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INSTRUCTIONS

FOR THE USE OF

A. W. FABER'S
CALCULATING RULE

FOR ELECTRICAL AND MECHANICAL ENGINEERS.

MANUFACTORY ESTABLISHED 1761.

Gold and First-class Prize Medals.

GRAND PRIX (highest award) PARIS 1900.

GRAND PRIZE (highest award) ST. LOUIS 1904.

MANUFACTORIES
in
GERMANY, FRANCE AND UNITED STATES.

HOUSES
in
LONDON, PARIS, BERLIN AND NEWARK (N. J.) U. S. A.

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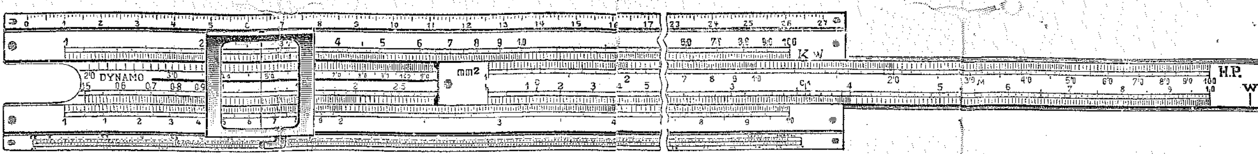
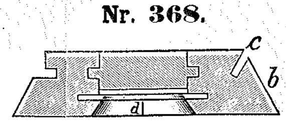
Instructions.



Nr. 368.



General Remarks. **A. W. FABER'S new Calculating Rule** is exclusively intended for **Mechanical and Electrical Engineers,** but all those calculations which can possibly be made with the standard Calculating Rule, can also be carried out with it. Only small modifications have been made in the construction of the rule, but it nevertheless results that three other important calculations can be made with it. In the new arrangement only the measuring scales on the bevelled side **b** and on the bottom of the groove at **d,** have been omitted. The guide groove for the cursor has been transferred to **c;** while the left end of the slide is fitted with a metal covering piece or index, having a sharp edge, which is used in conjunction with new scales on the bottom of the groove of the rule. As will be seen from the illustration, the new Calculating Rule is of almost exactly the same form as the previous construction.

Log-log Scales. By removing the measuring scale from the bevelled side **b,** this entire surface has become available and has been filled with two sets of graduations, side by side, — the so-called log-log scales. These two sets of graduations form a continuous log-log scale running from 1.1 to 100,000. The first half runs from 1.1 to 2.9, and the second half from 2.9 to 100,000. The cursor, at the bevelled side of the rule, carries a metal tongue, the end of which serves as a marker and corresponds exactly with the line on the cursor glass. With this arrangement, the log-log scale can be used in conjunction with the lower scale on the slide, and powers and roots within the limits of 1.1 and 100,000 and of the form $\mathbf{a}^x$ or $\sqrt[x]{\mathbf{a}}$ can be obtained, in which neither **a** nor **x** need be a whole number. The choice of the lower limit, 1.1, was determined by considerations of the most usually occurring values, and the length of the scale then determined the upper limit, 100,000. Both parts of the log-log scales extend somewhat beyond the limits of the lower scale of the rule; while on the lower scale of the slide, to the right of 10, is a special index mark W, the length 1-W being equal to that of the lower log-log scale.

Involution (Powers).

Example 1: $1.124^{2.24} = 1.2993$.

Set the metal tongue of the cursor to the root 1.124, on the log-log scale, and bring 1 on the lower scale on the slide under the line on the glass; then set the line on the glass to the exponent 2.24 on the lower scale of the slide, when the power, 1.2993 can be read off on the log-log scale under the metal tongue of the cursor.

As will be seen from the above example, the reading [illegible] esults which do not exceed 2.9 is very simple. But if the number, when r[illegible] the given power, exceeds 2.9, then the special index mark W is used in [illegible] 1 and the result is found on the second or upper half of the log-log scale.

Example 2: $1.665^{3.17} = 5.03$.

As before, set the cursor to 1.665 on the log-log scale, bring W on the lower scale of the slide under the cursor line, set the cursor to the exponent 3.17 on the lower scale of the slide and read the power, 5.03, under the tongue of the cursor, on the second log-log scale.

Evolution (Extracting roots).

Example 3: $\sqrt[2.8]{26.5} = 3.22$.

Set the cursor to 26.5 on the log-log scale, bring the exponent, 2.8 on the lower scale on the slide under the cursor line, and after setting the cursor to 1 on the lower scale on the slide, read off the root, 3.22, on the upper log-log scale.

If the root is less than 2.9, the special index mark W is used, and the result is found in the first log-log scale.

Example 4. $\sqrt[7.15]{8.75} = 1.354$.

Set the cursor to 8.75 on the log-log scale; bring the exponent 7.15 on the lower scale on the slide under the cursor line, the cursor to the index mark W, and read off the root, 1.354 on the lower log-log scale.

If in extracting roots the result falls below 1.1, the calculation cannot be made with this slide rule; neither can numbers less than 1.1 be raised to powers.

Graduations on the Bottom of the Calculating Rule.

The measuring scale omitted from the bottom side **d** of the Calculating Rule has been replaced by two new Sets of logarithmic graduations, which are read by means of the metal indicator attached to the left end of the slide. The upper of the two scales enables the efficiency of dynamos and electric motors to be calculated, or the out-put in kilowatts, or the effective horse power, with a given degree of efficiency; and this with a single setting of the slide.

By the lower scale, and with only two settings of the slide, the loss of potential in an electric circuit, can be calculated from the quantities: current strength, length of lead, and section of lead. Obviously any one of these factors may be the unknown quantity. The scale is only applicable to direct current calculations, or for an alternating current free from induction.

For simplicity the upper scales will be called the "Efficiency Scale" and the lower graduations, the "Loss of Potential", or "Volt Scale".

The upper scale of the rule is marked "KW", signifying Kilowatts, on the right; the upper scale on the slide is marked "H. P.", signifying effective horse-power. The upper scale on the bottom of the rule, that is, the efficiency scale, gives the efficiency of dynamos (from 100 to the left); and the efficiency of motors (from 100 to the right).

Efficiency of Dynamos.

Example 5: Determine the efficiency of a dynamo of 90 KW and 132 H. P.

Set 13.2 on the upper scale of the slide (corresponding to 132 H. P.) under 90 KW on the upper scale of the rule, and read off, at the left end of the slide, 91.3% on the efficiency scale for dynamos.

From this example it is at once evident, that with a given degree of efficiency all possible electrical and effective horse powers can be immediately read off with a single setting of the slide.

For this purpose the left end of the slide is set to the degree of efficiency, and the corresponding values are read off on the two upper scales on the rule and slide respectively.

Example 6: Efficiency 90%.

Set the left end of the slide to 90 on the "dynamo" scale, and above H. P. = 20, read KW = 13.41; above H. P. = 50, KW = 33.6; above H. P. = 100, KW = 67.1 etc.

Efficiency of Motors.

Example 7: Determine the efficiency of a motor of 20 H. P. and 17.1 KW.

Set 2 on the H. P. scale to 17.1 on the KW scale and read off the efficiency (87.3 %) on the "Motor" scale. From this example it is also evident that for a given efficiency, the power in KW can be read immediately above any H. P.

Scale of Loss of Potential — Volt Scale.

The use of the "Volt Scale" is as simple as that of the scale last described. The loss of potential in a simple copper lead with direct current, or with alternating current free from induction, is determined by the formula $\mathbf{e} = \frac{J \times L}{c \times q}$, in which **e** denotes the loss of potential in volts, **J**, the strength of current in amperes, **L** the single length of lead in metres, **q**, the necessary sectional area of the copper, and **c** a copper constant, which on the slide rule has been taken as 28.7. The volt scale gives the loss of potential from 0.5 to 10 directly in volts.

Example 8: Determine the loss of potential for a copper lead of 70 sq. mm. section and 80 metres in length, with a current strength of 60 amperes.

Set 1 on the upper scale on the slide to 6 on the upper scale on the rule, bring the cursor line to 8 on the upper scale on the slide (obtaining the product $J \times E$); then bring 7 on the upper scale on the slide to the cursor line (obtaining the quotient $\frac{J \times L}{q}$) and read, at the left end of the slide on the volt scale, 2.38 volts. The advantage afforded by the slide rule now becomes evident, for if the loss of potential found is too large, a further setting of the slide enables the sectional area to be found for any desired loss of potential. Suppose, for example, the loss of potential is to be only 1 volt. The cursor is kept unchanged in position, the left end of the slide set to 1 on the volt scale and 167 sq. mm. is read off under the line on the cursor on the upper scale of the slide.

If the left end of the slide is set to a certain loss of potential and the cursor to a certain section, then by moving the slide, all values of the product "length of lead" and "strength of current" can be obtained, which are applicable to the known section and loss of potential.

Thus by means of the volt scale any one of the factors in the above formula can be very easily ascertained, if the other factors are known.

The rule has the constants 28.7 and 746 marked on the upper scales of both rule and slide, while on the back is a collection of useful constants and other data.