A KEY

TO THE

EXAMPLES

INCLUDED IN THE

EXAMINATION QUESTIONS

IN THIS VOLUME

It will be noticed that the Keys have been given the same section numbers as the Examination Questions to which they refer. All article references refer to the Instruction Paper bearing the same section number as the Key in which it occurs, unless another "Part" or the title of some other Instruction Paper is given in connection with the article number. Answers have been given only to those questions which require an arithmetical calculation.

To be of the greatest benefit, the Keys should be used sparingly. They should be used much in the same manner as a pupil would go to a teacher for instruction with regard to answering some example he was unable to solve. If used in this manner, the Keys will be of great help and assistance to the student, and will be a source of encouragement to him in studying the various papers composing the Course.

ANSWERS TO QUESTIONS REQUIRING NUMERICAL CALCULATIONS.

SHOP HINTS.

(PART 2.)

(11) In Table II, for turned head-shafts, look down the first column for 3, which is the diameter in inches, and then across to the right in the same horizontal line and in the column headed 100 rev. per min. the H. P. is found to be 20. Ans.

(12) In Table V, for cold-rolled line shafting, look down the first column for $2\frac{1}{2}$, which is the diameter in inches, and then across to the right in the same horizontal line and in the column headed 200 rev. per min. the H. P. is found to be 62. Ans.

TOOLMAKING.

(PART 3.)

(15) By Art. **20,** the outside diameter of the hob is

$$2\tfrac{1}{2} + \tfrac{1}{10} \times \tfrac{1}{2} = 2.5 + .05 = 2.55''. \quad \text{Ans.}$$

The inside diameter is

$$2.5 - [2 \times .6866 \times .5] = 1.8134''. \quad \text{Ans.}$$

(17) By Art. **23,** the width of the slots is

$$.17 \times .5 + .12 = .085 + .12 = .205. \quad \text{Ans.}$$

The number of the slots is

$$\frac{1.8134 \times 3.1416}{.6866 \times .5 + .12 + .25} = \frac{5.6969}{.713} = 7.99, \text{ or } 8 \text{ slots.} \quad \text{Ans.}$$

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GAUGES AND GAUGE MAKING.

(6) By Art. **16,**

Length of cylindrical part of plug. . . . . $= 1.8 \times 1.5 + .4'' = 3.1''$
Length of handle. . . . . $= .5 \times 1.5 + 1.5'' = 2.25''$
Diameter of handle. . . . . $= .5 \times 1.5 + .2'' = .95''$
Height of ring gauge. . . . $= .9 \times 1.5 + .3'' = 1.65''$
Diameter of ring gauge. . $= 2.2 \times 1.5 + .5'' = 3.8''$ } Ans.

In practice the handle would be made 1 in. in diameter in place of .95 in.

(12) By rule, Art. **30,**

Difference in diameters of disks $= 2\frac{1}{4} - 1\frac{3}{4} = \frac{1}{2}$ in. $\frac{1}{2} \div (2 \times 3) = \frac{1}{12} = .08333$; from a table of natural sines the corresponding angle is found to be 4° 47′. The natural tangent of this angle is .08368, which multiplied by 24 gives a taper equal to

$$.08368 \times 24 = 2.0083 \text{ in. per ft.} \quad \text{Ans.}$$

(13) By rule, Art. **30,**

Difference in diameters of disks is $\frac{3}{4}$ in. $\frac{3}{4} \div (2 \times 4) = \frac{3}{32} = .09375$; from a table of natural sines the corresponding angle is found to be 5° 22′, whose tangent is .09394, which multiplied by 24 and divided by 2 gives a taper of

$$.09394 \times \tfrac{24}{2} = .09394 \times 12 = 1.1273 \text{ in. per ft.} \quad \text{Ans.}$$

(14) By rule, Art. **31,**

Difference in diameters of disks is $\frac{7}{8}$ in. $\frac{7}{8} \div (2 \times 3\frac{1}{2}) = \frac{7}{56} = \frac{1}{8} = .125$. From a table of sines the corresponding angle is found to be 7° 11′; the tangent of double this angle, or 14° 22′, is .25614, which multiplied by 12 gives a taper equal to

$$.25614 \times 12 = 3.0737 \text{ in. per ft.} \quad \text{Ans.}$$

(15) According to rule, Art. **32,**

$\frac{1}{12} = .08333$. From a table of natural tangents the corresponding angle is found to be 4° 46′, whose sine is .08310, so that the distance between centers must be

$$\frac{2-1}{2\times .0831}=\frac{1}{.1662}=6.0168 \text{ in.} \quad \text{Ans.}$$

(16) According to rule, Art. **34,**

$\frac{1\frac{1}{2}}{24}=\frac{3}{48}=\frac{1}{16}=.0625$. From a table of natural tangents the corresponding angle is found to be 3° 35′, so that the angle between the sides of the gauge is 7° 10′. Ans.

(17) By rule, Art. **37,**

The sine of half the given angle, or 5°, is .08716, so that the center-to-center distance is

$$\frac{3-2}{2\times .08716}=\frac{1}{.17432}=5.7366''. \quad \text{Ans.}$$

(18) By rule, Art. **38,**

$\frac{3-2\frac{1}{4}}{2\times 5}=\frac{3}{40}=.075$. From a table of sines the corresponding angle is found to be 4° 18′, so that the angle included between the straightedges is 8° 36′. Ans.

DIES AND DIE MAKING.

(PART 2.)

(17) By the formula in Art. **29,**

$x=\sqrt{d^2+4dh}-r=\sqrt{3^2+4\times 3\times 1\frac{1}{2}}-\frac{3}{16}=\sqrt{27}$ $-.1875=5.1962-.1875=5.0087$, say, 5″. Ans.