 322.
Leg vise with parallel motion, ii, 63.
Lever feed drilling machine, i, 428.
drilling for blacksmiths, i, 457.
principles of, ii, 405.
Lift and force pumps, ii, 387.
Line of contact of skew bevel gear wheels, i, 61.
Line shafts, couplings for, ii, 194.
Line shifting, diameters of, ii, 189.
ordinary, ii, 186.
setting in line, ii, 184, 185.
sizes of, ii, 186.
the strength of, ii, 189.
Lined boxes, babbit metal, ii, 155.
Lining connecting rod brasses, ii, 126.
Link-motion gear, ii, 383.
fitting up, ii, 127.
for expansion engines, ii, 438.
for marine engines, ii, 443.
quick return shaper, i, 399.
setting the valves for, ii, 383.
the action of, ii, 383.
Link slot, templates for filing, ii, 127.
Lip drill, i, 443.
Live centres, tapers for, i, 159.
spindle, end adjustment of, i, 158.
wear of bearings, i, 158.
with coned journals, i, 157.
Locking, differential threads for, i, 190.
Lock work, drilling device for, i, 459.
Locomotive ash pan, ii, 390.
automatic air brake, ii, 390, 398.
axle boxes, ii, 147.
blower, ii, 390.
boiler and frames, ii, 389.
connecting-rod, ii, 116.
freight engine, ii, 389-404.
injector, ii, 395.
link motion, ii, 391-393.
passenger engine, ii, 390.
reversing gear, ii, 391.
sand valves, ii, 390.
safety and pop valves, ii, 389.
- Locomotive wheel forging, ii, 244.
yoke and guide bars, ii, 389.
Longevity of lubricants, ii, 153.
Lost motion in valve setting, ii, 174.
Low water in boilers, ii, 370.
Lubricants, longevity of, ii, 153.
qualities of, ii, 152.
testing, ii, 152.
Lubricators, steam, ii, 444.
- M**
- Machine centre drilling, i, 300.
cross cutting or gaining, ii, 305, 306.
for cutting mitre joint, ii, 338.
finishing horseshoes, ii, 262.
forging threads, ii, 261, 262.
gang edging, ii, 301.
gumming or gulleting, ii, 290.
horizontal saw frame, ii, 313.
moulding, ii, 334.
scroll sawing, ii, 306.
Machinery for wood working, ii, 287.
Machinists' chisels, applications, ii, 76.
hand hammers, ii, 66.
sledge hammer, ii, 71.
Main bearings, adjusting, ii, 386.
Mallet, ii, 72.
Mandrels, expanding, i, 227.
for threaded work, i, 228.
lathe, i, 227.
expanding, i, 228.
for eccentric work, i, 229.
for nuts, forms of, i, 229.
with expanding cones, i, 228.
with expanding pieces, i, 228.
or arbors for lathe work, i, 227.
Mangle gearing, various forms of, i, 76.
Manufacturers' temper, ii, 460.
Marine-engine boilers, ii, 436, 437.
connecting-rod, ii, 116.
Hink motion, ii, 443.
pumps, ii, 436.
valves, ii, 444.
Marine engines, pipes of, ii, 445.
various, ii, 434.
Marriott's law, ii, 411.
Matched cutters, ii, 23.
Matching and planing machines, ii, 326.
Mean effective steam pressure, ii, 420.
Measurements, the standards of, in various countries, i, 341.
Measuring by sight, and feeling, i, 341.
machine for sheet metal, i, 348.
special, i, 342-346.
tools, classification of, i, 354.
valve lead, ii, 173.
Mechanical equivalent of heat, ii, 411.
powers, ii, 405.
Metal, soft, files for, ii, 95.
Metric pitch screws, i, 322.
Meyer's cut-off valve, ii, 378.
Micrometer caliper, i, 354.
gauge for thread angles, i, 91.
Mill boring, i, 211.
turning, i, 211.
Milling-cutters, grinding, ii, 32.
or mills, ii, 16.
with inserted teeth, ii, 24.
Milling-machine, ii, 1-16.
advantages of, ii, 1.
chucks for, ii, 31.
cam cutting attachment, ii, 12.
cutters, ii, 17-31.
double-spindle, ii, 16.
fixtures for, ii, 10.
hand, i, 410.
head for spiral cutting, ii, 12.
holding work on, ii, 30.
power, ii, 2.
rotary vise for, ii, 10.
universal, ii, 2, 4, 12, 15.
vertical, ii, 31.
Milling or knurling tools, i, 328.
Milling taper work, ii, 30.
Mitre gauge, use of, ii, 295.
joint, ii, 275.
machine, ii, 338.
wheels, i, 1.
Monkey wrench, i, 125.
Mortise gauge, ii, 274.
Mortised gear-wheels, i, 63.
Mortising machines, ii, 344.
Moulding knives, scale for marking out the necessary shapes of, ii, 83.
Moulding-machines, ii, 334, 339.
cutters for, ii, 336, 337, 341.
Muffle, ii, 461.
Mule pulleys for belts, ii, 211.
Music wire, gauge for, i, 386.
- N**
- Nail bit, i, 452.
Nail forging machines, ii, 261.
Non-condensing engine, ii, 372.
Nose bit, i, 453.
Notch wire gauges, i, 384.
Number of cutters used for a train of wheels, i, 41.
of cutters on boring bars, i, 290.
of cutting edges on taps, i, 105.
of cutting edges on reamers, i, 282.
Nut-tapping-machine, i, 475.
automatic socket for, i, 475.
rotary, i, 475.
- Nut-tapping-machine, three-spindle, i, 475.
Nuts, filing, ii, 105.
jam, i, 119.
lock, i, 119.
lost motion in, i, 120.
not moving corroded, i, 122.
securing by cotters, i, 121.
by notched plates, i, 121.
by taper pins, i, 121.
devices, i, 120.
steam tight, the forms of, i, 118.
taking up the wear of, i, 120.
- O**
- Odontograph, using, i, 47, 49.
Oil and lubrication, ii, 151.
cavities for brasses, ii, 150.
groove or curved chisel, ii, 76.
for brasses, ii, 150.
heavy, for hot bearings, ii, 386.
stones, truing, ii, 54.
various kinds of, ii, 54.
test, Swiss, ii, 153.
Oiling apparatus, ii, 439, 440.
devices for planer beds, i, 476.
true surfaces, ii, 135.
Oils, testing for acids, ii, 153.
testing for salts, ii, 153.
Oilstone edge tools, ii, 54.
Olivers, ii, 252, 253.
Open brasses, ii, 149.
sided shafting hangers, ii, 193.
spindle lathes, tailstocks for, i, 189.
Originating angles for screw threads, i, 92.
cams, i, 326.
fly cutters, ii, 21.
gear teeth, i, chaps. I, II, III.
index wheels, i, 345.
surface plates, ii, 135.
templates for screw threads, i, 92.
Outside and inside chasers, i, 335.
calipers, making, ii, 105.
the various forms of, i, 360.
threads, starting, i, 338.
- P**
- Paddle wheels, ii, 444, 445.
Panel planing, ii, 332, 333.
Panning or pening, ii, 72.
hammers, ii, 68.
Pantagraph engine for dressing the cutters for gear teeth, i, 38.
motions, ii, 417.
Paper friction wheel, i, 78.
Parallel cutters, grinding, ii, 32.
holes and taper plugs for hydraulic fits, i, 365.
rods, keys for, i, 128.
Paring chisels, ii, 271.
Patching broken frames, ii, 178.
Path of gear tooth contact, i, 13, 16.
Pattern lathe, brake for, i, 149.
slide-rest for, i, 149.
with wooden bed, i, 149.
Pattern-makers' lathe, i, 148.
pipe gauge, i, 379.
Pattern-making, woods for, ii, 264.
Patterns, building up, ii, 278.
brasses, proper shape for, ii, 132.
choice of wood for, ii, 264, 265.
for angle pipe, ii, 284, 285.
glands, ii, 275.
globe valves, ii, 281, 282.
pillow blocks, ii, 277.
pipes, ii, 280, 281.
pulleys, ii, 278, 279.
spacing gear-wheel teeth on, i, 58.
Pattern-wheel scale, i, 51.
Pening or paning, ii, 72.
Platé gear cutting machine, ii, 56-61.
Pillow-block casting, ii, 277.
fitting brasses to, ii, 131.
for shafting, ii, 194.
patterns, ii, 277.
Pinion bevel, drawings for, i, 59.
with dovetail teeth, i, 60.
Pins, securing, for adjustment, i, 121.
filing, ii, 103.
fitting in double eyes, i, 121.
fixed, i, 122.
taper, i, 128.
working, i, 122.
wrench, i, 126.
Pine cutters, ii, 142.
gauge, pattern-makers', i, 379.
patterns, ii, 280, 281.
threads, taper for, i, 95.
tongs, ii, 143.
vises, ii, 142.
work, erecting, ii, 144.
Pipe-threading by hand, i, 463.
by power, i, 463.
machine, i, 475-477.
machines, construction of, i, 463.
Piston valves, ii, 378.
Pitch, alteration in hardening, i, 108.
circle, the diameter of, i, 1.
correcting the errors of, i, 109.
gauging the, after hardening, i, 108.
line of cams, i, 80.
lines of elliptical gear-teeth, i, 70.
number of teeth, and pitch diameter, i, 68.
of screw threads, i, 85.
- Pitch of teeth for band saws, ii, 309.
Pivoted arms for tooth templates, i, 44.
Plane blades, ii, 77.
blades, finding shapes of, for mouldings, ii, 78-83.
Planer beds, flat guideways for, i, 414.
beds, oiling devices for, i, 416.
centres, i, 408.
chuck, for curved work, i, 420.
chucking halves of pulleys on, i, 423.
chucks, i, 419.
for spiral grooved work, i, 419.
for timber, ii, 330, 331.
head slides, wear of, i, 410.
or iron planing machine, i, 402.
shapers, reversing, i, 398, 399.
swivel heads for, i, 411.
swivelling tool holder, i, 411.
tool, aprons for, i, 411.
heads, feed motions for, i, 414.
graduations of, i, 390.
safety devices for, i, 413.
V-guideways for, i, 414.
tables, angle plates for, i, 418.
chucking devices for, i, 422.
chucking machine beds on, i, 421.
forms of bolts for, i, 417.
supplementary tables for, i, 417.
tool-holder, applications of, i, 425.
with tool post, i, 425.
examples of application of, i, 426.
simple form of, i, 426.
tools for coarse finishing feeds, i, 423.
for slotted work, i, 424.
clearance of, i, 424.
shapes of, i, 423.
gauge for, i, 423.
Planes, ii, 267-270.
circular, ii, 268.
combination, ii, 269.
compass, ii, 268.
core-box, ii, 269.
for pattern making, ii, 268, 269.
fore, ii, 268.
grinding of, ii, 267.
jack, ii, 267.
oilstoning of, ii, 267.
rabetting, ii, 268.
Plane surfaces, friction of, ii, 135.
Planet motion, i, 75.
Planimeter, ii, 420.
Planing and matching machine, ii, 326.
curved work, i, 420.
guideways, i, 421.
Planing-machine, i, 406-426.
gear, ii, 56.
large, chucks for, i, 423.
motions of, i, 402, 403.
tables, i, 414.
tables, slots and holes in, i, 415.
with double heads, i, 404.
wood, ii, 326.
Plate couplings, ii, 196.
straightener's hammers, ii, 68.
Plates, angle, for planer tables, i, 418.
iron, grindstones for, ii, 52.
saw, grindstones for, ii, 52.
straightening, ii, 69.
Plug and collar gauges, i, 357.
Plug gauges for threads, i, 91.
Plumb level, ii, 136.
rule, ii, 136.
Plunger pumps, ii, 370, 387.
Point of compression, ii, 376.
cut off, ii, 376.
release, ii, 376.
Poker, ii, 369.
Polishing clamps, i, 311.
device for engraver's plates, ii, 51.
materials, for brush wheels, ii, 50.
for polishing wheels, ii, 50.
for rag wheels, ii, 51.
wheels, ii, 49-51.
construction of, ii, 49.
emery charging, ii, 50.
for brass work, ii, 50.
lapping leather on, ii, 49.
large, keeping true, ii, 50.
materials for, ii, 50.
rag, ii, 51.
speed of, ii, 50.
Polygons, measuring sides, ii, 283.
Pony planer, ii, 323.
Position of emery wheel, ii, 35-37.
of dies in bolt cutting, i, 473.
of taper pins for locking, i, 128.
Positive feed, gear cutter, ii, 55.
Pounding, the causes of, ii, 168.
Power drilling machine, i, 428.
hammer, ii, 252.
lathes, i, 130.
milling machine, i, 470.
of an engine, testing, ii, 408.
threading machine, i, 465.
Powers, mechanical, ii, 405.
Preserving wood, ii, 264.
Press for forging, ii, 260.
Pressure and volume of steam, ii, 411.
Priming, its causes and prevention, ii, 370.
Profiling machine, ii, 31, 32.
Protractors, bevel, i, 380.
Propeller, screw, ii, 445.
Pulley arms, ii, 280.
Pulley balancing, device for, ii, 203.
boring machine, i, 438.
considered as a lever, ii, 405.
diameter, change for grindingstone speed, ii, 52.

- Pulley, crowned, ii, 201.
 expansion, ii, 200.
 lathe, i, 150.
 patterns for, ii, 278.
 self-oiling, ii, 200.
 solid and split, ii, 200.
 calculating speeds of, ii, 204.
 transmitting power of, ii, 204.
 turning, i, 318.
 turning, special lathe for, i, 211.
 wood, ii, 200.
- Pump air chambers, ii, 388.
 capacity of, ii, 388.
 displacement, ii, 387.
 plunger, ii, 387.
 principles of action of, ii, 387.
- Pumps belt, ii, 388.
 for circulating, ii, 440.
 double acting, ii, 387.
 lift and force, ii, 387.
 for marine engines, ii, 436.
 regulating, ii, 388.
 rotary, ii, 387.
 single acting, ii, 387.
- Q**
- Quartering machine, i, 434.
 Questions for Engineers, ii, 467.
 Quick removal, bolts for, i, 116.
 Quick-return motion, Whitworth's, i, 401.
 shapers, link motion for, i, 399.
- R**
- Rabbit planes, ii, 260.
 Rack and pinion wheel, i, 1.
 Rack feed saw bench, ii, 301.
 Radial drilling machines, i, 430, 431.
 Radiation of heat, ii, 412.
 Rag polishing wheels, ii, 51.
 wheel, polishing materials for, ii, 51.
 Raised V-guideways, lathes with, i, 182.
 Rake, ii, 360.
 Ramsden's dividing engine, i, 349.
 Rasps, kinds and cut of, ii, 87.
 Ratchet brace, i, 457.
 feeds, i, 173.
 Rates of feed for finishing cuts, i, 307.
 Reamers, adjustable, ii, 99.
 chucking, i, 280.
 chucking for true work, i, 283.
 for framing, ii, 99.
 grinding the teeth of, i, 282.
 half round, ii, 99.
 hand, ii, 98.
 number of teeth for, i, 282.
 rose-bit or rose, i, 283.
 shell, i, 283.
 shell rose, i, 284.
 spacing the teeth of, i, 282.
 spiral teeth for, i, 282.
 square, ii, 99.
 taper, ii, 99.
 Reamer-pin, with facing tool, i, 449.
 Reamer-teeth, odd or even, i, 282.
 spacing of, i, 282.
 Reaper-files, ii, 91.
 Reboring cylinders in place, ii, 160.
 Recentring turned work, i, 304.
 Recessed emery wheels, ii, 47.
 Reciprocating motion, gear for, i, 77.
 Red marking for vise work, ii, 96.
 Reducing knife, i, 209.
 Reduction of temper, ii, 461.
 Refitting leaky cocks and plugs, ii, 144.
 Regulating pumps, ii, 388.
 Release, the point of, ii, 376.
 Releasing devices, tailblock with, i, 185.
 Relief feed valve, ii, 441.
 Removing corroded bolts, i, 122.
 corroded nuts, i, 122.
 featheredge, ii, 54.
 Repairing broken frames, ii, 178.
 connecting rods, ii, 124.
 Resharpener files, ii, 95.
 Rests, follower, i, 234.
 Return cams, designing, i, 82.
 motions compared, i, 401.
 Reversible jawed chucks, i, 237.
 Revolving cutters for gear teeth, i, 37.
 Ribbing lathe shears, i, 184.
 Right and left angular cutters, ii, 18.
 and left hand cutters, ii, 18.
 Ring work, expanding chucks for, i, 241.
 Rings, welding, ii, 235.
 Rip saws, ii, 272, 273.
 Rivet diameters, ii, 356.
 Riveter's hammer, ii, 71.
 Riveting crank pins, ii, 73.
 Riveted-joints, forms of, ii, 352.
 proportioning, ii, 354-356.
 strength of, ii, 354.
 unevenly spaced rivets, ii, 353.
 Rivets, diagonal pitch of, ii, 353.
 spacing of, ii, 353.
 Rod-feed for screw machines, i, 206.
 Roll-feed circular saw, ii, 298-300.
 wood planing machine, ii, 317.
 Rolling motion of gear teeth, i, 16, 27.
 Rolling-circles, by using two, the pinion may contain but one tooth less than the wheel, i, 26.
 circles for internal gearing, i, 25.
 curves for gear teeth, i, 43.
 Roll-turning lathe, i, 215.
 lathe, tools for, i, 216.
 calender, method of driving, i, 200.
- Rolls for knife blades, ii, 261.
 Rope socket, forging, ii, 243.
 Rose-bit or rose reamers, i, 283.
 Rotary nut tapping machine, i, 475.
 planing machine, i, 395.
 pumps, ii, 387.
 Roughing cuts, feeds for, i, 306.
 Rough surfaces, joints for, ii, 138.
 Round corners, filing out, ii, 95.
 files, using of, ii, 95.
 half-round, three-square files, ii, 90.
 Round-nosed chisels, ii, 75.
 tools, i, 257.
 Rudder frame, forging, ii, 245.
 Rule for finding horse-power, ii, 418.
 for locating pitch line of worm, i, 29.
 for finding the chord pitch, diametral pitch, and arc pitch, i, 3.
 for proportioning the steps of the driving cone, i, 159, 161.
 Russian sheet iron, gauge for, i, 387.
 Rust or caulked joints, ii, 140.
- S**
- Safety devices for planer heads, i, 413.
 Safety-valve, the inspection of, ii, 368.
 calculations for, ii, 409.
 Sag of belts, ii, 210.
 Salts and acids, testing oils for, ii, 153.
 Sand blast process, ii, 96.
 Sand-papering machines, ii, 347-349.
 Saturated steam, ii, 410.
 Saw bench, rack feed, ii, 301.
 frame, horizontal, ii, 312.
 hack, ii, 97.
 hammering, ii, 70, 71.
 machine, tubular, ii, 305.
 machines, re-sawing band, ii, 310.
 maker's hammer, ii, 68.
 plates, grindstones for, ii, 52.
 straightening, ii, 70, 71.
 teeth, shapes of, ii, 263, 287.
 Sawing hot iron, ii, 263, 287.
 Saws, chisel teeth for, ii, 290.
 concave, ii, 287, 288.
 cross-cut, ii, 272, 273.
 for swing frame, ii, 292.
 grindstones for, ii, 52.
 hardening, ii, 462.
 heating of circular, ii, 288.
 insertion of teeth in, ii, 290.
 rip, ii, 272, 273.
 sharpening the teeth of, ii, 290.
 shingle, ii, 287, 288.
 stiffening, ii, 463.
 tension of, ii, 288.
 truth of circular, ii, 288.
 Sawyer's valve for governors, ii, 384.
 Scale for moulding knives, ii, 83.
 of tooth proportions, i, 54.
 Scraped joint making, ii, 137.
 Scrapers, angles for facets of, ii, 97.
 applications of, i, 332.
 for finishing, i, 307.
 for true surfaces, ii, 97.
 various forms of, ii, 97.
 Scraping out cylinder heads, ii, 160.
 Scrap iron, furnaces, ii, 247.
 welding, ii, 247.
 Screw-cutting, driver for, i, 223.
 face plate for, i, 223, 228.
 feed regulators for, i, 171.
 hand tools, i, 96.
 pitches, metric system, i, 322.
 reversing tool traverse in, i, 168.
 with hand tools, i, 334.
 Screw-driver, and shape, ii, 97.
 Screw-machine, box tools for, i, 208.
 chuck for, i, 205.
 cross-slide for, i, 205.
 feed gear for, i, 205.
 cutting off tool for, i, 208.
 examples of use of, i, 203.
 for heavy work, i, 201.
 light work, i, 203, 204.
 or screw making lathe, i, 200.
 stop motion for, i, 206.
 threading tool for, i, 208.
 tool holders and tools for, i, 202.
 turret of, i, 205.
 with special wire feed, i, 206.
 Screw-propeller, ii, 445.
 Screw-slitting lathe, i, 192.
 Screw-thread angles, gauge for, i, 91.
 cutting tools, the wear of, i, 89.
 standard forms of, i, 85, 86.
 Screw-threads, alteration of shape, i, 89.
 pitch of, i, 85.
 requirements of, i, 86.
 self-locking, i, 85.
 tools for cutting, i, 87.
 variation of pitch, i, 87.
 Screws, i, 115.
 belt, ii, 216.
 set, i, 127.
 variation of pitch, i, 87.
 Scroll chucks, i, 238.
 chuck threads, wear of, i, 238.
 sawing machine, ii, 306.
 Seams for boilers, forms of, ii, 352.
 Securing leathers, methods of, i, 120.
 devices, nut, i, 120.
 pins for exact adjustments, i, 121.
 Segment circular saws, ii, 300.
 Segments, for patterns, ii, 278, 279.
 saw, fastening to discs, ii, 301.
- Self-acting lathe, English form of, i, 148.
 locking bolts, i, 117.
 nuts, i, 85.
 screw threads, i, 85.
 Self-adjusting couplings, ii, 198.
 Self-oiling pulleys, ii, 201.
 Set-screws, i, 115.
 application to hubs, i, 127.
 Setting angular grooving cutters, ii, 28.
 brasses to pillow-blocks or axle-boxes, ii, 131.
 double eccentric by lines, ii, 175.
 connecting-rod brasses, ii, 125.
 eccentrics on crank shafts, ii, 174.
 engine cylinders, ii, 159.
 engine guide bars, ii, 162.
 guide-bars by stretched line, ii, 163.
 line shafting in line, ii, 184, 185.
 locomotive slide valves, ii, 304.
 numbers and tabular values for odontograph, i, 50.
 over tailstock to turn tapers, i, 312.
 slide valves, ii, 173.
 threading tools, i, 266.
 up or aligning new engines, ii, 165.
 up axle box wedges, ii, 404.
 up keys of connecting rods, ii, 127.
 work after case hardening, ii, 129.
 Settings for boilers, ii, 364.
 Shaft, flexible, for driving drills, i, 459.
 forging, ii, 249-252.
 Shafting, collars for, ii, 189.
 couplings, errors in, ii, 196.
 pillow blocks for, ii, 194.
 speeds for, ii, 190.
 tests of, ii, 188.
 turning, three-tooth slide-rest, i, 143.
 hangers, open-sided, ii, 193.
 various forms of, ii, 192.
 Shafts, sinking feathers in, ii, 101.
 welding to exact lengths, ii, 234.
 Shaking grate bars, ii, 369.
 Shank cutters, ii, 19.
 cutters, applications of, ii, 20.
 feed for, ii, 20.
 sizes of, ii, 21.
 drill, improved form of, i, 446.
 Shanks, drill, i, 445.
 Shapes of boring bar cutters, i, 291.
 of centres for large work, i, 299.
 crowns of brasses, ii, 127.
 cutting edges of chisels, ii, 74.
 file teeth, ii, 85.
 hammer eyes, ii, 66.
 lathe boring tools, i, 285.
 lathe tools, i, 254.
 planer tools, i, 423.
 Shaping-machine, centres for, i, 397.
 crank motions for, i, 401.
 general description of, i, 389.
 or planer shaper, with tappet motion for reversing, i, 399.
 quick return link motion, i, 399.
 with traveling head, i, 397.
 Shears, lathe, i, 182.
 Sheet iron, gauge for, i, 387.
 metal, measuring, machine for, i, 348.
 zinc, gauge for, i, 387.
 Shell reamers, i, 283.
 rose reamers, arbor for, i, 283.
 rose reamers, i, 284.
 Shimer heads, ii, 337.
 Shingle saw, ii, 287, 288.
 Shrinkage fits, i, 366.
 gauge for, i, 367.
 of iron, i, 368, 374.
 system at the royal gun factory at Woolwich, i, 367.
 Shrinking work, to re-fit it, i, 374.
 Side rake in lathe tools, i, 256.
 tools for lathe work, i, 261.
 Siphon, ii, 442.
 Size of mandrel holes for saws, ii, 287.
 Sizes of lathes, i, 130.
 Skew bevel gear-wheels, i, 61.
 cutters, ii, 316.
 knives, ii, 316.
 Sledge hammer, machinist's, ii, 71.
 Slice bar, ii, 369.
 Slide, construction of, i, 390.
 Slide-rest, American form of, i, 132.
 application of, to a crank, i, 155.
 compound tool-holder for, i, 174.
 detachable, i, 143.
 double tool-holder for, i, 169.
 English form of, i, 132.
 for lathe crank turning, i, 154.
 lathes, i, 131.
 pattern lathe, i, 149.
 special lathe, i, 145.
 spherical work, i, 133.
 gibbed, elevating, i, 169.
 Various forms of, i, 132.
 Slides of planers, construction of, i, 410.
 of planer heads, wear of, i, 410.
 Sliding motion of gear teeth, i, 16, 27.
 motion of worm-wheel teeth, i, 28.
 Slide-valve, exhaust lap of, ii, 376.
 lead adjusting, ii, 376.
 setting, ii, 386, 394.
 squaring, ii, 386.
 the Allen, ii, 377.
 the D, ii, 376.
 Webb's, ii, 377.
 Slide-valves, balanced, ii, 377.
 circular, ii, 377.
 designing, ii, 380.
 double ported, ii, 377.
- Slide-valves, steam lap of, ii, 376.
 the lead of, ii, 376.
 Slots and holes in planing-machine tables, i, 417.
 Slotted work, tools for, i, 424.
 Slotted-machine, i, 459.
 sectional view of, i, 460.
 tool-holders, i, 460, 461.
 tools, i, 461.
 Sniffing valve, ii, 440.
 Socket forging, ii, 243, 244.
 wrench, i, 125.
 Sockets, drill, i, 445.
 Solid and split pulleys, ii, 200.
 ended connecting rods, ii, 114.
 leather wheels, ii, 51.
 tap wrenches, i, 110.
 Spacing gear-wheel teeth, i, 57, 58.
 reamer teeth, i, 282, ii, 98.
 rivets in boiler seams, ii, 353.
 Special chucks for watchmakers' lathes, i, 190.
 index plate for gear cutting, ii, 7.
 forms of chucks, i, 241.
 lathe for pulley turning, i, 211.
 for wood working, i, 208.
 for brass work, i, 216.
 Specks in cast-iron work, i, 307.
 Speeders for governors, ii, 384.
 Speed of a hammer blow, effects of, ii, 65.
 of automatic engines, ii, 427.
 brush-wheels, ii, 50.
 cutter heads or discs, ii, 338.
 emery-wheels, ii, 39.
 governors, ii, 384.
 grindstones, ii, 52.
 pulleys, calculating, ii, 204.
 polishing wheels, ii, 50.
 shafting, ii, 190.
 Speeds and feeds for twist drills, i, 277.
 for cutting wrought iron, i, 294.
 Spherical work, slide-rest for, i, 133.
 Spindles live, with coned journals, i, 157.
 various methods of locking, i, 186.
 Spiral cutters, grinding teeth of, ii, 36.
 feed in cutting, ii, 27.
 grooves, drill stock with, i, 445.
 planer chucks for, i, 410.
 springs, winding in the lathe, i, 329.
 teeth for reamers, i, 282.
 Spirit levels, ii, 136.
 Spoon bit, i, 452.
 Spring adjustment of governors, ii, 384.
 calipers, i, 360.
 of engine guide-bars, ii, 162.
 swages for blacksmiths, ii, 231.
 tools, i, 263.
 Springs for indicators, ii, 416.
 Spur-wheel, annular, i, 23.
 compared with annular, i, 32.
 construction of pattern for, i, 54.
 Square work, steady rest for, i, 233.
 centre, advantage of, i, 303.
 various forms of, i, 303.
 centring, i, 300.
 holes, device for drilling, i, 450.
 reamers, ii, 99.
 bevel, i, 380.
 shanked drills, i, 446.
 the T, i, 379.
 the try, i, 379.
 Squaring a valve, ii, 386.
 Square-threads, clearance of tools, i, 269.
 cutting, i, 269.
 dies for finishing, i, 250.
 worms to work with, i, 29.
 Stable fork, forging of, ii, 247.
 Standard-cutters, ii, 17.
 Standard bar for the United States standard of measurement, i, 341.
 gauges, diameter of work limits the application of, i, 363.
 for taper work, i, 316.
 for wire, etc., i, 384.
 plug and collar gauges, i, 91.
 screw threads, i, 91.
 sizes of washers, i, 123.
 taps, i, 104.
 variations in, i, 341.
 Starting a slide valve engine, ii, 384.
 a locomotive, ii, 400.
 Stationary engine boilers, ii, 350-371.
 Steady-rest, cat-head, i, 233.
 clamps, i, 233.
 for square and taper work, i, 232.
 improved form of, i, 233.
 or back rest, i, 231.
 work, drivers for, i, 225.
 Steam, ii, 410.
 admitted to indicator, ii, 414.
 amount of, used in engines, ii, 420.
 engine high pressure, ii, 372.
 expansion of, ii, 411.
 fire engine, ii, 430, 431.
 hammer forging, examples in, ii, 241.
 hammers, ii, 252-259.
 laps of slide valves, ii, 376.
 lubricators, ii, 444.
 pipe thread, tapping machine, i, 477.
 pipes, dies for, i, 101.
 ports, jigs for cutting out, i, 431.
 pressure absolute, ii, 411.
 reversing gear, locomotive, ii, 390.
 saturated, ii, 410.
 superheated, ii, 410.
 tight nuts, i, 118.
 volume and pressure of, ii, 411.

- Steam, weight of, ii, 411.
 Steaming, wood for bending, ii, 266, 267.
 Steel and iron welding, ii, 233, 234.
 plates, engraver's, polishing, ii, 51.
 Steering gear for fire engines, i, 75.
 Stepped connecting-rod straps, ii, 117.
 reamers for taper work, i, 285.
 Stiffening saws, ii, 463.
 Stock, adjustable, i, 448.
 Stocks and dies, i, 97, 101.
 for drilling machines, i, 449.
 forms of, i, 101.
 Stone drill, i, 454.
 Stop motion for gear-wheels, i, 7.
 for screw machines, i, 206.
 Straight-edge and applications, i, 381.
 Straightening saws, ii, 70, 71.
 lathe work, device for, i, 305.
 machine for bar iron, i, 304.
 plates, ii, 69.
 wire, check for, i, 305.
 work by pening, ii, 72.
 Straight-line-engine, automatic, ii, 428.
 important details of, ii, 429, 430.
 Strains on boiler shells, ii, 351.
 Strap ended connecting rod, ii, 116.
 Straps, connecting rod, ii, 115.
 connecting rod, fitting, ii, 120.
 Strength of boiler plate, ii, 350.
 boiler shells, ii, 350.
 gear-wheel cogs, i, 66.
 gear-wheel teeth, i, 64.
 line shafting, ii, 190.
 wire, experiments on the, i, 387.
 Stroke jointers, ii, 338, 339.
 Studs, i, 115.
 Sun-and-planet motion, i, 75.
 Superheated steam, ii, 410.
 Supplementary planer tables, i, 417.
 Surface condensers, ii, 440, 442.
 condensing engine valves, ii, 442.
 Surface gauge, i, 378.
 Surface plates, originating, i, 383; ii, 132.
 Surfaces, rough, joints for, ii, 138.
 true, scrapers for, ii, 97.
 Swage blocks, ii, 232.
 Swages, spring, ii, 232.
 for blacksmiths, ii, 230, 231.
 Swaging, blacksmiths' work, ii, 232, 233.
 Swing-frame, i, 158.
 attaching, i, 166.
 for lead screw, i, 139.
 saws, ii, 290, 291.
 Swing machine with fixed table, ii, 294.
 Swing machine level or mitre, ii, 296.
 Swiveled tool-holding devices, i, 411.
 Swiveling vice chucks, i, 395.
 vises, ii, 63.
 Swivel-heads, construction of, i, 389.
 for planers, i, 411.
 Swiveling tool-rest, i, 174.
- T**
- Table of arc and diametral pitches, i, 3.
 change wheels, screw cutting, i, 180.
 circular saw diameters, ii, 287.
 feeds for twist-drills, i, 277.
 index holes for gear cutting, ii, 7.
 natural sines, i, 3.
 of wrought iron tubes, i, 95.
 pitch-diameter, pitch, and number of
 teeth in gear-wheels, i, 68.
 pressure, temperature and volume of
 steam, ii, 367.
 screw threads, i, 95, 96, 107.
 sizes of, bolts and nuts, i, 114.
 milling-machine cutters, ii, 17.
 tapping drills, i, 445.
 twist drills and shanks, i, 442.
 speeds for twist drills, i, 277.
 spring for indicators, ii, 416.
 standard for the V-thread, i, 95.
 Tabular values and setting numbers for
 odontograph, i, 51.
 Tail-block lathe, i, 185.
 Tailstock, adjustments of, i, 245.
 chucks, i, 135, 145.
 construction of, i, 209.
 for drilled work, i, 279.
 engine lathe, i, 135.
 open spindle lathes, i, 189.
 securing and releasing, i, 136.
 Tangent screw, i, 1.
 Tap-wrenches, adjustable, i, 110.
 Taper bolts, standards, i, 350.
 cutters, fixtures for, ii, 34.
 for pipe threads, i, 95.
 grinding, ii, 33.
 holes, device for drilling, i, 451.
 milling, ii, 30.
 pins, fitting, i, 128.
 position for locking, i, 128.
 plugs for hydraulic fits, i, 365.
 reamers, ii, 99.
 taps for blacksmiths, i, 106.
 threads, cutting, i, 338.
 turning attachments, i, 143.
 lathe, i, 142.
 Tapered connecting-rod ends, ii, 117.
 Taper-work, centres for, i, 226.
 chucking, i, 394.
 fitting, i, 313.
 fixture for grinding, ii, 33.
 gauge for setting over, i, 313.
 grinding, i, 313.
 plug and collar gauges for, i, 357.
 standard gauges for, i, 316.
- Taper-work, steady rest for, i, 233.
 stepped reamers for, i, 285.
 turning, i, 312, 313.
 wear of lathe centres in, i, 312.
 Tapers for live centres, i, 159.
 Tapping, i, 111.
 drills, table of sizes of, i, 445.
 machine for steam pipe thread, i, 477.
 Taps, clearance on, i, 102.
 collapsing, machine, i, 107.
 for lead, i, 109.
 for very straight holes, i, 109.
 form of, i, 103, 104.
 improved forms of, i, 103.
 number of cutting edges, i, 106, 471.
 taper, for blacksmiths, i, 106.
 taper, the friction of, i, 102.
 wear of, i, 89.
 Technical terms in lathe work, i, 296.
 Tees, patterns for, ii, 284.
 Teeth, angular, end thrust of, i, 69.
 angular or herring bone, i, 69.
 band saw, ii, 308, 309.
 cast, the contact of, i, 67.
 curves of elliptical, i, 73.
 file, shapes of, ii, 85.
 gear-wheel, factors of safety, i, 64.
 for variable motion, i, 74.
 requirements of curves, i, 7.
 helical, i, 69.
 reamer, number of, i, 282.
 spacing of, ii, 98.
 saw, ii, 273, 287.
 Temper, blacksmiths', ii, 460.
 drawing, the, ii, 462.
 manufacturers', ii, 460.
 reduction of, ii, 461.
 Tempering, ii, 460-464.
 color, ii, 460.
 heating in fluxes, ii, 462.
 methods of, special, ii, 461-464.
 outside, ii, 462.
 using a muffle, ii, 461.
 warping in, ii, 461.
 Template, ii, 110-112.
 of Corliss bevel-gear-engine, i, 45.
 for curves, i, 384.
 marking division lines on the face
 of a gear wheel, i, 59.
 filing a link slot, ii, 129.
 gear-teeth, i, 43, 44.
 involute curves, i, 32.
 planing teeth to shape, i, 54.
 rolling gear-tooth curves, i, 43.
 gauges for end measurements, i, 376.
 Tenoning machines, ii, 344.
 Tenon joints, ii, 274.
 Tension of band saws, ii, 310, 311.
 belts, ii, 211.
 circular saws, ii, 288.
 Testing angle of bevel wheels while in
 the lathe, i, 60.
 boilers, strength of, ii, 456.
 engine alignment, ii, 166-172.
 engine guide-bars, ii, 163.
 indicator expansion curves, ii, 417.
 iron, ii, 226-228.
 lathe carriages, ii, 182.
 lathe tailblock, i, 187.
 lathes, i, 180, 181.
 lubricants, ii, 152.
 machines for iron, ii, 227, 228.
 oils, ii, 153, 154.
 shafting, ii, 188.
 squares, various methods of, i, 379.
 the power of an engine, ii, 408.
 various methods of, i, 187.
 Theoretical compression curve, ii, 421.
 diagram, ii, 415.
 expansion curve, ii, 417, 418.
 Thimble joints, ii, 141.
 Thinning twist-drill points, ii, 44.
 Thread angles, gauge for, i, 91.
 cutting, i, 111.
 avoiding friction in, i, 474.
 dies, i, 97.
 taps, i, 102.
 tools, angles of, i, 91.
 wear of, i, 88.
 pitch varied by hardening, i, 87.
 screw, forms of, i, 85.
 Threaded work, drivers for, i, 225.
 Threading dies, cutting speeds for, i, 474.
 dies, hob for, i, 474.
 machine, hand bolt, i, 464.
 hand, revolving head, i, 465.
 pipe, i, 463, 475-477.
 power, i, 466.
 tools, circular, i, 264, 267.
 for gauges, i, 266.
 screw machine, i, 203.
 holders, i, 267.
 internal, i, 264.
 setting, i, 266.
 the level of, i, 265.
 Threads, diameter at the roots of, i, 269.
 left-hand cutting, i, 322.
 square, clearance of tools for, i, 269.
 Three and four-jawed chucks, i, 237.
 Three-spindle drilling machine, i, 434.
 nut tapping machine, i, 475.
 Three-tool slide-rest for shafting, i, 143.
 Three or four boring bar cutters, i, 290.
 Throttle valves leaky, ii, 386.
 Throttling governors, ii, 384.
 Thrust bearings, ii, 445.
 Thrust on wheel shafts, i, 16.
 Timber, bending, ii, 265, 266.
- Timber, shakes or cracks in, ii, 264.
 shrinkage of, ii, 264.
 steaming to bend it, ii, 266.
 Timber-planer, ii, 330, 331.
 Tit drill, i, 443.
 Tongs, blacksmiths', ii, 229.
 Tool aprons for planers, i, 411.
 edge, oilstoning, ii, 54.
 front for lathe work, i, 254.
 facing with reamer pin, i, 449.
 grinding and grindstones, ii, 51.
 holders, boring, i, 287.
 combined, i, 273.
 for compound slide-rests, i, 174.
 circular cutters, i, 272.
 octagon boring tools, i, 175.
 screw machine, i, 202.
 lathe for outside work, i, 270.
 planer, i, 426.
 slotting machine, i, 460, 461.
 swiveled, i, 273.
 threading, i, 267.
 holding devices, i, 173.
 swiveled for planers, i, 411.
 rest, swiveling, i, 174.
 taps, improved, i, 103.
 Tools, caulking, ii, 141.
 bolt heading, ii, 237.
 box for screw machine, i, 208.
 circular cutting, i, 267.
 cutting-off or grooving, i, 262.
 cutting, the utmost duty of, i, 258.
 diamond-pointed, i, 254.
 facing or knife, i, 262.
 for blacksmiths, ii, 229, 230.
 cutting rods in pieces, i, 305.
 screw threads, i, 87.
 wood slips, ii, 271.
 a worm in a lathe, i, 62.
 mortising machines, ii, 344.
 roll turning, i, 215.
 screw machine, i, 202.
 standard shapes, i, 111.
 testing lathe centres, i, 298.
 planer, clearance of, i, 424.
 for coarse finishing feeds, i, 423.
 slotted work, i, 424.
 gauge for, i, 423.
 shapes of, i, 423.
 round-nosed, i, 258.
 spring, i, 263.
 square-nosed, i, 260.
 thread-cutting, i, 97.
 threading for screw machine, i, 264.
 wood working, grindstones for, ii, 52.
 with side rake, i, 256.
 Tooth form, variation of, i, 15.
 proportions, scale of, i, 54.
 templates, pivoted arms for, i, 44.
 Trammeling connecting rods, ii, 122.
 Trams or trammels, i, 377.
 Traversing grindstones, automatic, ii, 53.
 spindle lathe, i, 218.
 Triple riveted joints, ii, 353.
 Triple-expansion-engine, ii, 436.
 link motions of, ii, 438.
 valves of, ii, 438, 439.
 Trip-hammers, ii, 254.
 swages for, ii, 231.
 Trying-up machines, ii, 332.
 Try-squares, i, 379.
 True surfaces, scrapers for, ii, 97.
 surfaces, oiling, ii, 135.
 plane, originating, ii, 132.
 Truing grindstones, ii, 53.
 lathe centres, devices for, i, 297.
 oilstones, ii, 54.
 Trundle-wheels, i, 1.
 T-squares, i, 379.
 Tube plate cutters, i, 448.
 Tubular saw machine, ii, 305.
 Tubular work, lathe mandrels for, i, 227.
 Tubes, boiler, arrangement of, ii, 364.
 bursted, ii, 403.
 Tumbler-files, ii, 91.
 Turn-buckle, forging, ii, 239.
 Turned work, recentering, i, 304.
 Turning a cylinder cover, i, 318.
 calendar rolls, i, 215.
 crank axles, lathe for, i, 152.
 crank, lathe for, i, 154.
 irregular shapes, i, 210.
 machine, feed motions of, i, 436.
 for boiler makers, i, 435.
 mill, i, 211.
 outside threads, i, 338.
 pulleys, i, 318.
 shafting, three tool slide rest, i, 143.
 tapers, i, 136, 312.
 Turret for screw machine, i, 205.
 Twin cutters, ii, 18.
 milling, advantages, ii, 25.
 Twist-drills, i, 274.
 clearance of, i, 274; ii, 41-44.
 effect of improper grinding, i, 276.
 fluting, ii, 29.
 feeds and speeds for, i, 277.
 front rake of, i, 275; ii, 44.
 grinding, i, 276.
 large, thinning the points of, ii, 44.
 table of sizes of, i, 442.
 Two-jawed chucks, i, 236.
- U**
- United States standard for gas pipe, i, 93.
 for finished bolts and nuts, i, 113.
 rough bolts and nuts, i, 114.
- United States standard for screw thread,
 i, 86.
 Universal chucks, i, 238.
 coupling, ii, 190.
 grinding lathes, i, 195.
 joint for drill brace, i, 456.
 milling-machines, ii, 2-15.
 for heavy work, ii, 15.
- V**
- Vacuum gauge, ii, 444.
 line of indicator diagram, ii, 415.
 Valve, cut off, ii, 378.
 expansion, ii, 443.
 for marine engines, ii, 444.
 for triple expansion engines, ii, 439.
 gear, principles of the Corliss, ii, 424.
 globe, pattern for, ii, 281.
 Kingston, ii, 440.
 lead adjusting, ii, 386.
 measuring, ii, 173.
 motion, designing, ii, 381.
 of surface condensing engines, ii, 442.
 snifting, ii, 440.
 squaring a, ii, 386.
 throttle freezing, ii, 386, 387.
 Velocity, uniform for gear wheels, i, 16.
 Vertical boilers, ii, 359, 361.
 milling machine, ii, 31.
 water tube boiler, ii, 360.
 V-guideways for planer heads, i, 414.
 Vise, ii, 62, 63.
 chucks for vise work, i, 396.
 construction of, i, 393.
 chucking work in, i, 393.
 holding taper work in, i, 394.
 rapid motion, i, 396.
 swiveling, i, 395.
 various forms of, i, 394.
 clamps, various forms of, ii, 64.
 hand, ii, 104.
 jaws, heights of, ii, 62.
 leg, with parallel motion, ii, 63.
 wood workers', ii, 62.
 work, classification of, ii, 62.
 examples in, ii, 102-135.
 red marking for, ii, 96.
 Vises, swiveling, ii, 63.
 Volume and pressure of steam, ii, 411.
 V-slide lathe shears, i, 182.
 V-thread standard, i, 93.
 V-tool for starting threads, i, 337.
- W**
- Wall hangers, ii, 193.
 Warping, ii, 461.
 Warping of files, ii, 93.
 Washers, i, 121.
 standard sizes of, i, 123.
 Watchmakers' lathes, i, 388.
 Watch manufacturers' hand lathe, i, 191.
 lathe, details of, i, 190.
 Water, ii, 410.
 evaporation, calculation of, ii, 420.
 gauge glass, ii, 368.
 joints, ii, 139.
 tube boiler, vertical, ii, 360.
 Wear of dies, i, 89.
 of back bearings, i, 158.
 emery wheels, ii, 48.
 groove cams, i, 84.
 nuts, i, 120.
 planer head slides, i, 410.
 scroll chuck threads, i, 238.
 spindles of lathe tailblock, i, 185.
 taps, i, 89.
 worm and worm-wheel, i, 28.
 upon grooved friction wheels, i, 79.
 Weight of steam, ii, 411.
 Weighted elevated slide rest, i, 168.
 slide-rest, feed motion for, i, 168.
 Weld, butt, ii, 234.
 lap, ii, 234.
 split, ii, 235.
 Welded connecting rods, aligning, ii, 118.
 Welding iron and steel, ii, 233, 234.
 scrap iron, ii, 247.
 stub ends of connecting rods, ii, 118.
 theory of, ii, 232.
 Wheel, emery, position of, ii, 35.
 forging of fifth, ii, 239.
 hubs, lathe for turning, i, 221.
 lathe, i, 151.
 rack and pinion, i, 1.
 rim, spacing the teeth on, i, 56, 58.
 shafts thrust on, i, 16.
 tire, throwing off, ii, 403.
 worm, i, 1.
 Wheels, bevel line of faces, i, 22.
 brush, for polishing, ii, 50.
 speed of, ii, 50.
 clock, i, 21.
 considered as levers, ii, 405.
 emery, annular, ii, 47.
 balancing, ii, 39.
 grades of, ii, 39.
 presenting, to work, ii, 47.
 qualifications of, ii, 38.
 recessed, ii, 47.
 swing frame, large work, ii, 46.
 speeds of, ii, 39.
 wear of, ii, 48.
 work suitable for, ii, 39.
 friction, i, 77.
 material for, i, 77.
 for transmitting motion, i, 21.
 gear drawings for, i, 59.

- Wheels, intermediate, i, 319.
locomotive, forging, ii, 244.
number of cutters for a train of, i, 39.
paddle, ii, 444.
polishing, construction of, ii, 49.
 charging with emery, ii, 50.
 for brass work, ii, 50.
 large, method of truing, ii, 50.
 polishing materials for, ii, 50.
 rag, ii, 51.
 speed of, ii, 50.
 solid leather, ii, 51.
 trundle, i, r.
White-metal lined boxes, ii, 155.
Width and thickness of chisels, ii, 74.
Winding spiral springs, i, 329.
 strips and their use, i, 382.
Wire-feed for screw machines, i, 206.
 gauge, i, 387.
- Wire, strength of, experiments on, i, 387.
Wood bending block, ii, 265, 266.
Wood boring machines, ii, 343.
 for patterns, ii, 264.
 gouges, ii, 272.
 moulding machines, knives of, ii, 84.
 planing machine, ii, 317-341.
 pulleys, ii, 200.
 steaming, ii, 266.
 turning, hand tools for, i, 338.
 work, chisels for, ii, 271.
 counterbore for, i, 449.
 drill for, i, 449.
 drivers for, i, 225.
 forms of joints for, ii, 275.
 lathe, face plates for, i, 247.
 on swing frame machine, ii, 292.
 twist drills for, i, 279.
 worker's vise, ii, 62.
- Wood-working, circular-saw gauges for,
 ii, 295.
 lathes, chucks for, i, 242.
 machinery, ii, 287-349.
 special lathe for, i, 268.
 tools, grindstones for, ii, 52.
Woods for patterns, ii, 264.
Work, cored, drivers for, i, 225.
 face plate, examples of, i, 249.
 holding straps, i, 244.
 hollow centres for, i, 226.
 shrinking, to refit, i, 374.
Worm and worm-wheel, i, 28.
 gears, i, 62.
 wheel, application of, i, 30.
 cutting teeth of, i, 42.
 enveloping teeth, i, 28.
 number of teeth in, i, 29.
 teeth, sliding motion of, i, 28.
- Worm to work with a square thread, i, 29.
Wrench, adjustable, i, 125.
 for carriage bolts, i, 125.
 jaws, angle for, i, 123.
 monkey, i, 125.
 pin, i, 126.
 sockets, i, 125.
 various forms of, i, 125.
Wrought iron, cutting speeds for, i, 294.
- Y**
- Yoke and guide-bars, ii, 389.
- Z**
- Zigzag riveted seams, ii, 352.
Zinc gauge, the American sheet, i, 387.
 gauge, the Belgian sheet, i, 387.

THE END.