No. 843,944.

PATENTED FEB. 12, 1907.

R. L. HIBBARD.

CALCULATING DEVICE.

APPLICATION FILED AUG. 7, 1905.

Fig. 1.

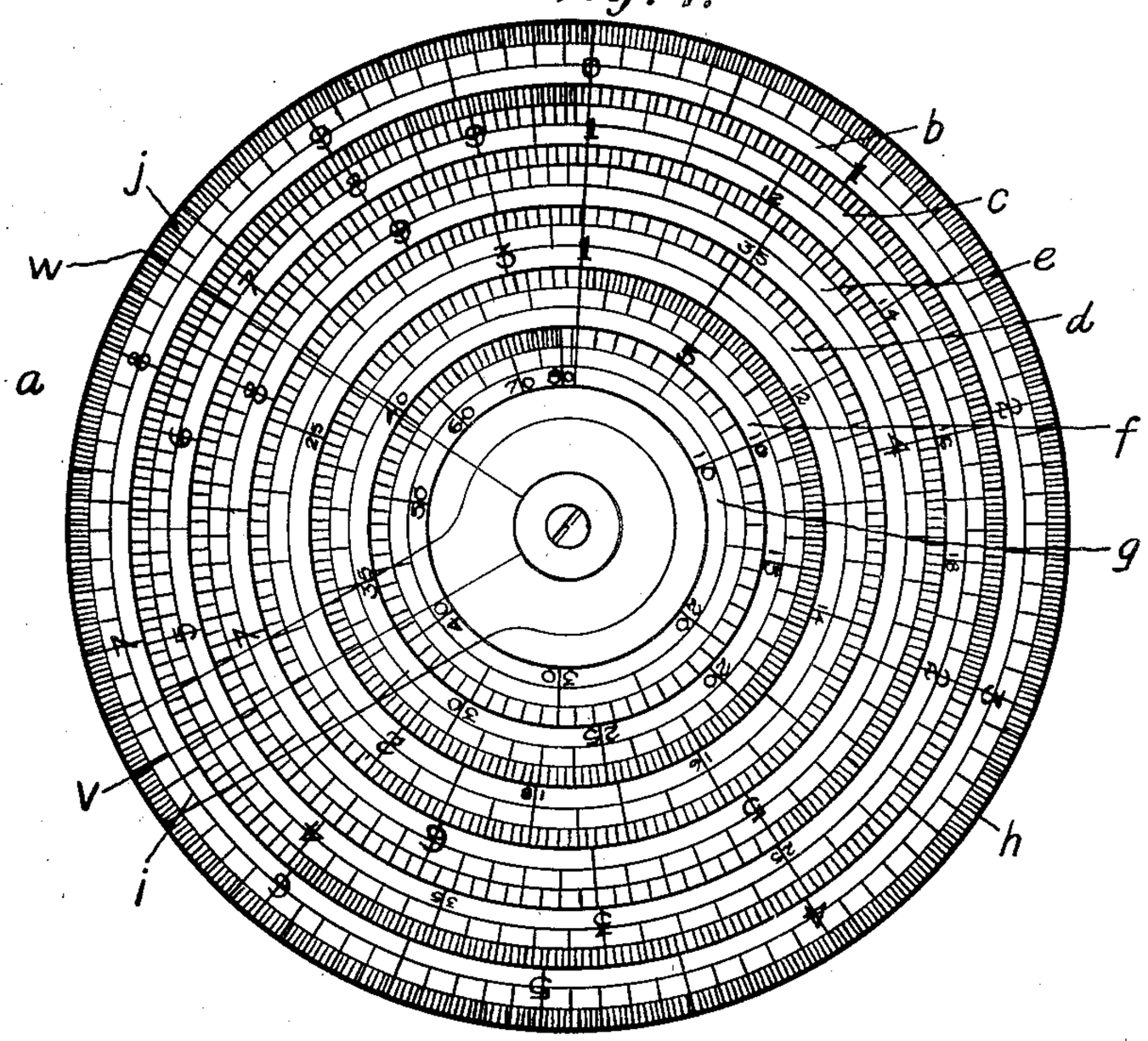
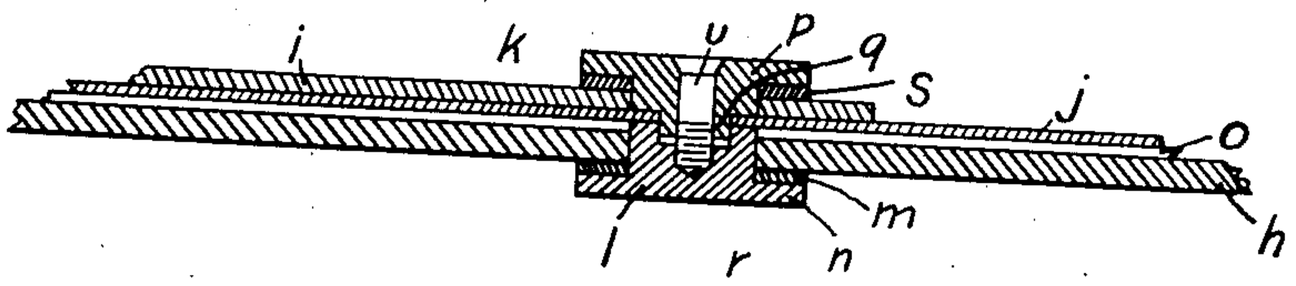


Fig. 2.



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CALCULATING DEVICE.

No. 843,944. Specification of Letters Patent. Patented Feb. 12, 1907.

Application filed August 7, 1905. Serial No. 273,031.

To all whom it may concern:

Be it known that I, ROBERT L. HIBBARD, a citizen of the United States, and a resident of Bellevue, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Calculating Devices, of which the following is a specification.

My invention relates to calculating devices, and has special reference to devices of the disk type, in which a plurality of annular scales are mounted in a single plane.

The object of my invention is to provide a disk slide-rule that shall be simple and inexpensive in construction, effective and accurate in operation, and that shall embody a plurality of annular scales all of which are relatively fixed.

Slide-rules or calculating devices of the disk type for the continuous calculation of a series of mathematical processes, as heretofore usually constructed, have embodied a plurality of logarithmic scales one or more of which were movable with respect to the others. This construction involved a relatively expensive and complicated design, since a careful alinement of the fixed and rotatable scales was essential for accurate results, and, furthermore, the rotatable scale members were comparatively fragile and subject to excessive wear.

Accurate results may readily be obtained by the use of the slide-rule of my invention, which comprises, in general, a plurality of relatively fixed concentric annular scales and a plurality of transparent disks that are provided with radial index-lines and are rotatably mounted at the common center of the scales. This construction is especially simple and durable, may be of convenient size and shape for transportation, and is relatively inexpensive.

Various desirable results, such as the functions of angles and the squares and square roots of numbers, may be obtained by referring from one scale to another, but the principal advantage in the slide-rule of my invention lies in the fact that problems involving the multiplication and division of a plurality of numbers may be solved with a minimum number of operations, the final result only being read and by reference to a single stationary scale.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a plan view, and Fig. 2 a partial section, on a larger scale, of a calculating device constructed in accordance therewith.

Referring to the drawings, the disk slide-rule *a* comprises a plurality of concentric circular scales *b*, *c*, *d*, *e*, *f*, and *g*, a plane base-surface of any convenient shape, such as the disk *h*, a transparent index-arm *i*, and a transparent disk *j*, that are rotatably mounted at the common center of the aforesaid scales, and an axial member *k*. The disk *h* is rotatably mounted on a lower cylindrical portion *l* of the axial member and engages a spring-washer *m*, which is interposed between the disk and an outer flange *n* on said member. The scales may be laid out on the disk *h*, but a scale-plate *o* is preferably provided, which is so mounted upon the disk that the scales are concentric with the axial member *k*.

The transparent arm *i* is rotatably mounted upon an upper portion *p* of the axial member and is similar to the lower portion, except that it is provided with a cylindrical projection *q*, which fits into a corresponding counterbore *r* in the lower member, the transparent arm *i* being in engagement with a spring-washer *s*, that corresponds to the washer *m* and separates the disk from an upper flange which corresponds to the lower flange *n*, while the transparent disk *j* is fitted to the cylindrical projection *q* and is fastened between the two axial members, which are rigidly clamped together by a screw *u* after the disks are assembled in position. Thus if the disk *h* upon which the scales are mounted is considered as a stationary element the arm *i* and the disk *j* are both rotatable relative to each other and to the disk and are provided, respectively, with radial index-lines *v* and *w*, by which values read on one scale may be transferred to another scale and various mathematical calculations performed, as hereinafter explained.

It is obvious that the arm *i*, which rotates in engagement with the disk *j*, may be replaced by a transparent disk similar to the disk *j* on which the index-line *v* could be maintained and that the scales which include a decimal-scale *b*, by which the common logarithms of numbers may be obtained in a well-known manner, a logarithmic scale *c* for performing multiplication, division, and similar processes, a pair of logarithmic scales *d* and *e*, of which *e* is a continuation of *d* and by which the squares and square roots of

numbers may be obtained in connection with the scale *c*, a scale *f* for the natural tangents, and a scale *g* for the natural sines of angles, may be varied in arrangement and radius of curvature without departing materially from the spirit of my invention, and I desire that all such variations shall be included within its scope.

To obtain the natural tangent of an angle, one of the radial indices is moved to correspond to the value of the angle on the scale *f*, when its natural tangent may be read from the scale *b*. Natural sines may be similarly obtained by referring from scale *g* to scale *b*. The mantissa for common logarithms of numbers may be read from the scale *b* in combination with the scale *c*.

In order to illustrate the continuous multiplication and division of a series of numbers, obtaining a single final result, I will assume a specific problem—

$$\frac{16\times 28\times 2}{4\times 7}$$

The index-line *w* on the transparent disk *j* is set at "16" on the scale *c*. The arm *i* is then independently moved until the index-line *v* coincides with "4" on the same scale. The disk *j* and the index-arm *i* are then both rotated until the index-line *v* coincides with "28" on the scale. The arm *i* is then independently moved until the index-line *v* coincides with "7," after which both are rotated until the index-line *v* is coincident with "2," the final result being read from the position of the index-line *w* on the scale *c*.

I claim as my invention—

1. A calculating device that comprises a body portion having a plane surface, a plurality of logarithmic scales mounted thereon, a transparent disk, having a radial index-line, rotatably mounted on the plane surface of the body portion, a second independently-rotatable, transparent index-bearing member that is mounted at the center of the disk and a two-part clamping device for said rotatable members.

2. A calculating device that comprises a body portion having a plane surface, a plurality of scales mounted thereon, a pair of axial clamping-sleeves, a transparent disk and a transparent arm rotatably mounted on the plane surface of the body portion and clamped in position relative thereto by said clamping-sleeves.

3. A calculating device that comprises a body portion having a plane surface, a plurality of concentric annular scales mounted thereon, a pair of axial clamping-sleeves that are provided with annular engaging surfaces a transparent disk which is clamped between said surfaces, cylindrical bearing portions, said disk being rotatably mounted on one of said portions, and a transparent arm which is rotatably mounted on the other bearing.

4. A calculating device that comprises a suitable disk-shaped body portion, a plurality of relatively fixed, concentric, annular scales mounted thereon, and a pair of axial clamping members that are provided with cylindrical engaging surfaces a transparent disk which is clamped between said surfaces, said body portion being rotatably mounted in engagement with said transparent disk and upon a cylindrical portion of said axial clamping members.

5. In a disk slide-rule, the combination with a suitable body portion that is provided with plane surfaces, a plurality of relatively fixed, concentric, annular scales mounted thereon, and a pair of axial clamping members that are provided with annular engaging surfaces, and a transparent disk that is provided with a radial index-line and is rigidly supported between said clamping-sleeves, said body portion being rotatably mounted in engagement with said transparent disk and upon a cylindrical portion of said axial clamping-sleeves, of a second independently-rotatable index that is mounted at the common center.

6. A calculating device that comprises a suitable body portion that is provided with a plane surface, a plurality of relatively fixed concentric, annular, logarithmic scales mounted thereon, a transparent disk and a transparent arm that are rotatably mounted, with respect to said body portion, at the common center of said scales and are provided with radial index-lines.

7. In a disk slide-rule, the combination with a suitable body portion that is provided with a plane surface, a plurality of scales mounted thereon and a pair of axial clamping members that are provided with annular engaging surfaces, and a transparent disk that is provided with a radial index-line and is rigidly supported between said clamping sleeves, said body portion being rotatably mounted in engagement with said transparent disk, of a second independently-rotatable index that is mounted at the common center.

8. A calculating device that comprises a disk-shaped portion, a plurality of scales mounted thereon, an axial clamping member on which said body-disk is rotatably mounted that comprises two similar flanged collars which are provided with complementary, annular, engaging surfaces, a transparent disk that is fixed to said axial member and is provided with a radial index-line, and a second transparent disk portion that is rotatably mounted on the first and is similarly provided with a radial index-line.

In testimony whereof I have hereunto subscribed my name this 3d day of August, 1905.

ROBERT L. HIBBARD.

Witnesses:

R. J. DEARBORN.

BIRNEY HINES.