

May 15, 1923.

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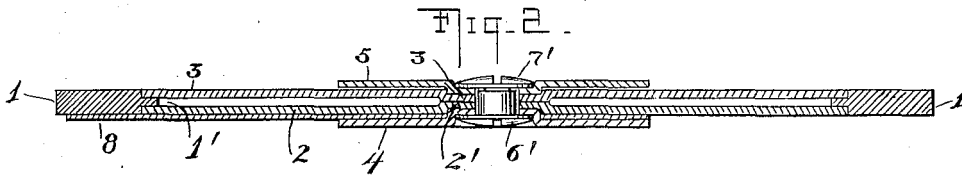
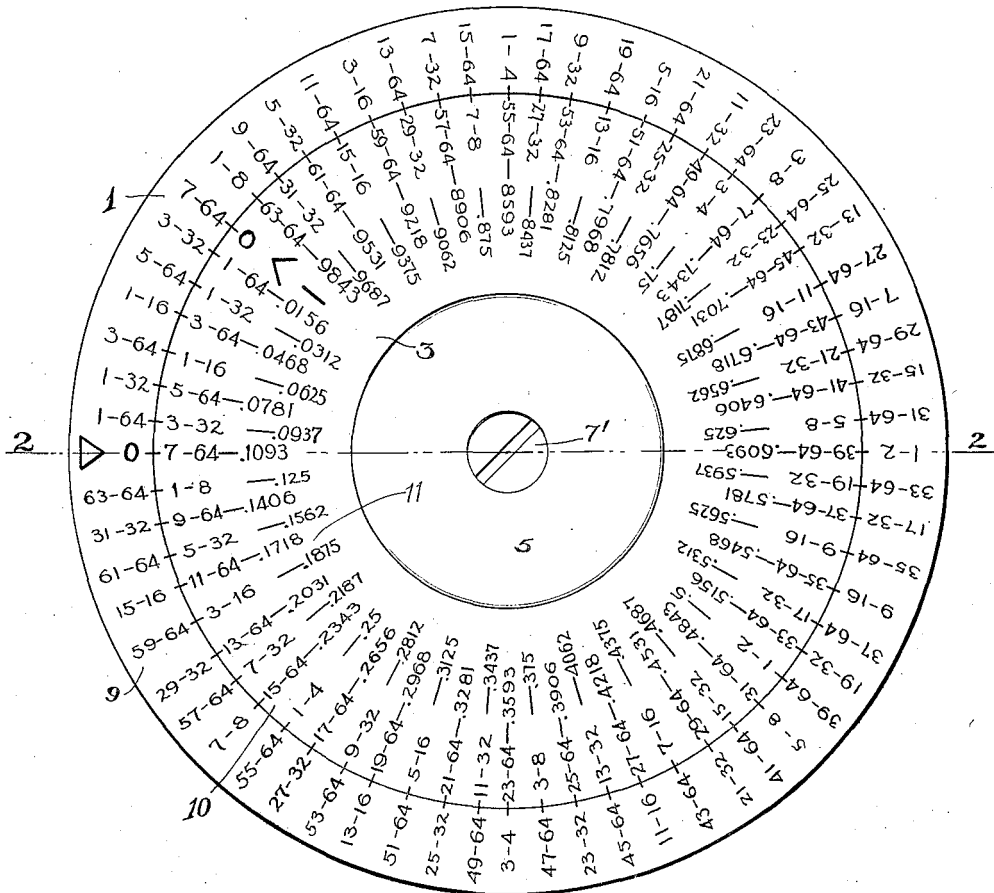
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CIRCULAR SLIDE RULE

Filed July 1, 1920

2 Sheets-Sheet 1

Fig. 1.



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FIG. 3.

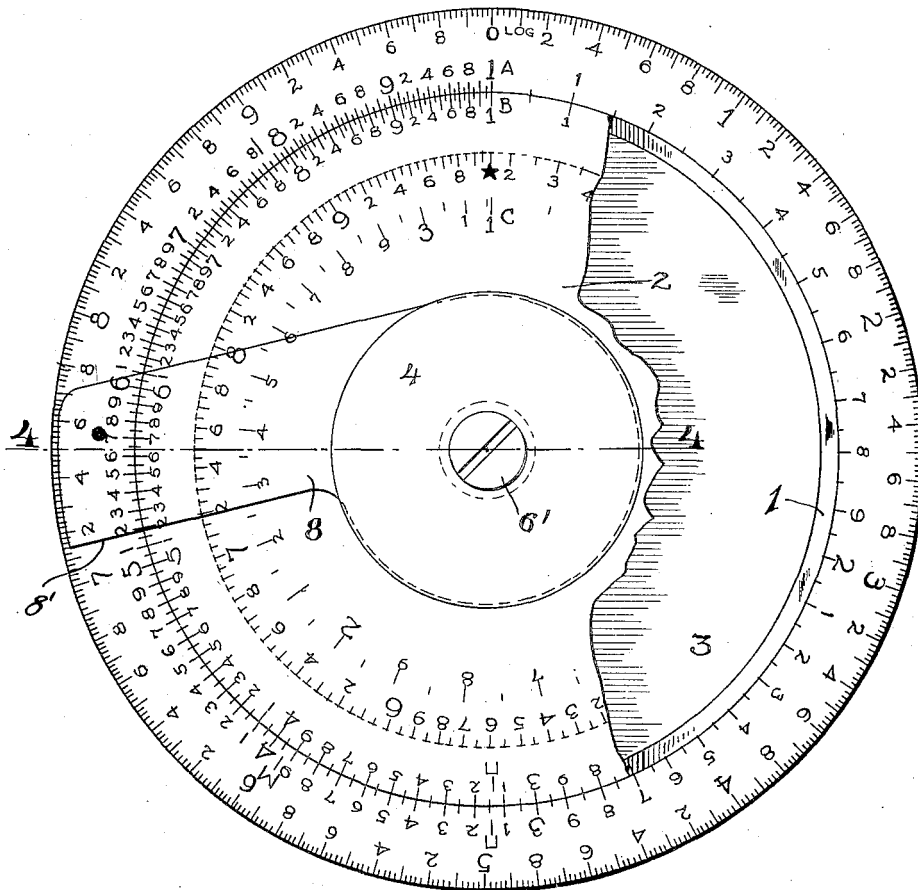
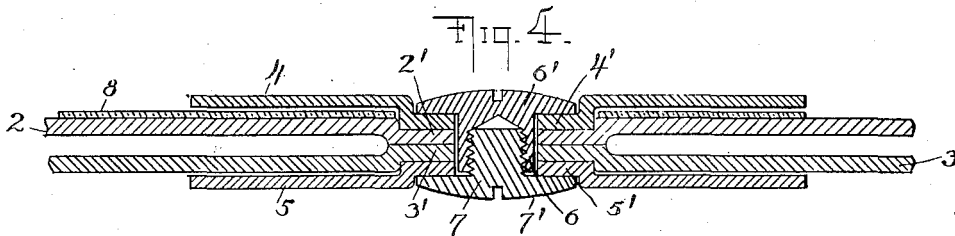


FIG. 4.



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UNITED STATES PATENT OFFICE.

JOSEPH F. KELLER, OF NEW YORK, AND FRANCIS J. BADGE, OF WOODHAVEN, NEW YORK, ASSIGNORS TO KELLER MECHANICAL ENGRAVING CO., OF BROOKLYN, NEW YORK, A CORPORATION OF NEW YORK.

CIRCULAR SLIDE RULE.

Application filed July 1, 1920. Serial No. 393,346.

To all whom it may concern:

Be it known that we, JOSEPH F. KELLER and FRANCIS J. BADGE, both citizens of the United States, and residents, respectively, of the city of New York, borough of Manhattan, and of the town of Woodhaven, borough of Queens, both in the State of New York, have invented certain new and useful Improvements in Circular Slide Rules, of which the following is a specification.

Our invention relates to circular slide rules and has for its object to provide a slide rule of the class specified which may be easily handled and manipulated so that calculations may be rapidly and accurately performed, and to embody these qualities in an article which may be economically manufactured and shall possess a neat and attractive appearance.

A further object of our invention is to provide a circular slide rule the co-acting members of which shall have common operative surfaces lying in one plane and which shall also as a whole be comparatively thin in cross section so that it may be conveniently carried upon the person.

A further object of our invention is to provide a circular slide rule so constructed that the effective bearing surfaces of the two relatively moving members may be made of material especially suited for bearings, regardless of the nature of the material of which the remainder of the rule is constructed; this construction also relieves those parts of the rule upon which the juxtaposed calculating scales are placed from any excessive frictional wear.

Still a further object of our invention is to provide a slide rule of the type specified such that the members composing the rule may be cheaply and expeditiously stamped out of sheet metal to exact size so as to require no further finishing and so as to be capable of instant assembly.

In the accompanying drawings, Fig. 1 is a plan view of a slide rule or calculator embodying our invention; Fig. 2 is a section thereof in a radial plane, say as indicated at 2—2 in Fig. 1; Fig. 3 is a face view looking from the side opposite to that shown in Fig. 1 with parts broken away, and Fig. 4 is a partial section on line 4—4 of Fig. 3, on an enlarged scale.

The device comprises a ring or rim 1 of circular outline and of uniform thickness from its outer edge to a short distance from its inner edge, the inner edge portion 1' being of reduced thickness so as to form annular seats or shoulders on each face of the rim, as shown best in Fig. 2. This rim may first be stamped out between dies with a uniform thickness between its inner and its outer edges, and then compressed at its inner edge portion between another set of dies to form the relatively thin edge portion 1'. On the faces of that portion which is of greater thickness, the rim is formed with graduations and with sets of figures, as will be explained hereinafter.

Flush or substantially flush with the graduated surfaces of the rim 1, are the corresponding surfaces of two disks 2, 3, which are exactly alike in construction, differing only as to the graduations and figures which they bear on their exposed surfaces. Each of these disks is shown as of uniform thickness, such thickness being practically equal to the distance to which the body portion of the rim 1 projects from the thin inner edge portion 1'. The outer edge portion of each disk 2, 3, with its flat side engages said edge portion 1' of the rim, and with its circular periphery engages the perpendicular or cylindrical shoulder, formed at the junction of the thick rim portion with the thin rim portion. The central portion 2' or 3' of each disk is offset toward the other disk, as shown best in Fig. 4, and such offset portion is provided with a central aperture. A single stamping operation between appropriate dies will suffice to produce the disk with its offset portion and central aperture. The graduations and figures may also be applied by the same stamping operation. In the case of the rim 1, too, the graduations and figures may be stamped into the material by the same operation which cuts or punches this element from a sheet of suitable metal.

The exposed surface of each of the disks 2, 3 is partly covered by a finger piece 4 or 5 respectively of circular outline and having a central offset portion 4' or 5' of such diameter and depth that it will seat itself in the recess produced by the offset portion 2' or 3' of the corresponding disk 2 or 3 respec-

tively. Each finger piece has a central aperture preferably of the same diameter as the apertures of said disks.

To hold the finger pieces 4, 5 and the disks 2, 3 connected with the rim 1, while leaving them free to turn relatively to said rim, we have shown a two-part center pin comprising an internally-threaded sleeve 6 of the proper length and diameter to fit into the apertures of the parts 2, 3, 4, 5, said sleeve having a head 6' adapted to be seated in the recess formed in the exposed face of one of the finger pieces, say the finger piece 4 by the offset portion 4' thereof. This head 6' has a diametral slot to receive a screw driver. The other part or member of the center pin consists of a screw having a shank 7 to fit into the sleeve 6, and a slotted head 7' seated in the central recess of the other finger piece 5. It is, of course, immaterial whether the heads 6', 7' engage the finger pieces 4, 5 as shown, or whether the center pin is used in the reverse position, so that the head 7' will engage the finger piece 4, and the head 6' the finger piece 5.

The two finger pieces 4, 5 might be made exactly alike. In the construction shown, however, there is a slight difference between them, the portion 4' being offset from the body of the finger piece 4 slightly more than the portion 5' is offset from the body of the finger piece 5. Thus, while the outer or marginal body portion of the finger piece 5 will engage the adjacent face of the disk 3, a slight space will be left between the marginal body portion of the finger piece 4 and the adjacent face of the disk 2, for the reception of an index member 8 mounted to turn loosely in said space and provided with a central aperture of proper size to fit around the hub-like portion of the finger piece 4. This index member is preferably made of celluloid or other transparent material, and has a straight radial edge 8' for use to indicate on the scales or graduations of the rim 1 and disk 2. This index member is not absolutely essential, and if it is omitted, both finger pieces 4 and 5 might be made exactly alike, corresponding to the finger piece 5 of the drawings.

The rim 1, disks 2, 3 and finger pieces 4, 5 are preferably made of aluminum, and the members of the center pin 6, 7 of brass.

The disks 2, 3 and rim 1, at least such portions thereof as carry the graduations and legends are provided with a surfacing of white celluloid, celluloid lacquer or equivalent material to afford a more clear background for the marking.

The distance to which the central disk portions 2', 3' are offset from their marginal or body portions is substantially equal to one-half the thickness of the reduced inner portion 1' of the rim 1; thus when the parts are assembled, the portion 2', 3'

will come into contact and hold the body portions of the disks 2, 3 apart a distance substantially equal to the thickness of said reduced portion 1', or slightly in excess of such thickness, so that the outer edges of the disks will fit against the rim snugly, yet without binding. The rim 1 may thus be turned freely relatively to the other parts of the device, the user generally holding the device with the left hand, the thumb engaging one of the finger pieces, and the other finger piece being engaged by two or three fingers, while the rim 1 is turned with the right hand. The center pin 6, 7 may either clamp the parts 2, 3, 4, 5 so tightly that they will hold against relative rotation, or more loosely, allowing one of the disks 2, 3 to turn relatively to the other, if desired, in either event, however, the index member 8, if used, will remain free to turn.

On that face of the rim 1 over which the index member 8 extends, we have shown a logarithmic scale adapted to co-operate with similar scale on the corresponding face of the disk 2, exact reading being facilitated by the use of the index member 8. No novelty is claimed for the particular scales on this face of the calculator.

On the other face of the device we have shown a novel arrangement of scales whereby fractions may be added or subtracted readily. For this purpose the rim 1 has a uniform scale 9 at the inner edge of its exposed portion, and the disk 3 has a scale 10 with the same spacing along its outer edge. In the particular example shown, the entire circumference is divided into sixty-four equal parts, but, of course, we do not restrict ourselves to this particular number. The two scales are numbered consecutively from 0, 1/64, 1/32, 3/64 and so on to 63/64, but in opposite directions; that is, on one scale the numbers increase clockwise, and on the other contra-clockwise.

The use of this device for adding or subtracting fractions will be readily understood from examples:

Suppose the fractions 3/64 and 1/16 are to be added together, the calculator is manipulated until the mark 3/64 of one scale registers with the mark 1/16 of the other (this will also substantially bring the mark 1/16 of the first-named scale into registry with the mark 3/64 of the second scale, see Fig. 1); the desired total (7/64) will then be found in registry with the zero mark of either scale. It will be noted that in this particular case the two numbers to be added are within the sector lying between the two zero marks, after the device has been set for the operation (Fig. 1). If, however, the fraction numbers to be added lie outside this sector, the unit 1 will have to be added to the result read off in registry with the zero mark. Thus, with the parts

set as in Fig. 1, if we wish to add $63/64$ and $1/8$, these numbers lying outside the sector bounded by the two zero marks, the total will be read off as $17/64$.

5 Again in subtracting, the number representing the minuend is brought in registry with the zero of the other scale, and the difference will then be found in registry with the subtrahend. Thus, supposing $1/32$ is
10 to be subtracted from $7/64$, the parts will be brought to the position Fig. 1, with the $7/64$, mark of each scale registering with the zero mark of the other scale. We then find
15 $1/32$ registers with $5/64$, which is the number (difference) sought.

Owing to the particular way of numbering the two scales, in any position thereof the total of any two registering numbers will be equal to the number registering with
20 the zero mark, or differ therefrom by unity, and the properties of the fraction adder and subtractor are based on this peculiarity.

On the disk 3, between the scale 10 and the finger piece 5, we may add, for the sake
25 of convenience, a scale 11 giving in decimal fractions the equivalents of the common fractions of scale 10.

Various modifications may be made without departing from the nature of our invention as set forth in the appended claims.
30

We claim:

1. A device of the character described, comprising a flat rim having a portion of
35 reduced thickness along its inner edge, two disks having their peripheral portions out of mutual contact and rotatably seated on opposite faces of said reduced rim portion, the exposed faces of said peripheral portions being substantially flush with the outer portions of said rim, the central portions of said
40 disks being offset toward each other and in mutual contact, and the exposed faces of the disks being formed with central depressions or sockets, finger pieces seated in said sockets, finger pieces seated in said sockets and themselves provided with depressions or recesses in their exposed faces, and
45 a clamping center pin comprising a headed tubular internally threaded member extending centrally through said disks and finger pieces, and a headed screw fitted into said
50 tubular member, the heads of said member and of said screw being located in the recesses of the respective finger pieces.

2. A device of the character described,
55 comprising a flat rim having a portion of reduced thickness along its inner edge, two disks having their peripheral portions out of mutual contact and rotatably seated on

opposite sides of said reduced rim portion, the central portions of said disks being offset
60 toward each other and in mutual contact, and the exposed faces of the disks being dishd to form central depressions or sockets, finger pieces seated in said sockets, and means for securing said finger pieces. 65

3. A device of the character described, comprising a rim, two rotary disks the marginal portions of which embrace a portion of
said rim while their central portions are offset toward each other to bring their opposing
70 faces into mutual contact and to form depressions or sockets in their exposed faces, finger pieces seated in said sockets, and a connecting device extending through said
75 finger pieces and disks.

4. A device of the character described, comprising a flat rim having a portion of
reduced thickness along its inner edge, two disks having their peripheral portions out of
80 mutual contact and rotatably seated on opposite sides of said reduced rim portion, the central portions of said disks being offset toward each other and in mutual contact, and the exposed faces of the disks being dishd
85 to form central depressions or sockets, finger pieces seated in said sockets and themselves provided with depressions or recesses in their exposed faces, and connecting means extending from one finger piece to the other and
90 provided with heads seated in the recesses of the respective finger pieces.

5. A device of the character described, comprising a flat rim having a portion of
reduced thickness along its inner edge, two
95 disks having their peripheral portions out of mutual contact and rotatably seated on opposite sides of said reduced rim portion, the central portions of said disks being offset toward each other and in mutual contact,
100 and the exposed faces of the disks being dishd to form central depressions or sockets, finger pieces seated in said sockets, one of said finger pieces having a plate-like portion in contact with the adjacent face of the
105 respective disk, the other finger piece having a plate-like portion out of contact with the adjacent face of the corresponding disk, an index member mounted to turn between the last-named disk and the plate-like portion
110 of the adjacent finger piece, and means for securing said finger pieces.

In testimony whereof, we have hereunto set our hands.

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