

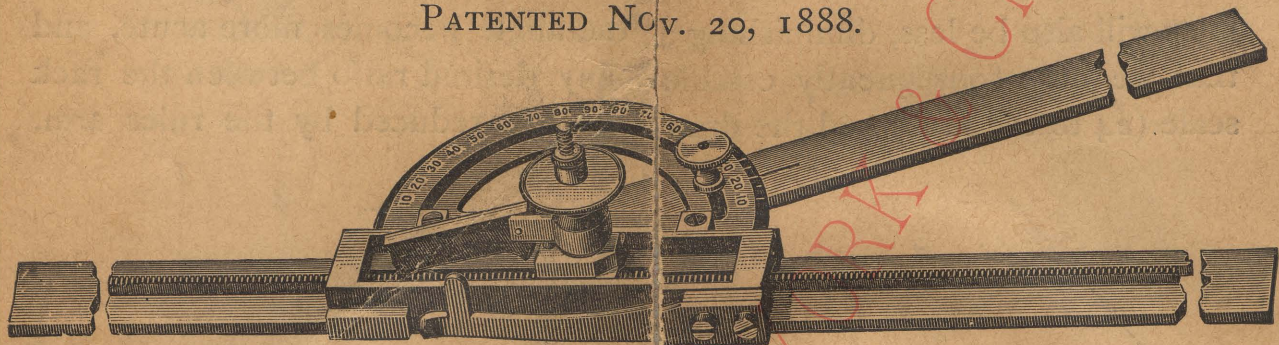
Keuffel & Esser Co. New York and Chicago.

KEUFFEL & ESSER CO.,

NEW YORK & CHICAGO.

BOTH'S SECTION-LINER AND SCALE-DIVIDER.

PATENTED Nov. 20, 1888.



No. 1159. BOTH'S SECTION-LINER AND SCALE-DIVIDER, in polished mahogany box, with full directions.....each \$12 00

THIS SECTION-LINER and Scale-Divider is the easiest to manipulate, the most rapid and exact in execution, the finest in workmanship, and the most durable of any hitherto known. It consists of the following principal parts:—

1st. A *flat* or *rack-bar*, forming the base of the instrument, $14\frac{3}{4}$ inches long, having affixed to it centrally and longitudinally, a fine rack, 9 inches long, with 24 teeth to the inch.

2nd. A *carriage*, nicely fitted and made to slide on the rack-bar.

3rd. An upright steel *pin* fastened to the centre of the carriage. A collar with a *knob* slides up and down on this pin, the length of its course being regulated by means of an *adjusting nut*. A spiral spring pushes the collar upwards until it is arrested by the nut.

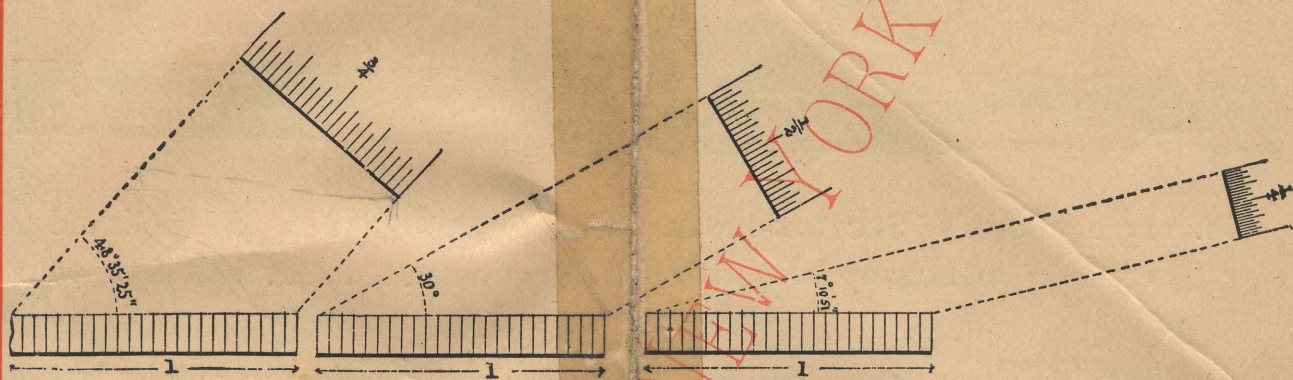
4th. A steel *pawl*, pivoted to the collar, with its other end engaged in the teeth of the rack, so that when the collar is pushed down by pressing the knob—the pawl being held by a tooth of the rack—the carriage is forced to advance along the rack-bar from 1 to 6 teeth at a time, according to the take-up to which the adjusting nut has been set.

5th. A semi-circular *protractor*, attached to the carriage and graduated to degrees.

6th. A *ruler arm*, pivoted to the protractor and projecting 10 inches beyond it, so that it may be placed at any angle to the rack-bar, and be firmly held there by a milled-headed screw.

HOW TO USE THE INSTRUMENT.

It will be evident from the illustration, Fig. 1, that if the ruler arm is set at a right angle to the rack-bar (shown by setting the index on the arm to 90° of the protractor) it will move with each pressure of the knob a distance equal to the number of teeth for which the take up has been adjusted, thus enabling lines $\frac{1}{24}$, $\frac{1}{12}$, $\frac{1}{8}$, $\frac{1}{6}$ or $\frac{1}{4}$ inches apart to be both accurately and rapidly drawn. It will also be clear that if the arm is set at an angle less than 90° , as shown in Fig. 2, that the space between the lines will also be less, diminishing as the angle becomes more acute, and that we may consequently establish any desired ratio between the rack scale (24 to the inch) and the drawn scale as reduced by the ruler arm.



This ratio is the natural sine of the angle formed by the ruler arm and the rack-bar, thus :—Let it be required to draw a scale of 12 to the inch, then we have $\frac{12}{24} = .5$, which is the sine of 30° , or the angle to which the ruler arm must be set. It should be noted that when obtaining settings or angles, the two scales must always be reduced to the same denomination.

The following simple rule will be found easy of application, and to answer all cases :

Take 24 divisions of the drawn scale and 24 divisions of the rack scale, each reduced to the same common denomination ; the quotient of the former divided by the latter will then be the sine of the angle to which the ruler arm must be set.

Example :—Required the setting for an Engineer's scale of 800 parts to a foot.

Here 24 divisions of the drawn scale = $\frac{24}{800}$, and as the rack has 24

teeth per inch or 288 per foot, 24 divisions of the rack, = $\frac{24}{288} = \frac{1}{12}$.

Then $\frac{24}{800} \div \frac{1}{12} = \frac{24 \times 12}{800} = .36 = \text{sine of } 21^\circ 06'$, the angle required.

Example:—Find the setting for a Surveyor's scale of 30 feet per inch.

Here 24 divisions of the drawn scale = $\frac{24}{30 \times 12}$, and 24 divisions of the rack as before = $\frac{1}{12}$, that we have $\frac{24}{30 \times 12} \div \frac{1}{12} = \frac{24 \times 12}{30 \times 12} = .8 = \text{sine of } 53^{\circ} 08' = \text{angle required.}$

Example:—What is the setting for an Architect's or Mechanical Draughtsman's scale of $\frac{3}{4}'' = 1$ foot, divided to twelfths or inches?

Here 1 division of the drawn scale = $\frac{3}{4 \times 12}$ inch = $\frac{3}{4 \times 12 \times 12}$ foot, and 24 divisions = $\frac{3 \times 24}{4 \times 12 \times 12}$; as 24 divisions of the rack as before = $\frac{1}{12}$, we have $\frac{3 \times 24 \times 12}{4 \times 12 \times 12} = 1.5$. Here it is evident that the angle is more than 90° , so we set the adjusting nut to allow the pawl to take up 2 teeth at a time, when 24 divisions of the rack will = $\frac{1}{6}$ foot, then we have $\frac{3 \times 24 \times 6}{4 \times 12 \times 12} = .75 = \text{sine of } 48^{\circ} 35'.$

Example:—What is the setting for a Metric scale of 1 Met. = 1^m 50 graduated to millimetres and halves?

In this case 1^m 50 will have 3000 graduations, so that 1 Metre will have 2000 lines or graduations, which gives

$$\frac{304.79 \times 2000}{1000} = 609.59 \text{ lines per foot, whence we have } \frac{24 \times 12}{609.59} = .47245 = \text{sine of } 28^{\circ} 12'.$$

The following table gives settings or angles for producing the different scales in general use, as well as the number of lines per inch obtained by various angular settings of the ruler arm and the pawl, from which a sample card may be easily prepared, thus facilitating the choice of a degree of shade and the prompt setting of the instrument.

The comfort and satisfaction attending the use of this instrument, the assurance of being able to do absolutely accurate work in less time than with any other, its easy adjustment for section-lining or for scales, its great scope, together with duration and neatness, make it without exception a superior instrument and a valuable and most useful addition to the outfit of every draughtsman who knows and appreciates the value of good tools.

LIST OF ANGLES OR SETTINGS FOR PRODUCING THE DIFFERENT SCALES IN GENERAL USE.

ENGINEERS' SCALES: SCALES FOR DECIMAL PARTS OF A FOOT.

Scale.	Lines per Foot.	Lines per Inch.	Angle.	Setting of Pawl.	
1' = 1000'	1000	83 $\frac{1}{3}$	16° 45'	1 Tooth.	
1' = 900'	900	75	18° 40'	1 "	
1' = 800	800	66 $\frac{2}{3}$	21° 06'	1 "	
1' = 700'	700	58 $\frac{1}{3}$	24° 18'	1 "	
1' = 600'	600	50	28° 41'	1 "	
1' = 500'	500	41 $\frac{2}{3}$	35° 10'	1 "	
1' = 400'	400	33 $\frac{1}{3}$	46° 04'	1 "	
1' = 300'	300	25	73° 45'	1 "	
1' = 200'	200	16 $\frac{2}{3}$	46° 04'	2 Teeth.	
1' = 100'	100	8 $\frac{1}{3}$	73° 45'	2 "	

ARCHITECTS' AND MECHANICAL DRAUGHTSMEN'S SCALES.
DUODECIMAL OR INCH SCALES.

Scale.	Lines per Foot.	Lines per Inch.	Angle.	Setting of Pawl.	Graduates to
$\frac{1}{32}$ " = 1'	1152	96	14° 29'	1 Tooth.	Inches.
$\frac{1}{16}$ " = 1'	864	72	19° 28'	1 "	"
$\frac{1}{8}$ " = 1'	576	48	30° 00'	1 "	"
$\frac{1}{4}$ " = 1'	768	64	22° 01'	1 "	Inches and halves.
$\frac{1}{2}$ " = 1'	576	48	30° 00'	1 "	"
1" = 1'	384	32	48° 35'	1 "	"
1 $\frac{1}{2}$ " = 1'	576	48	30° 00'	1 "	Inches, $\frac{1}{2}$ s. and $\frac{1}{4}$ s.
2" = 1'	384	32	48° 35'	1 "	"
3" = 1'	576	48	30° 00'	1 "	Inches, $\frac{1}{2}$ s, $\frac{1}{4}$ s, and $\frac{1}{8}$ s.
	384	32	48° 35'	1 "	"

SURVEYORS' SCALES: SCALES OF DECIMAL PARTS OF AN INCH.

Scale.	Lines per Foot.	Lines per Inch.	Angle.	Setting of Pawl.	
1" = 100'	1200	100	13° 53'	1 Tooth	
1" = 90'	1080	90	15° 28'	1 "	
1" = 80'	960	80	17° 28'	1 "	
1" = 70'	840	70	20° 03'	1 "	
1" = 60'	720	60	23° 35'	1 "	
1" = 50'	600	50	28° 41'	1 "	
1" = 40'	480	40	36° 52'	1 "	
1" = 30'	360	30	53° 08'	1 "	
1" = 20'	240	20	36° 52'	2 Teeth.	
1" = 10'	120	10	53° 08'	3 "	

METRIC SCALES.

Scale.	Lines per Metre.	Lines per Foot.	Angle.	Setting of Pawl.	Graduates to
1 Met. = 100 cm.	1000	304.79	70° 54'	1 Tooth.	Millimetres.
1 " = 1 m. 25	1600	487.67	36° 12'	1 "	mm. and halves.
1 " = 1.33 $\frac{1}{3}$	1500	457.19	39° 03'	1 "	"
1 " = 1.66 $\frac{2}{3}$	1200	365.75	51° 53'	1 "	"
1 " = 2.00	2500	761.98	22° 12'	1 "	mm. and fifths.
1 " = 2.50	2000	609.59	28° 12'	1 "	"
1 " = 3.00	1666 $\frac{2}{3}$	507.99	34° 32'	1 "	"
1 " = 3.33 $\frac{1}{3}$	1500	457.19	39° 03'	1 "	"
1 " = 4.00	1250	380.99	49° 06'	1 "	"
1 " = 5.00	2000	609.59	28° 12'	1 "	mm. and tenths.