H. DAEMEN-SCHMID.

COMPUTING DEVICE.

APPLICATION FILED JULY 28, 1908.

1,036,575.

Patented Aug. 27, 1912.

2 SHEETS—SHEET 1.

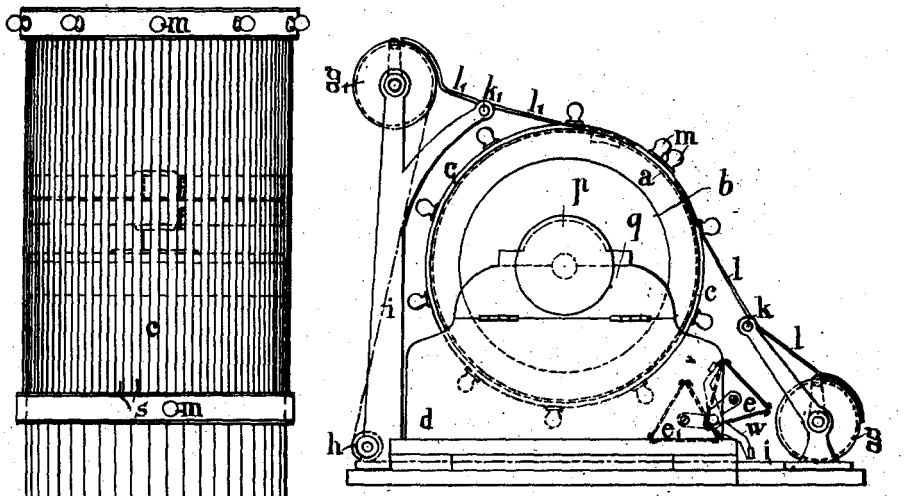

Fig. 2.

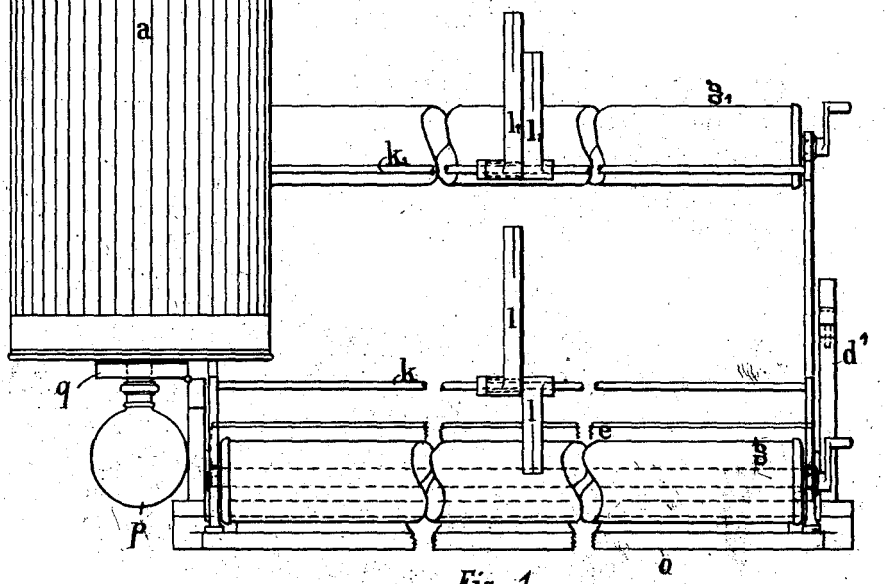

Fig. 1.

Witnesses:

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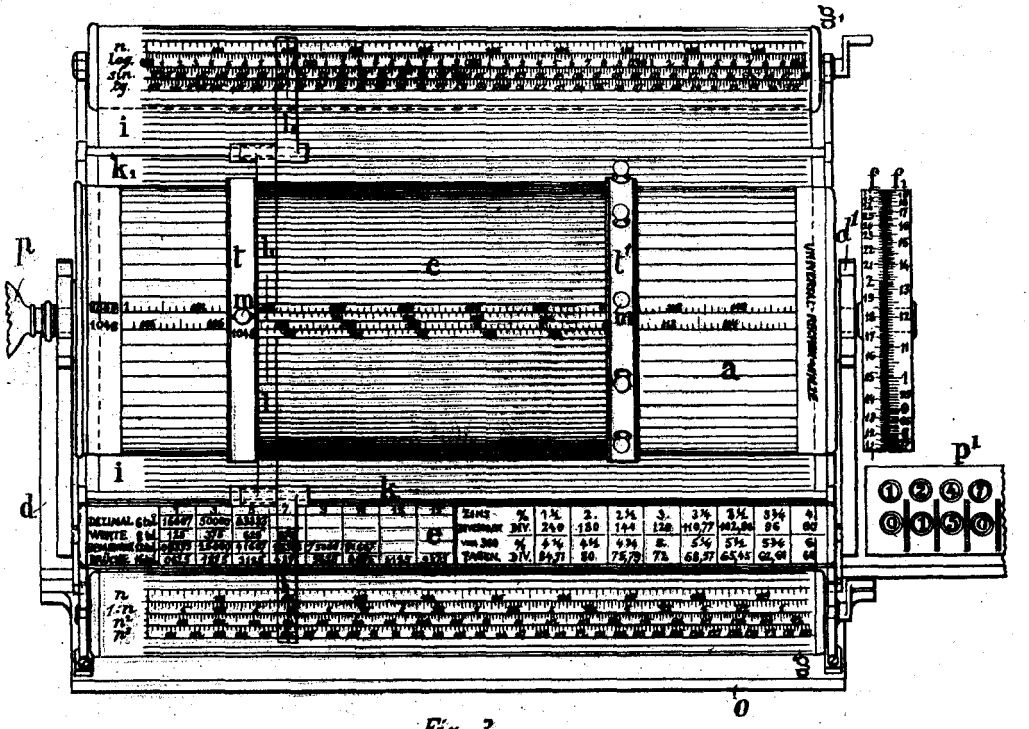

Fig. 3.

Fig. 4.

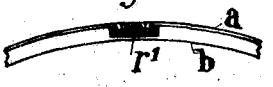

Fig. 5.

Fig. 6.

Fig. 7.

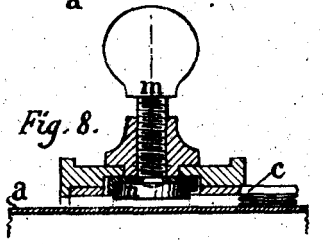

Fig. 8.

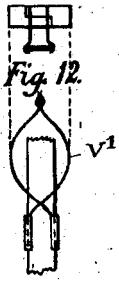

Fig. 12.

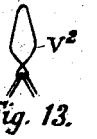

Fig. 13.

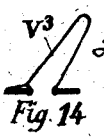

Fig. 14.

Fig. 9.

Fig. 10.

Fig. 11.

Witnesses:

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UNITED STATES PATENT OFFICE.

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COMPUTING DEVICE.

1,036,575. Specification of Letters Patent. Patented Aug. 27, 1912.

Application filed July 28, 1908. Serial No. 445,838.

To all whom it may concern:

Be it known that I, HEINRICH DAEMEN-SCHMID, a citizen of the German Empire, and residing at Oerlikon, near Zürich, Switzerland, have invented a new and useful Computing Device, of which the following is a specification.

My invention relates to computing devices based upon logarithms.

The object of the invention is to provide a calculating instrument of the above class with which not only the more simple operations such as simple multiplication, division and proportion of arithmetical calculations can be performed but even the most complex problems may easily be solved, obviating thereby the intricacies of the computing scales known heretofore.

With these and other objects in view the invention consists of certain novel features of construction, combination and arrangement of parts as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawings Figure 1 shows the apparatus with some parts removed in a front elevation, the cylinder with half drawn out slide being raised to its vertical position. Fig. 2 is a side view of the complete instrument. Fig. 3 is a front view of the apparatus projected upon a plane at 45° elevation from a horizontal plane. Figs. 4, 5, 6 show three different means of connecting the ends of the interchangeable mantle bearing on its surface the common logarithmic cylinder scale. Figs. 7 and 8 show two braking devices in section. Figs. 9, 10 and 11 show by way of example three cross sections of graduated slide bars with movable pointers. Figs. 12, 13 and 14 show by way of example three different forms of removable pointers adapted to be set on or between the bars of the slide.

The instrument has a cylinder b rotatably mounted in the standards d d^1 fixed to a base o. One bearing q is hinged to the standard d, while the other is an "open" bearing. The axle of the cylinder b is further provided on its left hand side with a knob p in the well known manner. By pressing knob p down the bearing q will tilt over and the cylinder b raised to the position shown in Fig. 1.

The cylinder b bears an interchangeable tabulator mantle a. On its surface the values of the common logarithms of numbers are marked off in parallel lines in the well known manner. This graduation will hereinafter shortly be called logarithmic cylinder scale. The mantle a can be made of any suitable material for instance of sheet metal, or of sheet metal in combination with fabrics, paper, celluloid, etc. If the mantle is formed from a band rolled to a cylinder, the joints or seams are preferably made as shown in Figs. 4, 5 and 6 but I wish it clearly understood that I do not confine my invention to these specific manners of joining as other joints may prove evenly good according to the material used. The joint shown in Fig. 4 consists of a strip r of hard material on to which the ends of the mantle a are gummed or soldered, etc. As shown in Fig. 6 the ends of the mantle bend over each other. The cylinder b is provided with a groove adapted to receive the joints of the mantle a whereby the mantle may easily be changed at any time.

In calculating machines having cylinders provided with logarithmic graduations it is more necessary than in machines with other graduations, that the sheet bearing the graduated scale should always occupy the same position with respect to the cylinder and that those edges of the sheet which are adjacent the joint, that is the abutting edges, should be kept in strict alinement. For this purpose the edges of the mantle bearing the graduation are permanently joined, as clearly shown in Figs. 4, 5 and 6 of the drawing, although the entire mantle may be removed from the cylinder.

The slide c is an open framework composed of bars s fixed with their ends to metal rings t and t^1 which have a good sliding fit on the mantle a, so that the slide may be moved in rotary and longitudinal directions. The bars s may have cross sections as shown by way of example in Figs. 9, 10 or 11. The bars bear a graduation representing the common logarithms of numbers. This graduation is called hereinafter the logarithmic slide scale. The bars s^2 and s^3 shown in Figs. 10 and 11 bear two different graduations for instance they may have on one face x the logarithmic slide scale while the other face y bears the same scale but on a reversed direction. Another modification is that while the face x of the bars bears the logarithmic scale the other face y bears numbers for instance the rates of interest

placed opposite to the corresponding numerical value of the slide scale. The division lines in such instances are prolonged over the edges right into the face x. Above each bar s a wire u may be arranged fixed into the two rings t, t^1 and carrying one or more pointers v, as shown in Figs. 9, 10 and 11. The pointers v, Figs. 9, 10 and 11 are slidably mounted on the wires u and run over the divisions of the bars. The pointers v^1 and v^2 shown in Figs. 12 and 13 ride removably on the bars and can be easily taken off, if not required. Fig. 14 shows a pointer v^3 adapted to be placed between two consecutive bars. The use of the pointers will be clearly pointed out hereafter.

For some purposes it is desirable to fix the slide c in certain position on the cylinder scale mantle a for instance when it is required to multiply a series of items with one and the same multiplicand. I arrange for this purpose on each of the rings t t^1 a spring m^1, one end of which is fixed to the ring, while the other end carries a brake block n of india-rubber or the like (Fig. 7). Above the spring m^1 a two armed lever m^2 is rotatably mounted on said rings, one arm of which forms an eccentric adapted to press the india-rubber piece (n) upon the mantle a.

Fig. 8 shows a modified construction of the brake device. The rings are provided with bosses in which screws with heads m are mounted. The free end of each screw carries a brake block n of india-rubber or like soft material. To fix the slide c it is only necessary to turn the screw m down, the soft brake block n will prevent injurious friction on the mantle a.

It will be clear from the above, that not only the mantle a but also the slide c is exchangeable, so that it is possible to use mantles and slides with different scales and to adapt the instrument to the special work desired. To exchange either mantle a or slide c the cylinder b is tilted so that it takes the position as shown in Fig. 1.

In the standards d d^1 of the apparatus two two armed levers w are rotatably fixed, which carry a three or more sided prism e, Figs. 1, 2 and 3. The prism may be swung out in any position by the said levers, it bears on its surface tables of constants, for instance divisors, reciprocals, cross sections, decimal equivalents of fractions, etc. These tables may be made as well on strips of paper pasted on the prism or removably fixed to the same. The prism may be made of sheet metal, the ends being turned over (as shown in Fig. 2) to form a guide for strips bearing on each side tables of constants. The prism if made hollow may serve as receptacle for the pointers or other small accessories of the instrument. I wish to point out that while I have found the prism very practical I nevertheless do not confine my claims on this particular construction. For instance the prism may be replaced by a band running over two rollers or by a roller rotatably mounted in suitable bearings.

On the axle of the cylinder b or on the standard d^1 on the right hand side of the same two rings f f^1 sliding tightly on each other are rotatably mounted. On the circumference of the rings scales for instance logarithmic scales are marked off for the purpose of effecting subsidiary or interpolated calculations. The rings are made exchangeable. The use of these rings will be explained in the Example III.

In the standards d d^1 of the instrument three rollers g, g^1 and h are rotatably mounted. The rollers g and g^1 are provided with cranks. The ends of a band i are fixed to the rollers g and g^1 which band is led over the guide roller h. The band i is arranged in such a manner, that on the upper roller g^1 the reverse and on the under roller g the front side of band i is in sight. By means of the cranks the band may be moved in any desired position. The band i bears on both faces logarithmic scales or tables of constants, for instance besides the cylinder scale, the decimal values of sine, tangents, squares, cubes, etc. To facilitate the reckoning the band i may be colored, so that each scale or each table is marked off on a different colored part of the surface.

To the bearings of the rollers g g^1 two guide rods k k^1 are fixed on each of which a pair of directing indexes l l^1 are mounted. The indexes l l^1 are movable on said guide rods k k^1 and each arm of them can be independently raised. The indexes are made of transparent material and are provided with a thin hair line. The object of these indexes is to transfer values of the band to the cylinder scale a and vice-versa or to compare the graduations of the band with each other. The transfer is easily obtained as will be readily seen by an inspection of Fig. 3 of the accompanying drawings. These indexes are of especial use in any complex calculation as will be readily seen by Example VIII described hereafter. As each arm of the indexes can be raised they do not interfere by tilting the cylinder b or by removing the band i.

On the right hand side of the apparatus an adding machine p^1 is removably mounted on the standard d^1 which may be of any of the well known constructions. The subresults in combined calculations which are obtained on the cylinder may be registered on the adding device, so that after the whole operation has been finished the end result may be read off.

Having described one form of construction of the calculating instrument with cer-

tain modifications of parts, I would point out that various other changes in the form, proportion and the minor details of constructions may be resorted to without departing from the principle or sacrificing any of the advantages of this invention.

To complete the foregoing description I will show by examples how the computing device may be advantageously used for the most varied practical purposes conceivable.

Examples.

I. Convert £5.2/1 in marks at the rate of 10.245 marks for 10 s.

Answer: From the table of the decimal equivalents of fractions marked on prism *e* it appears, that $\frac{1}{12}$ equals 0.08333. Hence the sum given viz. £5.2/1 equals

$$5\times20+2\times0.08333=102.08333.$$

Place figure 1 of the slide scale opposite figure 1020833 of the mantle and find figure 10.245 on the slide. The coinciding figure on the mantle gives the result *i. e.* 10458 marks.

II. What is the discount on $10492 at the rate of 3½% interest for 105 days?

The use of factor for interest has become familiar in mercantile calculations. To find same, multiply the number of days of one year with 100 and divide the product by the rate of interest. The result of this operation are constants and have been reckoned out for the most common rates of interest and put down on tables placed upon the prism *e*. These constants simplify any discount calculation. The discount in the present example is given by

$$\frac{10492\times3\frac{1}{2}\times105}{100\times360}$$

Looking up the table of constants on the right hand side of the prism *e* (Fig. 3) we find the factor to be 10286, hence the above formula takes the form:

$$\frac{10492\times105}{10286}$$

Answer: The factor of 3½% (10286) is marked on the slide with one of the pointers (Figs. 9, 12 or 14) and placed opposite the amount (10492) on the mantle. Find now the number of days (105) on the slide and coinciding with it the result namely (107.10) on the mantle. This operation may be made still more simple by using a special slide with bars s^2 or s^3 as shown in Fig. 10. On the upper (*x*) faces of these bars the common logarithmic scale is marked off while the lower (*y*) faces bear the different rates of interest. To perform the above operation it is only necessary to mark the number 3½ with a pointer (shown in Figs. 10 or 13) on the *y* face of the respective slide bar and to place its corresponding *x* face below the amount (10492) on the mantle. The days (105) are then found on the *x* side of the respective slide bar and the result (107.10) read off the mantle.

III. Example, (embroidery calculation:) 35 different designs are to be calculated. The price of the stitches being 1.02 mk. per thousand; the price of the fabrics being different for each single design, must be added to the calculated working expenses. The first design contains per stripe 10757 stitches, the price per thousand stitches is mk. 1.02 and 14 stripes of fabric for this design cost mk. 21. What is the total cost of one stripe of this particular design?

To perform this calculation the rings *f* f^1 are of especial use to determine the cost of fabric used for one stripe of each design. If we would try to solve the problem without using them we would have to ascertain separately the price of the fabrics and the working expenses of each design; therefore two settings of the slide on the mantle would be necessary for each design, which would need $35\times2=70$ operations to solve the problem given. Making use of the rings *f* f^1 the number of operations to be performed is reduced to 35.

Answer: The initial figure 1 of the slide is placed under the figure 1.02 on the mantle and now the slide is fixed on the mantle by means of the braking device *m* as described above. The number of stitches (10757, etc.) is then looked up on the slide and the coinciding figure (1097, etc.) on the mantle indicates the price of the embroidering.

To obtain the price of the fabric used for one design we have to divide 21 (the price of the fabric) by 14 (number of stripes). We place now the figure 14 of the ring f^1 opposite the figure 21 of the other ring *f*. We find the quotient 15 (M. 1.50) opposite the figure 1 of the ring f^1 on the ring *f*. Making use further of the adding-machine p^1 on the right hand side of the standard (Fig. 3) we add to the price for embroidering (M. 10.97) obtained before the price of the fabric (M. 1.50) and we get the total cost of the first design (M. 12.47).

IV. Example: The use of reciprocals and the multiplication of three factors with only one setting of the slide will be made clear by the following example:

The dimensions of an area are 98.04 m. by 104.04 m.; one square meter is valued to M. 1.05. What is the value of the area?

Answer: The reciprocal of one of the dimensions for instance of the number 98.04

$$\left(\text{is } \frac{1}{98.04}\right)$$

will be found on the scale headed with "1:n" of the band *i* on the roller *g* to be 0.0102. We search the number 102 on the slide and mark it with a pointer shown in Figs. 9, 12 or 14. This number is the di-

visor the division being performed as previously described by placing the number marked (102) opposite the number 10404 on the mantle. The quotient 10710 is then to be found opposite of the number 105 of the slide on the mantle.

The same problem may be solved by using a slide with bars as shown in Fig. 10. The faces x of the bars bear the common logarithmic scale, while on the faces y of the bars the same scale is marked off but in a reversed direction the end of the scale on the faces x coinciding with the beginning of the scale on the faces y. In this case one of the numbers *i. e.* 98.04 is marked on the scale of the y face of the respective bar, by a pointer as shown in pages 10 or 13, and placed opposite the other number (104.04) on the mantle and the third number (1.05) is now found on the upper x face of the respective slide bar. The number on the mantle coinciding with the third number (1.05) is the result (M. 10710).

V. Example, (reading off squares and square roots of numbers:) To find the area of a rod the cross section of which having equal sides and measuring each 10.2 mm.

Answer: The lower index l (Fig. 3) is placed over the number 102 of the scale headed with "n" on the band i and the result may be directly read off on the scale of the band i headed with "n^2" to be 104.04 mm. It is obvious, that the square roots may be found in an analogous manner.

VI. Example, (reading off cubes and cube-roots:) What is the contents of a cube the length of one edge being 1.02 m.?

Answer: The lower index l is placed with its hair line over the figure 102 of the scale headed with "n" on band i and the number on the scale marked by n^3 coinciding with the said hair line is the result namely 1.0612 m^3. The cube roots are obtained in an analogous manner.

VII. Example: To find the mantissa of the common logarithm of the number 102.

Answer: Place the upper index l^1 on the number 102 of the scale headed with "n" and read off the desired value 0086 on the scale headed with "Log" on the band i.

VIII. Example: The use of the scale of natural sines in conjunction with the scale on the mantle will be made apparent by the following example:

The hypotenuse of a right angled triangle is given to 105 m., one of the angles $\alpha = 5° 51' 15''$. The length of the side A lying opposite the angle α is to be found.

Answer: The length of the side A is given by the formula

$$A = C \times \sin.\ \alpha = 105 \times \sin.\ 5° 51' 15''.$$

Place now the hair line of the upper index l^1 (Fig. 3) over $5° 51' 15''$ on the scale headed with "Sin" and by looking over the scale headed with "n" you will find that the hair line of the index coincides with a mark denoting the number 102, indicating the natural sine *i. e.* 0.102. Place now the initial figure 1 of the slide opposite the figure 102 of the mantle and search for the number 105 on the slide. Opposite the figure 105 you will find on the mantle 1071 from which it follows, that the length of side A is equal to 10.71 m.

IX. Example: Use may be made of the scale of tangents on the band i by solving a problem of the following kind: Two sides, the base and the perpendicular of a right angled triangle are given to 105 cm. and 10.71 cm. Find the size of the angle α lying opposite the side 105. The tangent of the angle α is given by the formula

$$\text{tg.}\alpha = \frac{10.71}{105}$$

Mark the number 105 on the slide with a pointer (Figs. 9, 12 or 14) place it opposite the number 1071 of the mantle and find opposite the initial figure 1 of the slide the number 102 hence the numerical value of the tangent of the angle α is 0.102. To find the angle in degrees minutes and seconds place the upper index of l^1 on the number 102 of the scale headed with "n" and find on the scale headed with "Tg" the value of the angle $\alpha = 5° 49' 27''$.

From the above it will be clear how the calculating instrument may be used but I wish it clearly understood that any other tables, scales, etc., may be used according to the special purpose for which the apparatus is to be used.

Having described fully my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a calculating instrument a cylinder, bearings for said cylinder, one of said bearings comprising a stationary portion, and a portion pivotally connected therewith, to allow of swinging movement of said cylinder in a vertical plane, the other bearing being open in its upper half.

2. In a calculating instrument a cylinder, bearings in engagement with said cylinder and supporting the same rotatably in horizontal position, one of said bearings comprising a stationary portion and a portion pivotally connected therewith and supporting said cylinder, to allow of swinging movement of said cylinder in a vertical plane, and means connected with said cylinder for maintaining the same in vertical position.

3. In a calculating instrument a cylinder, bearings in engagement with said cylinder and supporting the same rotatably, one of said bearings comprising a stationary por-

tion and a portion pivotally connected therewith, to allow of swinging movement of said cylinder in a vertical plane, and means connected with said cylinder for maintaining the same in vertical position, said means engaging said stationary bearing portion, when the cylinder is in vertical position.

4. In a calculating instrument a graduated cylinder, a graduated slide rotatably and longitudinally movable on said cylinder, a block of soft material projecting through a portion of said slide, and a releasable means for pressing said block into engagement with said cylinder.

5. In an instrument of the class described the combination of a cylinder provided with graduations on a logarithmic scale, a slide movably disposed on said cylinder and provided with graduations on a logarithmic scale, a prismatic body in parallel arrangement with the axis of said cylinder, the sides of said body being provided with indications, adapted to be brought in calculatory co-action with the graduations on said cylinder and slide.

6. In an instrument of the class described the combination of a cylinder provided with logarithmic graduations, a slide movably disposed on said cylinder and provided with logarithmic graduations, a prismatic body in parallel arrangement with the axis of said cylinder and rotatable with respect to the same, the sides of said body being provided with indications adapted to be brought in calculatory co-action with the graduations on said cylinder and slide.

7. In an instrument of the class described the combination of a cylinder provided with logarithmic graduations, a slide movably disposed on said cylinder and provided with logarithmic graduations, a plurality of interchangeable rings in juxtaposition mounted on the axis of said cylinder and rotatable independently from the same, said rings being provided with graduations adapted to be brought in calculatory co-action with each other and with the graduations on said cylinder and slide.

8. In an instrument of the class described the combination of a cylinder provided with logarithmic graduations, a slide movably disposed on said cylinder and provided with logarithmic graduations, a plurality of rotatable members parallel to the axis of said cylinder, and a ribbon connecting said members and being provided with indications adapted to be brought in calculatory co-action with said graduations.

9. In an instrument of the class described the combination of a cylinder provided with logarithmic graduations, a slide movably disposed on said cylinder and provided with logarithmic graduations, a plurality of rotatable members parallel to the axis of said cylinder, and a ribbon connecting said members, said ribbon being partly rolled up on each of said members, both sides of said ribbon being provided with indications adapted to be brought in calculatory co-action with said graduations, and one of said members being adapted to display one side of said ribbon, another one of said members being adapted to display the other side thereof.

10. In an instrument of the class described the combination of a cylinder provided with logarithmic graduations, a slide movably disposed on said cylinder and provided with logarithmic graduations, a plurality of rotatable members in parallel arrangement to the axis of said cylinder, a ribbon supported on said members and being provided with indications adapted to be brought in calculatory co-action with said graduations, a plurality of rods parallel to the axis of said cylinder, and a plurality of pointers pivotally and slidably mounted on said rods, and pointers being directed toward said cylinder, slide and said rotatable members respectively.

11. In a calculating instrument a graduated cylinder, a slide rotatably and longitudinally movable with respect to said cylinder, said slide including a plurality of graduated rods, pointers on said rods, said pointers comprising a resilient bail shaped portion, an indicating portion, and a portion in engagement with a rod portion, said pointer being releasable from said rod by pressure on said bail shaped portion.

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Witnesses:
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