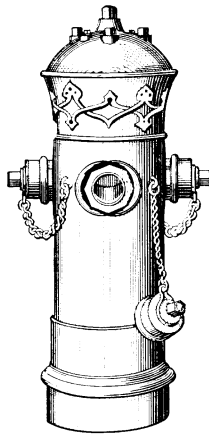




TABLES
AND
INDEX



TABLES USEFUL FOR MACHINISTS.

The speeds required for machining advantageously the different materials, according to the different diameters, may be termed "surface speeds." Roughly speaking, the surface speeds for the different materials vary in comparatively narrow limits. We may assume the following speeds for the following :

TABLE OF SURFACE SPEEDS.

| | |
|------------------------|---------------------------|
| Cast iron | 30 to 45 feet per minute. |
| Steel | 20 to 25 feet per minute. |
| Wrought iron | 30 feet per minute. |
| Brass | 40 to 60 feet per minute. |

For cast iron as found in Europe, we may assume 20 to 35 feet per minute. This is owing to the fact that European iron is considerably harder.

SPEED OF SAWS, ETC.

Band saws for hot iron and steel run at about 200 to 300 feet per minute. Plain soft iron discs run at a rim velocity of 12,000 feet per minute, and are sometimes used to cut off ends of steel rails, jets of water playing on the circumference of the saw.

AVERAGE CUTTING SPEED FOR DRILLS.

The following table represents the most approved practice in rate of cutting speed for drills ranging from $\frac{1}{16}$ inch to 2 inches in diameter.

| Diameter of Drills | Speed on Steel | Speed on Cast Iron | Speed on Brass | Diameter of Drills | Speed on Steel | Speed on Cast Iron | Speed on Brass |
|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|
| $\frac{1}{16}$ | 1,712 | 2,383 | 3,544 | $1\frac{1}{8}$ | 72 | 106 | 180 |
| $\frac{1}{8}$ | 855 | 1,191 | 1,772 | $1\frac{1}{4}$ | 68 | 102 | 170 |
| $\frac{3}{16}$ | 571 | 794 | 1,181 | $1\frac{3}{8}$ | 64 | 97 | 161 |
| $\frac{1}{4}$ | 397 | 565 | 855 | $1\frac{1}{2}$ | 58 | 89 | 150 |
| $\frac{5}{16}$ | 318 | 452 | 684 | $1\frac{5}{8}$ | 55 | 84 | 143 |
| $\frac{3}{8}$ | 265 | 377 | 570 | $1\frac{3}{4}$ | 53 | 81 | 136 |
| $\frac{7}{16}$ | 227 | 323 | 489 | $1\frac{7}{8}$ | 50 | 77 | 130 |
| $\frac{1}{2}$ | 183 | 267 | 412 | $1\frac{1}{2}$ | 46 | 74 | 122 |
| $\frac{9}{16}$ | 163 | 238 | 367 | $1\frac{9}{16}$ | 44 | 71 | 117 |
| $\frac{5}{8}$ | 147 | 214 | 330 | $1\frac{5}{8}$ | 40 | 66 | 113 |
| $\frac{11}{16}$ | 133 | 194 | 300 | $1\frac{11}{16}$ | 38 | 63 | 109 |
| $\frac{3}{4}$ | 112 | 168 | 265 | $1\frac{3}{4}$ | 37 | 61 | 105 |
| $1\frac{1}{8}$ | 103 | 155 | 244 | $1\frac{7}{8}$ | 36 | 59 | 101 |
| $\frac{7}{8}$ | 96 | 144 | 227 | $1\frac{1}{2}$ | 33 | 55 | 98 |
| $1\frac{1}{16}$ | 89 | 134 | 212 | $1\frac{5}{8}$ | 32 | 53 | 95 |
| 1 | 76 | 115 | 191 | 2 | 31 | 51 | 92 |

SIZE OF DRILLS FOR U. S. STANDARD TAPS.

| Diam. of Tap | Threads per inch | Diam. of Drill | Diam. of Tap | Threads per inch | Diam. of Drill | Diam. of Tap | Threads per inch | Diam. of Drill |
|----------------|------------------|----------------|----------------|------------------|----------------|----------------|------------------|------------------|
| $\frac{1}{4}$ | 20 | $\frac{3}{16}$ | $\frac{7}{8}$ | 9 | $\frac{3}{4}$ | $1\frac{3}{4}$ | 5 | $1\frac{1}{2}$ |
| $\frac{5}{16}$ | 18 | $\frac{1}{4}$ | 1 | 8 | $\frac{7}{8}$ | $1\frac{7}{8}$ | 5 | $1\frac{3}{8}$ |
| $\frac{3}{8}$ | 16 | $\frac{5}{16}$ | $1\frac{1}{8}$ | 7 | $\frac{1}{2}$ | 2 | $4\frac{1}{2}$ | $1\frac{3}{4}$ |
| $\frac{7}{16}$ | 14 | $\frac{3}{8}$ | $1\frac{1}{4}$ | 7 | $\frac{3}{4}$ | $2\frac{1}{4}$ | $4\frac{1}{2}$ | $1\frac{11}{16}$ |
| $\frac{1}{2}$ | 13 | $\frac{1}{2}$ | $1\frac{3}{8}$ | 6 | $\frac{1}{2}$ | $2\frac{1}{2}$ | 4 | $2\frac{3}{16}$ |
| $\frac{5}{8}$ | 11 | $\frac{3}{4}$ | $1\frac{1}{2}$ | 6 | $\frac{3}{4}$ | $2\frac{3}{4}$ | 4 | $2\frac{7}{16}$ |
| $\frac{3}{4}$ | 10 | $\frac{1}{2}$ | $1\frac{5}{8}$ | $5\frac{1}{2}$ | $\frac{1}{2}$ | 3 | $3\frac{1}{2}$ | $2\frac{3}{8}$ |

TABLE OF EMERY WHEEL SPEEDS.

| Diam. Wheel. | Rev. per Minute for Surface Speed of 4,000 ft. | Rev. per Minute for Surface Speed of 5,000 ft. | Rev. per Minute for Surface Speed of 6,000 ft. |
|--------------|--|--|--|
| 1 in. | 15,279 | 19,090 | 22,918 |
| 2 " | 7,639 | 9,549 | 11,459 |
| 3 " | 5,093 | 6,366 | 7,639 |
| 4 " | 3,820 | 4,775 | 5,370 |
| 5 " | 3,056 | 3,820 | 4,584 |
| 6 " | 2,546 | 3,183 | 3,820 |
| 7 " | 2,183 | 2,728 | 3,274 |
| 8 " | 1,910 | 2,387 | 2,865 |
| 10 " | 1,528 | 1,910 | 2,292 |
| 12 " | 1,273 | 1,592 | 1,910 |
| 14 " | 1,091 | 1,364 | 1,637 |
| 16 " | 955 | 1,194 | 1,432 |
| 18 " | 849 | 1,061 | 1,273 |
| 20 " | 764 | 955 | 1,146 |
| 22 " | 694 | 868 | 1,042 |
| 24 " | 637 | 796 | 955 |
| 30 " | 509 | 637 | 764 |
| 36 " | 424 | 531 | 637 |

The above table designates the number of revolutions per minute for specific diameters of emery wheels to cause them to run at the respective periphery rates of 4,000, 5,600 and 6,000 feet per minute.

The medium of 5,000 feet is usually employed in ordinary work, but in special cases it is sometimes desirable to run them at a lower or higher rate, according to requirements.

The stress on the wheel at 4,000 feet periphery speed per minute is 48 lbs. per square inch; at 5,000 feet, 75 lbs.; at 6,000 feet, 108 lbs.

U. S. STANDARD SCREW THREADS.

| Nominal Diameter of Screw. | | Number of Threads per inch. | Diameter of Tap at Root of Thread. | | Size of Tap Drill, giving a Clearance of $\frac{1}{8}$ the Height of the Original Thread Triangle. | | Area at Root of Thread. | Safe Load on Threaded Bolt on basis of 6,000 lbs. Stress per sq. in. of Section at Root of Thread. |
|----------------------------|--------|-----------------------------|------------------------------------|-------------------|--|-------------------|-------------------------|--|
| Inches | Inches | | Inches | Nearest 64ths | Inches | Nearest 64ths | | |
| $\frac{1}{4}$ | .250 | 20 | .185 | $\frac{3}{16}$ — | .196 | $\frac{1}{8}$ — | .027 | 162 |
| $\frac{1}{8}$ | .312 | 18 | .240 | $\frac{1}{4}$ + | .252 | $\frac{1}{4}$ + | .045 | 270 |
| $\frac{3}{8}$ | .375 | 16 | .294 | $\frac{1}{4}$ — | .307 | $\frac{1}{4}$ — | .068 | 408 |
| $\frac{7}{8}$ | .437 | 14 | .345 | $\frac{1}{2}$ + | .360 | $\frac{1}{2}$ + | .093 | 558 |
| $\frac{1}{2}$ | .500 | 13 | .400 | $\frac{1}{2}$ — | .417 | $\frac{1}{2}$ — | .126 | 756 |
| $\frac{9}{8}$ | .562 | 12 | .454 | $\frac{3}{4}$ + | .472 | $\frac{3}{4}$ + | .162 | 997 |
| $\frac{5}{8}$ | .625 | 11 | .507 | $\frac{1}{2}$ + | .527 | $\frac{1}{2}$ — | .202 | 1210 |
| $\frac{1}{2}$ | .687 | 11 | .569 | $\frac{9}{16}$ + | .589 | $\frac{1}{2}$ — | .254 | 1520 |
| $\frac{3}{4}$ | .750 | 10 | .620 | $\frac{5}{8}$ — | .642 | $\frac{1}{2}$ + | .302 | 1810 |
| $\frac{1}{2}$ | .812 | 10 | .683 | $\frac{1}{2}$ — | .704 | $\frac{3}{4}$ + | .366 | 2190 |
| $\frac{7}{8}$ | .875 | 9 | .731 | $\frac{1}{2}$ — | .755 | $\frac{3}{4}$ + | .420 | 2520 |
| $\frac{1}{2}$ | .937 | 9 | .793 | $\frac{1}{2}$ — | .817 | $\frac{1}{2}$ — | .494 | 2960 |
| 1 | 1.000 | 8 | .838 | $\frac{1}{2}$ — | .865 | $\frac{1}{2}$ + | .551 | 3300 |
| $\frac{1}{8}$ | 1.062 | 8 | .900 | $\frac{1}{2}$ — | .927 | $\frac{1}{2}$ + | .636 | 3810 |
| $\frac{1}{8}$ | 1.125 | 7 | .939 | $\frac{1}{2}$ + | .970 | $\frac{1}{2}$ + | .694 | 4160 |
| $\frac{1}{8}$ | 1.187 | 7 | 1.002 | 1 + | 1.032 | 1 + | .788 | 4720 |
| $\frac{1}{4}$ | 1.250 | 7 | 1.064 | $\frac{1}{8}$ + | 1.095 | $\frac{1}{2}$ + | .893 | 5350 |
| $\frac{3}{8}$ | 1.375 | 6 | 1.158 | $\frac{1}{2}$ + | 1.215 | $\frac{1}{2}$ + | 1.057 | 6340 |
| $\frac{1}{2}$ | 1.500 | 6 | 1.283 | $\frac{1}{2}$ + | 1.345 | $\frac{1}{2}$ + | 1.295 | 7770 |
| $\frac{5}{8}$ | 1.625 | 5 $\frac{1}{2}$ | 1.389 | $\frac{1}{2}$ — | 1.428 | $\frac{1}{2}$ + | 1.515 | 9090 |
| $\frac{3}{4}$ | 1.750 | 5 | 1.490 | $\frac{1}{2}$ + | 1.534 | $\frac{1}{2}$ + | 1.746 | 10470 |
| $\frac{7}{8}$ | 1.875 | 5 | 1.615 | $\frac{1}{2}$ + | 1.659 | $\frac{1}{2}$ + | 2.051 | 12300 |
| 2 | 2.000 | 4 $\frac{1}{2}$ | 1.711 | $\frac{1}{2}$ — | 1.760 | $\frac{1}{2}$ + | 2.302 | 13800 |
| 2 $\frac{1}{4}$ | 2.250 | 4 $\frac{1}{2}$ | 1.961 | $\frac{1}{2}$ + | 2.010 | 2 $\frac{1}{4}$ — | 3.023 | 18100 |
| 2 $\frac{1}{2}$ | 2.500 | 4 | 2.175 | 2 $\frac{1}{2}$ + | 2.230 | 2 $\frac{1}{2}$ + | 3.719 | 22300 |
| 2 $\frac{3}{4}$ | 2.750 | 4 | 2.425 | 2 $\frac{3}{4}$ + | 2.480 | 2 $\frac{3}{4}$ — | 4.620 | 27700 |
| 3 | 3.000 | 3 $\frac{1}{2}$ | 2.629 | 2 $\frac{7}{8}$ + | 2.691 | 2 $\frac{1}{2}$ + | 5.428 | 32500 |
| 3 $\frac{1}{4}$ | 3.250 | 3 $\frac{1}{2}$ | 2.879 | 2 $\frac{7}{8}$ + | 2.941 | 2 $\frac{1}{2}$ + | 6.510 | 39000 |
| 3 $\frac{1}{2}$ | 3.500 | 3 $\frac{1}{4}$ | 3.100 | 3 $\frac{1}{2}$ + | 3.167 | 3 $\frac{1}{2}$ + | 7.548 | 45300 |
| 3 $\frac{3}{4}$ | 3.750 | 3 | 3.317 | 3 $\frac{1}{2}$ + | 3.389 | 3 $\frac{3}{4}$ — | 8.641 | 51800 |
| 4 | 4.000 | 3 | 3.567 | 3 $\frac{1}{2}$ + | 3.639 | 3 $\frac{3}{4}$ — | 9.063 | 59700 |

STANDARD SIZES OF WROUGHT IRON WELDED PIPE.

| Inside diameter, nom. | Actual outside Diameter. | Thickness. | Actual inside Diameter. | External circumference. | Internal circumference. | Length of pipe per square foot of outside surface. | Length of pipe per square foot of inside surface. | External area. | Actual internal area. | Length of pipe containing one cubic foot. | Weight per foot of length. | No. of threads per inch of screw. | Length per foot of screw. |
|-----------------------|--------------------------|------------|-------------------------|-------------------------|-------------------------|--|---|----------------|-----------------------|---|----------------------------|-----------------------------------|---------------------------|
| 1/8 | .405 | .068 | 0.269 | 1.272 | 0.848 | 9.440 | 14.15 | .129 | .0572 | 2500. | .243 | 27 | 0.19 |
| 1/4 | .54 | .088 | 0.364 | 1.696 | 1.144 | 7.075 | 10.50 | .229 | .1041 | 1385. | .422 | 18 | 0.29 |
| 3/8 | .675 | .091 | 0.493 | 2.121 | 1.552 | 5.657 | 7.67 | .358 | .1916 | 751 5 | .561 | 18 | 0.30 |
| 1/2 | .840 | .109 | 0.622 | 2.652 | 1.957 | 4.502 | 6.13 | .554 | .3048 | 472 4 | .845 | 14 | 0.39 |
| 3/4 | 1.050 | .113 | 0.824 | 3.299 | 2.589 | 3.637 | 4.635 | .866 | .5333 | 270 0 | 1.120 | 14 | 0.40 |
| 1 | 1.315 | .134 | 1.047 | 4.134 | 3.292 | 2.903 | 3.679 | 1.357 | .8627 | 166 9 | 1.670 | 11 1/2 | 0.51 |
| 1 1/4 | 1.660 | .140 | 1.38 | 5.215 | 4.335 | 2.301 | 2.758 | 2.164 | 1.496 | 96.25 | 2.258 | 11 1/2 | 0.54 |
| 1 1/2 | 1.90 | .145 | 1.61 | 5.969 | 5.061 | 2.010 | 2.371 | 2.835 | 2.038 | 70.65 | 2.694 | 11 1/2 | 0.55 |
| 2 | 2.375 | .151 | 2.067 | 7.461 | 6.494 | 1.611 | 1.848 | 4.430 | 3.355 | 42.36 | 3.667 | 11 1/2 | 0.58 |
| 2 1/2 | 2.875 | .204 | 2.467 | 9.032 | 7.754 | 1.328 | 1.547 | 6.491 | 4.783 | 30.11 | 5.773 | 8 | 0.89 |
| 3 | 3.50 | .217 | 3.066 | 10.996 | 9.636 | 1.091 | 1.245 | 9.621 | 7.388 | 19.40 | 7.547 | 8 | 0.95 |
| 3 1/2 | 4.0 | .226 | 3.518 | 12.566 | 11.146 | .955 | 1.077 | 12.566 | 9.837 | 14.56 | 9.055 | 8 | 1.00 |
| 4 | 4.50 | .237 | 4.026 | 14.137 | 12.648 | .819 | 0.949 | 15.901 | 12.730 | 11.31 | 10.728 | 8 | 1.05 |
| 4 1/2 | 5.0 | .247 | 4.506 | 15.708 | 14.153 | .765 | 0.848 | 19.635 | 15.939 | 9.03 | 12.492 | 8 | 1.10 |
| 5 | 5.563 | .259 | 5.045 | 17.475 | 15.849 | .629 | 0.757 | 24.299 | 19.990 | 7.20 | 14.564 | 8 | 1.16 |
| 6 | 6.625 | .280 | 6.065 | 20.813 | 19.054 | .577 | 0.630 | 34.471 | 28.889 | 4.98 | 18.767 | 8 | 1.26 |
| 7 | 7.625 | .301 | 7.023 | 23.954 | 22.063 | .505 | 0.544 | 45.663 | 38.737 | 3.72 | 23.410 | 8 | 1.36 |
| 8 | 8.625 | .322 | 7.981 | 27.096 | 25.076 | .444 | 0.478 | 58.426 | 50.039 | 2.88 | 28.348 | 8 | 1.46 |
| 9 | 9.688 | .344 | 9.000 | 30.433 | 28.277 | .394 | 0.425 | 73.715 | 63.633 | 2.26 | 34.677 | 8 | 1.57 |
| 10 | 10.750 | .366 | 10.018 | 33.772 | 31.475 | .355 | 0.381 | 90.762 | 78.838 | 1.80 | 40.641 | 8 | 1.68 |

“Any shop which makes it a fixed rule to discharge any man for any act, not distinctly malicious or revealing incurable habits of carelessness or negligence, will soon lose its best men, and the average of skill and reliability in its force cannot fail to deteriorate.

“It is just the same the other way, too. A man shouldn't be in too much of a hurry about discharging his boss. His job calls for skill as much as any other, and the skill that is required to do a first-class job of bossing is just as rare, and takes as much sifting and training to produce, as any other.

“To retain an employer it is necessary sometimes to overlook some of his shortcomings. As he learns by experience that it will not do to discharge every man whenever he proves that he is not quite perfect, so it is well to remember, on the other side, that you can't run things very well or very long without a boss, even if he may not be the most satisfactory boss in the world. It is a rather poor boss who is not generally better than none at all.”

TECUMSEH SWIFT.

INDEX

FOR THE ADVANCED MACHINIST.

A

- ABRASIVE**, definition, 215.
ACCESSORY, definition, 266.
ACCIDENTS AND HOW TO AVOID THEM, note, 298.
ADDITION, 28.
Of decimals, 46.
Of fractions, 42.
AID TO THE INJURED, 297-316.
Note on the importance of the subject, 297.
ALGEBRA, definition, 23.
ALUMINIUM, how to solder, 290.
AMERICAN STANDARD THREAD, 120.
- ANGLE OR SPIRAL CUTTERS** for milling machines, illustrations, 188.
ARBOR PRESS, description and illustrations, 251-253.
ARC, complement of the, definition, 83.
ARISTOTLE, quotation from, 34.
ARITHMETIC, formulas, 22.
Note, 19.
Summary of, 19-56.
AUTOMATIC SCREW CUTTING DIES, 238.
Illustrations, 234, 238, 239, 240, 241.
AUXILIARY MACHINES, 243-262.

B

- BABBITT METAL**, recipe for, 289.
BANDAGES, how to make, 313.
BAND-SAWS, speed for cutting hot iron, 319.
BEVEL PLANING TOOL, 161.
BIRMINGHAM GAUGES, illustrations, 92.
BLADES, flexible for hack-saws, 249.
BLEEDING, how to stop, 299, 300, 301.
Of three kinds, 299.
BLOCK, rope sheave, illustration, 270.
Snatch, illustration, 270.
BLUING BRASS, recipe, 294.
BOLT-CUTTING, speed for, 241.
Thread cutter, 235.
BONES, broken, how to treat in case of accident, 302.
BORING-BAR, illustrations, 140, 141.
With adjustable cutter, description, 148, illustration, 150.
BORING MACHINES, horizontal, 142.
Taper holes in the lathe, illustration, 143.
Vertical, 147.
BORING MILL, advantages of, 140.
Description, 144-150.
Facing a valve in a, illustration, 147.
Illustrations, 138, 144, 146.
Tools used in a, illustrations, 149, 150.
BORING-OPERATIONS, 139-150.
BOSSES, gang, 286.
BRACKETS, definition, 21, 55.
BRASS, recipe for bluing, 294.
BRAZING CAST IRON, recipe, 291.
BROAD FINISHING TOOLS, description, 148; illustration, 149.
Nose planing tool, 161.
BROKEN BONES, the treatment for, in case of accident, 302.
BUFF MACHINE, illustration, 272.
BURN MIXTURE, recipe, 306.
BURNS, treatment of, 305, 306.

CALCULATION, definition, 19.
CANCELLATION, 40.
CALIPERING MACHINES, illustrations, 87, 88.
CARE OF SELF, 314.
CASTINGS, recipe for "pickling," 294.
CAST IRON, cutting angle for, 157.
 Recipe for filling holes in, 296.
 Surface speed for machining, 319.
CEMENT, for fastening paper or leather to iron, 295.
CHANGE-WHEELS, illustration and description, 122-128.
CHASERS, illustrations, 104, 105, 106, 107.
 Operation of, 104-108.
 Note, 105.
CHUCKS FOR DRILLS, 206, 207.
 The swivel, illustration and description, 159.
CIRCLE, circumference and area of a, 65-67.
 Definitions, 65.
 Degrees of a, note, 82.
 Parts of a, 82.
 Radius of a, definition and illustration, 82.
 Rule for finding diameter of a, 66.
"CLAMPS," illustration and description, 268.
CLAPPER-BOX, illustration, 158.
CO, definition, 83.

DECIMAL POINT, location of, 21.
DECIMALS, 44.
 Reading of, 26.
DEFINIT.ONS. arithmetical, 20.
DEGREES OF A CIRCLE, note, 82.
DENOMINATE NUMBERS, 35.
DEPARTMENTS IN SHOPS, 283.
DEVICE, for setting planer and shaper tools, 168.
 Use on twist drills, illustration, 209.
DIAMOND-POINT PLANING TOOL, 161.

C

COLLET, description and illustration, 25.
COMPLEMENT OF AN ARC, definition, 83.
CONSTANT, a, definition, 81.
COPPER, varnish for, recipe, 294.
 To, iron or steel wire, recipe, 297.
COSECANI OF AN ANGLE, definition, 82.
COSINE, definition and illustration, 82.
COTANGENT OF A CIRCLE, definition and illustration, 82.
COUNTERSHAFT, illustration, 249.
CRANE, wall, illustration, 271.
CUBE, definition, 72.
CUTS, how to treat, 301.
CUTTERS, for milling machines, 188, 190, 192, 193.
 Side and other, in operation, illustration, 194.
CUTTER-SPEEDS, explanation for figuring, description, 189.
CUTTING ANGLES, for cast and wrought iron and brass, 157.
CUTTING-OFF MACHINES, description, 245.
 Planer tool, 161.
 Saw, description, 247, illustration, 247.
 Tools, illustrated, 246.
CYLINDER, rule for finding the surface of a, 69.

D

DIE HEAD, screw-cutting, description and illustration, 259.
DIE OF POWER PUNCH, illustration, 232.
DIES, automatic bolt-cutting, illustrations, 234, 238, 239, 240, 241.
 Lubrication of, 235.
 Revolutions of, 241.
DIFFERENTIAL PLAN OF PAYMENT, 280.
DISCS, plain iron, speed for cutting off ends of steel rails, 319.
 Standard reference, illustration, 87.

D

DIVIDING HEAD AND TAIL STOCK, 181.
Illustrations, 181, 182.

DIVISION, 32.
Of decimals, 47.
Of fractions, 43.

DODECAHEDRON, the, definition, 81.

DRESSING-TOOLS FOR EMERY WHEELS, 268.

DRILL CHUCKS, description and illustrations, 206, 207.
Turret, illustrations, 257, 258.

DRILLING MACHINE, adjustable reamer for, illustration, 203.
Description of parts, 203.
Drill chucks, illustration, 206.
Radial, 206.
Recipe for a cheap lubricant for, 292.

DRILLING MACHINE, shell reamer, illustration, 209.
Socket or drill collet, description and illustration, 205.
Speeds for twist drills, 210, 211.
Special forms of, 203.
Twist drill, grinding gauge, 209.
Vertical, illustration, 202.

DRILLING OPERATIONS, 201-211.

DRILLS, how to grind flat, 207.
Table of average cutting speeds for, 320.
Table of sizes for U. S. standard taps, 320.
Table of speeds, 211.
Twist, illustration, 208.
Variations of, 205.

DRIVER AND DRIVEN WHEELS, 130.

E

ELECTRIC SHOCK, how to resuscitate from, 309-312.

ELLIPSE, rule for finding area of, 68.

EMERY, description, in note, 226.
Grinders, illustrations, 212, 214, 215, 216, 218, 219; in operation, illustrations, 220, 221, 222.

EMERY WHEEL DRESSING TOOLS, illustration, 266.
Speeds, table, 321.
Grade of, by numbers, 225.
"Points" relating to, 226.

EMERY WHEEL DRESSING TOOLS, stress per square inch when running, 321.

EMPLOYERS' responsibility to workmen in case of accident, 314-316.

ENLARGING DRILL, illustration, 208.

"EQUIPMENT" IN SHOPS, 279.

EVOLUTION, 50.

EXPANSION OF A STEEL ROD, 84.

EXTRACTING BROKEN TOOLS, recipe, 295.

EYE, treatment for removing foreign bodies, 308.

F

FACE OR STRADDLE MILL IN OPERATION, 185.

FACTORS, definitions, 24, 30.

FEED MECHANISM, milling machine, 184.
Illustration, 184.

FELLOWS' GEAR SHAPER, illustration, 165.

FILES, equivalent grades of emery, 225.

FIVE REGULAR SOLIDS, illustration, 80.

FOREMAN, who reformed shop, 284.
Model, 284, 285, 286.

FORMULA, definition, 22.

FRACTIONS, 37.
Addition of, 42.
Division of, 43.
Subtraction of, 42.

FRENCH SYSTEM OF MEASURES AND WEIGHTS, 56.

FROST BITE, treatment for, 308.

FUSING POINTS OF TIN-LEAD ALLOYS, 292.

G

GANG BOSSES, 286.

GAUGE, U. S. standard, illustrations, 92, 136.

GAUGE FOR MEASURING ANGLES, illustration, 93.

GAUGES, adjustable parallel measuring, illustration, 91.

Corrective standards, illustration, 87.

English or Birmingham, illustration, 92.

Inside micrometer, illustrations, 85, 86.

Internal and external limit, illustrations, 89, 90.

GAUGING ANGLE OF LATHE CENTRES, 137.

GEAR SHAPER, Fellows', illustration, 165.

Example of work, 160.

GENERAL MANAGER, 277.

GLOSSARY, definition, 20.

GREEK LETTER π , definition, 21.

GRINDING, a face or straddle mill, illustrations, 220, 221.

A spiral tooth cutter, illustration, 221.

Cutting tools, 224.

GRINDING MACHINES, definition, 215.

Description of parts, 217.

Self-acting, universal and surface, 217; illustrations, 218, 219.

GRINDING OPERATIONS, 214-226.

Hardening, 226.

Sharpening a circular saw, illustration, 215.

Sharpening a twist drill, illustration, 214.

Sharpening a tap, illustration, 222.

GRINDSTONE TROUGH, illustration, 271.

Note relating to, 272.

H

HACK SAW BLADES, flexible, illustration, 249.

Magazine coil, description, 248.

Power, illustration, 248.

HEXAHEDRON, the, definition, 81.

HOG-NOSE ROUGHING TOOL, description, 148.

Illustration, 149.

I

ICOSAHEDRON, the, definition, 81.

INDEX-PLATE FOR CHANGE-GEAR SHAFT, 133.

INVOLUTION, 53.

IRON, cast, recipe for brazing, 291.

Cutting angle for cast and wrought, 157.

IRON PIPE, table of sizes, 323.

J

"**JACK-SCREW**," illustration, 269.

"**JIG**," definition, 266.

Note, 266.

K

KEYSEATING MACHINE, illustration, 261.

KEYWAY CUTTING MACHINE, 172-174.

Illustration of, 174.

"**KINK**," shop, definition, 266.

L

- LATHE**, arrangement of, for cutting screws, 108.
Centers, manner of gauging angle of, 137.
Pan, illustration, 264.
Screw cutting in the, 103-137.
- LAYING OUT WORK**, recipe for marking surface on steel or iron, 296.
- LEAD**, as an anti-friction metal, 292.
- LEFT-HAND "SIDE" PLANING TOOL**, 161.
- LIME**, use of, to keep shop floors clean, recipe, 292.
- LIMIT-GAUGES**, illustrations, 89, 90.
- LOGARITHM**, definition, 23.
- LUBRICANT**, recipe for milling and drilling, 292.
For use in cutting bolts and tapping nuts, 296.

M

- MACHINE**, bolt cutting, 235-241.
Cutting-off, description, 245.
For buffing, illustration, 273.
For shaft straightening, illustration, 254.
Keyseating, illustration, 261.
Screwing, illustration, 235.
- MACHINES**, auxiliary, 243-262.
- MANAGER**, works or general, 277.
- MANDREL**, how driven into work, 25.
- MARKING SOLUTION**, recipe, 293.
Presses, illustration, 265.
- MATHEMATICAL STUDIES**, value of, 34.
- MEASURING-MACHINE**, standard form, illustration, 87.
End rod, illustration, 85.
- MEASURING MACHINES, TOOLS AND DEVICES**, 84.
- MECHANICS' POCKET REFERENCE BOOKS**, note, 70.
- MENSURATION**, 58.
- METAL**, a, that will expand in cooling, recipe, 296.
- METER**, definition, 56.
- METRIC SYSTEM OF WEIGHTS AND MEASURES**, 56.
- MILLING MACHINES**; a cheap lubricant for, 292.
Bevel or angle, in operation, illustration, 196.
- MILLING MACHINES**, cutters, illustrations, 185, 186, 188, 190, 192, 193.
Cutter in operation illustration, 185.
Descriptions, 177-197.
Illustrations, 176, 178, 180.
- MILLING CUTTERS**, dividing head and tail stock, description, 181; illustrations, 181, 182.
Feed mechanism, description and illustration, 184.
Horizontal, plain, illustration, 180.
Horizontal with vertical head, illustration, 178.
Operation of, 177-197.
Rose cutter in operation, illustration, 195.
Rule for finding the speed of cutters, 187.
Side cutter in operation, illustration, 194.
Traverse feed, 191.
Used with keyseating machines, sizes of, 261.
- MILLING MACHINE**, "universal," 177; illustration, 176.
Vise, description and illustration, 183.
- MONITOR LATHES**, why so named, 254.
- MULTIPLICATION**, 30.
Of decimals, 46.
Of fractions, 42.

- NEEDLE FOR "SCRIBER."** 294.
- NICKEL-PLATING,** solution, recipe, 293.
- NOTATION,** 25.
Arabic, method of, 25.
Roman, 27.
- NUMBER, a compound,** 35.
A simple, 35.
- OCTAHEDRON,** the, definition, 81.
- OIL-PUMPS,** described, 235, 237.
- PAN,** shop, illustration, 262.
- PARALLELOGRAM,** definition, 68.
- PARTS OF A CIRCLE,** 82.
- PATTERN SHOP,** a model, 283, 284.
- PENTAGON,** definition, 64.
- PERSON,** an injured, how to carry, 303, 304.
- "PICKLING" CASTINGS,** recipe, 294.
- "PIECE-WORK,"** definition, 280.
- PIPE,** rule for finding sectional area of a, 68.
Wrought iron, table of sizes, 323.
- PLANER,** the open side, illustration and description, 159.
- PLANER CENTERS,** illustration, 160.
- PLANER OPERATION,** centers, 160.
- PLANER TOOLS,** device for setting, 168.
- PLANING,** tools used in, 157.
- PLANING MACHINE TOOLS,** description and illustration, 161.
Illustrations, 152, 154, 159.
- PLANING OPERATIONS,** 153-174.
Cutter or cross-bar head, illustration, 158.
Cutting tool, illustration, 156.
Cutting tool, speed of, 156.
Device for setting tools, 167: illustration, 168.
Tool post and clapper head, the, 157.
- PLANNING A SHOP,** 282.
- PLANS OF PAYMENT,** piece work, differential and premium, 280, 281.
- "PLANT,"** definition, 279.
- N**
- NUMBERS,** definition, 24.
Denominate, 35.
Powers of, 54.
Roots of, 54.
- NUMERATION,** 25.
Table, 26.
- O**
- "ORGANIZATION,"** in shop management, 279.
- P**
- PLATE STEEL AND IRON GAUGES,** illustration, 92.
- PLATEN,** definition, 157.
- "POINTS,"** relating to emery wheels, 226.
Relating to grinding operations, 222.
- POLISH FOR WROUGHT STEEL,** 290.
- POLISHING MACHINE,** illustration, 273.
- POLYGON,** definition, 64.
- POWERS OF NUMBERS,** 55.
- PREMIUM PLAN OF PAYMENT,** 281.
- PRESS,** arbor, description and illustrations, 251-253.
- PRESSES,** properly punches, 229.
- PROPORTION,** or rule of three, 48.
- PROTRACTOR,** bevel, illustration, 94.
- PUMP,** for lubricating with oil, 235, 237.
- PUNCH END OF MACHINE,** illustration, 231.
- PUNCHING AND SHEARING,** similar operations, 230.
- PUNCHING AND SHEARING MACHINE,** eccentric driven, illustration, 231.
Illustrations, 228, 231.
Lever punching, description, 233; illustration, 231.
Presses for stamping, 229.
Why combined, 229.
- PUNCHING AND SHEARING OPERATIONS,** 229-234.
Action of the punch, 230; illustrations, 231, 232.
- PUNCHING TOOLS,** set of, description, 232.

Q

QUANTITY, definition of, 24.

QUOTATIONS, 274, 276, 288.

R

RADIAL DRILL, description, 205; illustration, 200.

RATIO, definition, 22, 48.

REAMER, adjustable, description, 148; illustration, 150.

Adjustable shell, 209.

Finishing, illustration, 208.

Fluted shell, 209.

For milling machines, illustration, 194.

RECIPES, useful, 287-316.

RECTANGLE, definition, 63.

REDUCTION, 35.

Of decimals, 45.

Of fractions, 38.

RESPONSIBILITY OF EMPLOYERS, to workmen in case of accident, 314-316.

RIGHT HAND SIDE PLANING TOOLS, 161.

ROMAN NOTATION, 27.

ROOT, square, 50.

ROOTS OF NUMBERS, 54.

ROPE SHEAVE BLOCKS, illustrations, 270.

ROSE CUTTER FOR MILLING MACHINE, 192.

ROUGHING DRILL, illustration, 208.

Tools, description, 148; illustration, 149.

ROUND-NOSE TOOL, description, 148; illustration, 149.

RULE, addition, 29.

Addition of decimals, 41.

Addition of fractions, 42.

Adjusting change wheels, 122-130.

Cancellation, 41.

Division, 32, 33.

Division of decimals, 47.

Division of fractions, 43.

Extracting square root, 50, 51.

For notation, 26.

RULE, Multiplication, 30.

Multiplication of fractions, 42.

Reduction of fractions, 38.

Subtraction, 29.

Subtraction of decimals, 46.

Subtraction of fractions, 42.

RULE FOR FINDING, the diameter of a circle, 65, 66.

The length of a circle, 65, 66.

The solidity of a cone, 77.

The solidity of a cylindrical ring, 76.

The solidity of a pyramid, 78, 79.

The solidity of a segment of a sphere, 75.

The solidity of an irregular solid, 80.

The solidity or capacity of any figure in the cubical form, 71, 72.

The speed for milling cutters, 187.

The surface and contents of the five regular solids, 81.

The surface of a cylinder, 69.

The surface of a sphere, 70.

RULE FOR FINDING THE AREA, of a circle, 67.

Of an ellipse, 68.

Of a parallelogram, 63.

Of a pentagon, 64.

Of a polygon, 64.

Of a rectangle, 63.

Of a square, 62.

Of a trapezium, 61.

Of a triangle, 60.

RULE FOR FINDING THE CONTENTS,

Of a hemisphere, 74.

Of a rectangular solid, 72.

Of a frustum of a cone (cubic), 78.

Of a solid cylinder (cubic), 76.

Of a sphere (cubic), 73.

RULE FOR PROVING, division, 34.

Multiplication, 30.

Multiplication of decimals, 46.

R

RULE FOR PROVING, the correctness of addition, 28.

RULE OF THREE, 48.

RULE FOR USING THE VERNIER, B. & S., 97.

SADDLE, illustration, 158.

SAWS, speed of, 319.

SCALDS, treatment of, 305, 306.
Important note, 305.

SCREW-CUTTING DIE-HEAD, description and illustration 259.

Example showing use of index plate, 133.

Machine, 235.

Section of seven pitch V-thread, 129-134.

SCREW-CUTTING IN THE LATHE, 103-137.

American standard thread, illustration, 120.

Change wheels, 122-130.

Cutting a double square thread, 118; illustration, 113.

Cutting a single square thread, illustration, 113.

Gauge for setting in tool, illustrations, 111, 112.

Hand tools, illustrations, 104, 105, 106, 107.

Head screw, the, 124.

Illustrations, 104-138.

Pitch of screw, 124.

The cross-slide feed screw, illustration, 116.

V-thread, illustration, 119.

With automatic cutting tools, 108-137; illustrations, 109, 110, 111, 112.

Without changing the wheels, 132-135.

SCREW-JACK, illustration, 269.

SCREW THREADS, U. S. Standard, table, 322.

"**SCRIBER**," sewing needle for, 294.

SELF, care of, 314.

RUST, to protect bright work from, recipe, 294.

Iron, recipe for removing, 291.

On tools, to prevent, recipe, 296.

RUST-JOINT COMPOSITION, 295.

S

SET OF PUNCHING TOOLS, description, 232.

SHAFT-STRAIGHTENING MACHINES, illustration, 254.

SHANK CUTTER FOR MILLING MACHINE, 191.

SHAPING MACHINE, description, 163-168; illustrations, 162, 164.

Fellow's gear, 164; illustrations, 165, 166, 167.

Fellow's gear, operation of, 166.

Setting tools in, device for, 167; illustration, 168.

Speed of Tool for, 163.

Travelling head, 163.

SHEET METAL GAUGE, U. S., illustration, 92.

SHEARS, definition, 229.

SHOCK, electric, how to resuscitate from, 309-312.

SHOP, planning a, 282; note, 282.

SHOP FLOORS, use of lime to keep clean, 292.

"**SHOP-KINKS**," definition, 266.

SHOP MANAGEMENT, 275-286.

SHOP-PANS, illustrations, 262-264.

SIDE PLANING TOOL, 161.

And other cutters in operation, illustrations, 194-197.

SIGNS, arithmetical, 20.

SINE, definition, 82.

SKIVING TOOL, description, 148; illustration, 149.

SLOT, provided for drill, 205.

SLOTING MACHINE, description, 169-174; illustration, 170.

For cutting keyways, 172; illustration, 174.

S

SLOTING MACHINE, Operation, 169 ; illustration, 173.
 Relief-tool block, 172; illustration, 172.
SNATCH-BLOCK, illustration, 270.
SOCKET FOR DRILL, description and illustration, 205.
SOCKETS, size of, 205.
SODA WATER FOR DRILLING, 292.
SOLDERING FLUIDS, recipe, 296.
SOLDERING IRON, how to tin, 291.
SOLDERS, recipes for, 290.
SOLIDS definition, 71.
 Five regular illustration, 80.
SPEED, for bolt cutting, 241.
 Of emery saws, 319.
 Of emery wheels, table, 321; note, 224.
SPHERE, rule to find the surface of a, 70.
SQUARE ROOT, 50.

STOCKING PLANING TOOL, 161.
STRIPPER OR PULL-OFF, OF POWER PUNCH, illustration, 232.
SUBTRACTION, 29.
 Of decimals, 46.
 Of fractions, 42.
SUN OR HEAT STROKE, treatment for, 307.
SUPERINTENDENTS, 277.
SURFACE FOR LAYING OUT WORK, recipe, 296.
SURFACE SPEEDS OF IRON, STEEL AND BRASS, table, 319.
SURFACES, definition, 60.
SWING FRAME OR SWIVEL-HEAD, illustration, 158.
SWIVEL APRON, illustration, 158.
SYMBOLS, ABBREVIATIONS AND DEFINITIONS, 20-24.
"SYSTEM" IN SHOP MANAGEMENT, quotation from Chordal's letters, 278.

T

TABLE, of average cutting speeds for drills, 320.
 Of cutting angles, 157.
 Of cutting speeds for dies, 241.
 Of fusing points of tin-lead alloys, 292.
 Of the grades of emery, 225.
 Of Roman notation, 27.
 Of speeds for emery wheels, 321.
 Of speeds for milling cutters, 189.
 Of speeds for twist drills, 210, 211.
 Of standard sizes of wrought iron pipe, 323.
 Of surface speeds, 319.
 Showing the periphery speed of milling cutters, 191.
TABLES USEFUL FOR MACHINISTS, 319-323.
 U. S. Standard screw-thread, 322.
TANGENT OF AN ANGLE, definition and illustration, 82.

TAP, sharpening a, illustration, 222.
TAPPING NUTS, lubricant for, 296.
 Speed table for, 241.
TAPS, adjustable collapsing, description and illustration, 259.
TETRAHEDRON, the, definition, 81.
TIN, to, a soldering iron, 291.
TIN-LEAD ALLOYS, fusing points of, 292.
TOOL, angle for planer, table, 157.
 Broad finishing, description, 148; illustration, 149.
 Four-lipped roughing drill, 150.
 Hog-nose roughing, description, 148; illustration, 149.
 Round-nose, description, 148; illustration, 149.
 Side, description, 148; illustration, 149.
 Skiving, description, 148; illustration, 149.

TOOL CHEST, illustration, 273.
TOOL-GRINDER, wet, illustration, 212.
TOOL-POST, description, 157; illustration, 158.
TOOL-POST APRON, illustration, 158.
TOOLS, broken, how to extract, 295.
 Cutting off, illustration, 246.
 To prevent rust on, recipe, 296.
TRAVELING-HEAD SHAPER, 163; illustration, 162.
TRAPEZIUM, definition, 61.
TRIANGLE, definition, 60.
TRIGONOMETRY, definition, 83.

UNIVERSAL MILLING MACHINE, description, 177; illustration, 176.
USEFUL RECIPES, 287-316.

VARNISH FOR COPPER, recipe, 294.
VERNIER, the, and its use, 95-99; illustrations, 95, 96, 98, 99.
VERTICAL DRILLING MACHINE, 203.

WALL CRANE, illustration, 271.
 Drilling machine, description, 204; illustration, 198.
WATER, to keep from freezing, recipe, 297.
WET TOOL GRINDER, 217; illustration, 212.
WHITWORTH THREAD, illustration, 120.

T

TURNING AND BORING, operation of, 103.
TURRET, fitted on the bed of a lathe, illustration, 255.
TURRET-DRILL, illustrations, 257, 258.
TURRET LATHE, advantages of, 256; illustration, 256.
TURRET LATHES, description in note, 254.
TURRET MACHINES, description, 254.
TWIST DRILLS, illustration, 208.
 Note, 210.
 Sharpening, illustration, 214.
 Table of speeds for, 210.

U

UTILITIES AND ACCESSORIES, 263, 274.
UTILITY, definition, 265.

V

VERSED SINE, definition and illustration, 82.
VICE FOR MILLING MACHINE, description and illustration, 183.

W

WORKS MANAGER, 277.
WOUNDS, how to treat, 298, 299.
 Recipe for solution for washing, 301, 302.
 Two ways of healing, 302.
 "WRINKLE," definition, 266.
WROUGHT STEEL, polish for, 290.

Announce- ment

If a further study of the theory and practice of STEAM AND ELECTRICAL ENGINEERING AND MECHANICAL DRAFTING is desired, the publishers recommend the

**"Hawkins'
Standard
Library"**

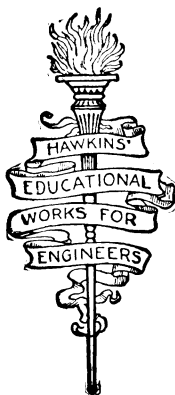
(See list.) Each volume is complete in itself and sold separately; the seven books are supplied for \$12 to responsible parties, on monthly payments.

Terms and particulars sent on request.

**Theo. Audel
& Co.**

Publishers

**63 Fifth Avenue
New York City
U. S. A.**



Original document page was blank

Hawkins'

Educational

Works

LIST

I.

Hawkins' Self-Help Mechanical Drawing, price
 post-paid, - - - - - \$2.00
 (For Home Study.)

II.

Hawkins' New Catechism of Electricity, price
 post-paid, - - - - - 2.00

III.

Hawkins' Aids to Engineers' Examinations, price
 postpaid, - - - - - 2.00
 (With Questions and Answers.)

IV.

Hawkins' Maxims and Instructions for the Boiler
 Room, price postpaid, - - - - - 2.00

V.

Hawkins' Hand Book of Calculations for En-
 gineers, price postpaid, - - - - - 2.00

VI.

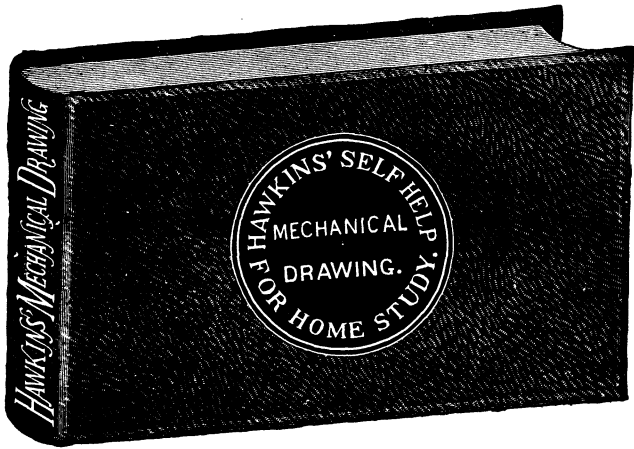
Hawkins' New Catechism of the Steam Engine,
 price post-paid, - - - - - 2.00

VII.

Hawkins' Indicator Catechism, (a practical trea-
 tise), price postpaid, - - - - - 1.00

The seven volumes comprise 2,266 pages and contain 7,143 paragraphs. Each book has an Index, the References totalling 5,171. There are 1,188 Questions and Answers, 199 Tables and 444 Rules, with 419 Examples; in addition there are 269 valuable Foot-notes and 1,258 Diagrams and Illustrations.

Each volume is complete in itself, and will be mailed, post-paid, to any address upon receipt of price above quoted.



Hawkins' Self-Help Mechanical Drawing.

Price, \$2.

This volume contains 320 pages, 300 illustrations, diagrams and suggestive sketches; it is attractively and strongly bound in green cloth, with full-gold edges and titles, making a handsome book, 7x10 inches, for the library, for study and ready reference.

It is superfluous for the publishers to say aught concerning the importance of knowing how to draw, and the utility of draughting in industrial pursuits; but the fact cannot be too frequently reiterated that the education of the mechanic is incomplete without a knowledge of drawing.

CONTENTS.

The work has been carefully arranged according to the fundamental principles of the art of drawing, each theme being separately treated, and many examples given for practice. A list of the subjects are given below, all of which are plainly described and illustrated.

Chalk Work.

Preliminary Terms and Definitions.

Freehand Drawing.

Geometrical Drawing.

Drawing Materials and Instruments.

Mechanical Drawing.

Penciling.

Projection.

"Inking in" Drawings.

Lettering Drawings.

Dimensioning Drawings.

Shading Drawings.

Section Lining and Colors.

Reproducing Drawings.

Drawing Office Rules.

Gearing.

Designing Gears.

Working Drawings.

Reading Working Drawings.

Patent Office Rules for Drawings.

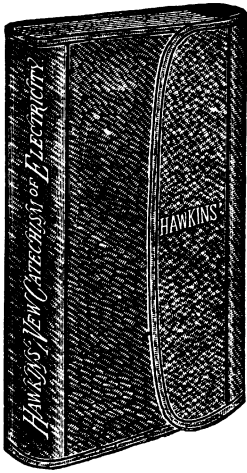
Useful Hints and Points.

Linear Perspective.

Useful Tables.

Personal, by the Editor.

The practical instructions given in this volume are in helpful language, such as a teacher would use, and it is to be hoped that the book will serve, at least, as a stepping stone toward a thorough mastery of the draughtsman's art.



**New
Catechism
of
Electricity.
A
Practical
Treatise
Price, \$2**

This volume contains 550 pages of valuable information, 300 diagrams and illustrations, handsomely bound in heavy red leather, with gold edges, making a handy pocket companion, replete with invaluable knowledge; size $4\frac{1}{2}$ x $6\frac{1}{2}$ inches.

This book has been issued in response to a real demand for a plain and practical treatise on the care and management of electrical plants and apparatus—a book to aid the average man, rather than the inventor or experimenter in this all-alive matter.

Hence the work will be found to be most complete in this particular direction, containing all the (book) information necessary for an experienced man to take charge of a dynamo or plant of any size.

So important is the subject matter of this admirable work that there is only one time to order it and that is **NOW**.

CONTENTS.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

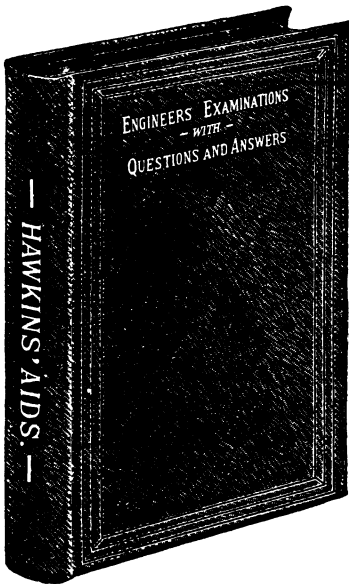
Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.



**Questions
and
Answers
for
Engineers.
Price, \$2.**

This volume has over 200 pages of practical "pointers" showing the path of advancement, so much desired by aspiring engineers and firemen. It is printed on excellent paper and handsomely bound in heavy red leather, with gold title and edges. It is strongly bound for continuous study; the size is 5 x 7½.

The work is a most important aid to all engineers, and is undoubtedly the most helpful ever issued relating to a safe and sure preparation for examination.

It presents in a condensed form the most approved practice in the care and management of Steam Boilers, Engines, Pumps, Electrical and Refrigerating Machines.

On the following page is a list of its "helpful" contents.

CONTENTS.

This book embraces information not elsewhere obtainable.

It tells exactly what an engineer will have to go through in getting a license, with much kindly and helpful advice to the applicant for a license.

It contains the annual report of the superintendents of "Steam Boiler Inspection and Certification of Engineers" for the cities of New York and Brooklyn.

It contains various rules, regulations and laws of cities for the examination of boilers and the licensing of engineers.

It contains the laws and regulations of the United States for the examination and grading of all marine engineers.

It gives a short chapter on the "Key to Success" in obtaining knowledge necessary for advancement in engineering. This is very important.

The book gives the underlying principles of steam engineering in plain language, with sample questions and answers likely to be asked by the examiner.

It gives a few plain rules of arithmetic with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the Steam Engine and Steam Boiler.

The main subjects treated, upon which are given detailed information with questions and answers, are as follows:—
The Steam Boiler, Boiler Braces, Incrustation and Scale, Firing of Steam Boilers, Water Circulation in Boilers, Construction and Strength of Boilers, The Steam Engine, Engine and Boiler Fittings, Pumps, The Injector, Electricity and Electric Machines, Steam Heating, Refrigeration, Valve



**Maxims
and
Instructions
for the
Boiler Room
Price, \$2.**

This is, of all the Hawkins books, perhaps the most useful to the Engineer-in-charge, to the Fireman, to the Steam user or owner, and to the student of Steam Engineering.

It is uniform in binding and size with "Calculations for Engineers" and the "New Catechism of the Steam Engine"; the size is $6 \times 8\frac{1}{4}$ inches, $1\frac{1}{4}$ inches thick; weight 2 lbs.; it is bound in green silk cloth, gilt top and titles in gold; it has 331 pages with 185 diagrams and illustrations.

See next page for further particulars relating to the practical subjects embraced in this valuable volume.

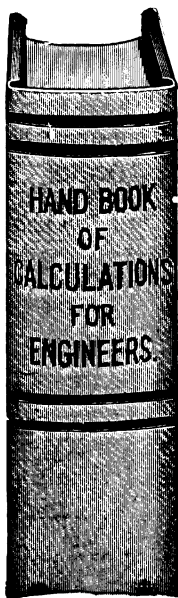
CONTENTS.

Materials; Evaporation; Fire Irons and Tools; Firing of Steam Boilers; Points relating to Fuels; Foaming; Chapter of Don'ts; Full descriptions of the Locomotive, Upright, Water Tube, Horizontal, and Marine Steam Boilers; Parts of a Boiler; Various Specifications for Construction of a Boiler; Riveting; Bracing; Various Repairs; Grate Bars; Boiler Cleaners; Boiler Scales; Boiler Tests; Scumming; Chemical Terms; Inspection of Boilers; Mechanical Stokers; Pumping Machinery; Feed Water Heaters; Steam Heating; Plumbing; Safety Valve Rules.

And many hundreds of other valuable pointers for Steam Users, Superintendents, Engineers, etc.

No Engineer, Fireman or Steam User can afford to be without this valuable book, as it contains the pith and vital "points" of economical and safe steam production.

The plan followed in this work is the same as that so generally approved in "Calculations"; it proceeds from the most simple rules and maxims to the highest problems; it is both a book of instruction and reference. The carefully prepared Index contains nearly one thousand references, **thus making it almost a dictionary of terms.**



Hand Book of Calculations for Engineers. Price \$2.

The work comprises the elements of Arithmetic, Mensuration, Geometry, Mechanical Philosophy, with copious notes, explanations and help rules useful to an Engineer.

And for reference, tables of squares and cubes, square and cube roots, circumference and areas of circles, tables of weights of metals and pipes, tables of pressures of steam, etc., etc.

This is a work of instruction and reference relating to the steam engine, the steam boiler, etc., and has been said to contain every calculation, rule and table necessary to be known by the Engineer, Fireman and steam user.

It is thus a complete course in Mathematics for the Engineer and steam user; all calculations are in plain arithmetical figures, so the average man need not be confused by the insertion of the terms, symbols and characters to be found in works of "higher mathematics," so-called, yet the book is a complete treatise.

It is bound uniform with the "New Catechism of the Steam Engine" and the "Instructions for the Boiler Room" (size $6 \times 8\frac{3}{4}$ inches, weight 2 lbs.); in green silk cloth; printed on heavy, fine surface paper; gold titles, gilt top; with 330 pages and 150 illustrations.

CONTENTS.

The work comprises the elements of Arithmetic, Mensuration, Geometry, Mechanical Philosophy, with copious notes, explanations and help rules useful to an Engineer.

And for reference, tables of squares and cubes, square and cube roots, circumference and areas of circles, tables of weights of metals and pipes, tables of pressures of steam, etc., etc.

The principal subjects enlarged upon are indicated by the following:

Mechanical Powers;

Natural or Mechanical Philosophy;

Strength of Materials;

Mensuration;

Arithmetic;

Description of Algebra and Geometry;

Tables of Weights, Measures,

Strength of Rope and Chains,

Pressures of Water,

Diameter of Pipes, etc.;

The Indicator, How to Compute;

The Safety Valve, How to Figure;

The Steam Boiler;

The Steam Pump;

Horse Powers, How to Figure for Engines and Boilers;

Steam, What It Is, etc.;

Index and Useful Definitions.



**New
Catechism
of the
Steam
Engine.
Price, \$2.**

This is a rarely fine book, handsomely bound in green silk cloth, gilt top, titles in gold; 440 pages; 325 illustrations; size $6 \times 8\frac{3}{4}$ inches, $1\frac{1}{4}$ inches thick; weight 2 lbs. It is bound uniform in style and size with the "Hand Book of Calculations" and "Maxims and Instructions for the Boiler Room."

This will prove a valuable book both for study and reference, being finely illustrated and indexed.

This work is gotten up to fill a long-felt need for a practical book. It gives directions for running the various types of steam engines that are to-day in the market. A list of subjects which are fully yet concisely discussed are found on the next page.

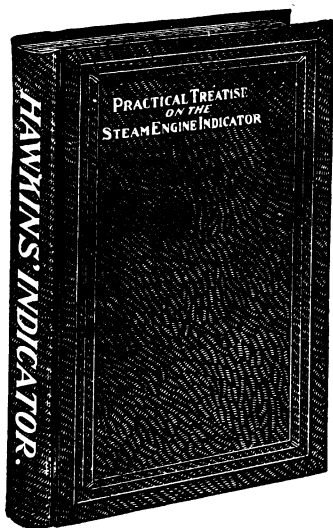
CONTENTS.

The subject matter of the New Catechism of the Steam Engine is not arranged in chapters, but according to the more natural order best designed to explain at greater or less length the different themes discussed. The following are the leading divisions of the 480 pages of the book:

Introduction; The Steam Engine; Historical Facts Relating to the Steam Engine; Engine Foundations; The Steam Piston; Connecting Rods; **Eccentric**; Governor; Materials; Workmanship; Care and Management; Lining up a Horizontal or Vertical Engine; Lining Shafting; Valve Setting; Condensers; Steam Separators; Air, Gas and Compressing Engines; Compounding; Arithmetic of the Steam Engine; Theory of the Steam Engine; Construction.

There is also a description of numerous types of the engines now in operation, such as the Corliss, Westinghouse, etc.

The book also treats generously upon the Marine, Locomotive and Gas Engines.



Indicator Catechism a Practical Treatise. Price, \$1.

This is a new book on an important subject. It is designed to thoroughly instruct the buyer upon the practical use of the Indicator, the Planimeter, the Pantagraph, Reducing Motions, etc. It contains nearly 200 pages with 115 valuable illustrations and diagrams, with questions and answers.

CONTENTS.—Preparing Indicator for Use; Reducing Motions; Piping up Indicator; Taking Indicator Cards; The Diagram; Figuring Steam Consumption by the Diagram; Revolution Counters; Examples of Diagrams; Description of Indicators; Measuring Diagram by Ordinates; Planimeters; Pantagraphs, Tables, etc.

The book is handsomely bound in silk (red) cloth, gilt edges, gold titles; it is $5\frac{1}{4} \times 8\frac{1}{4}$ inches and weighs $1\frac{1}{4}$ lbs.