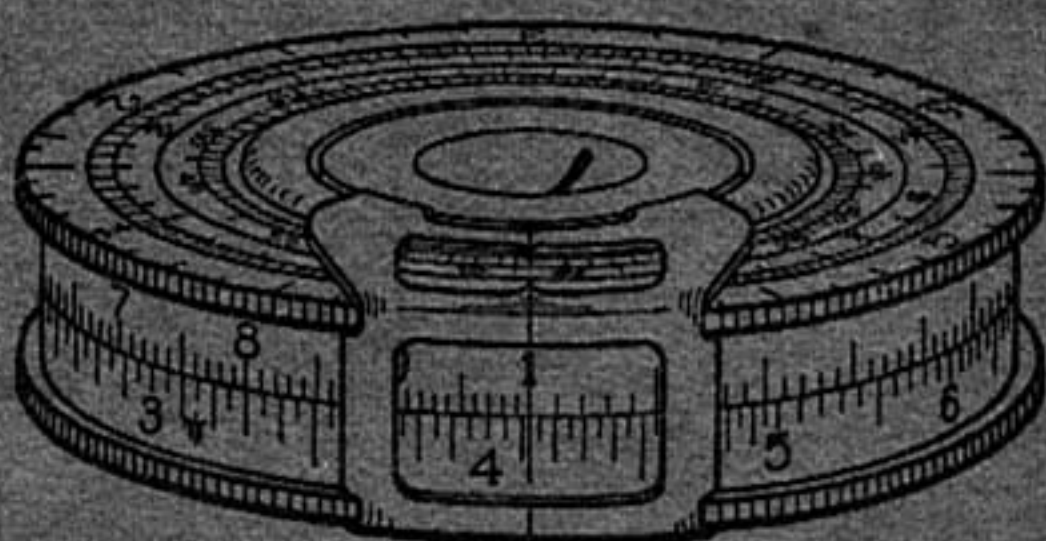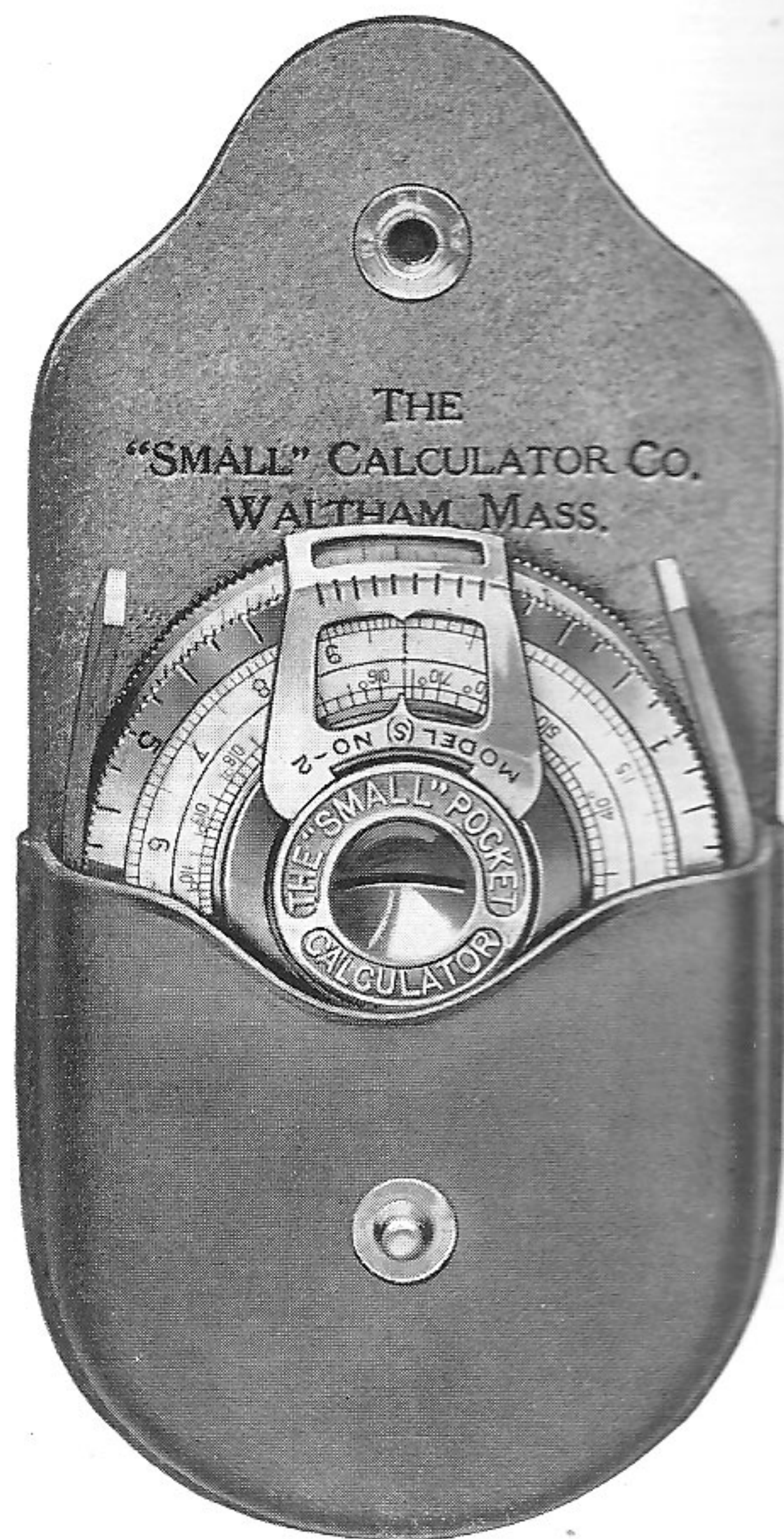# THE "SMALL" POCKET

CALCULATOR

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INSTRUCTION
BOOKLET

PREFACE.

The "Small Pocket Calculator" is a complete slide rule of compact circular form. It is designed for both field and office use by the Student, Merchant, Engineer;—in fact anyone having to perform rapid calculations of ordinary precision will find it a most practical time saver of dependable accuracy.

Many deny themselves the assistance of the slide rule because of the fear that their limited mathematical training may not prove sufficient to enable them to master its principles. To such persons the assurance may be given that a good working knowledge of slide rule operations can be acquired easily, with but little practice and with no previous knowledge of higher mathematics. It is for those familiar, perhaps, with only the tedious, long hand methods of arithmetic that this Booklet of Instructions has been prepared.

In the text which follows, the aim has been toward simple explanations to enable those who may not be familiar with the ordinary straight slide rule, to comprehend the principle of its operation. Then continuing by natural steps, the more logical circular form is introduced, and by a few examples explained in detail, the beginner may acquire the information and confidence that will lead to the easy solution of the most complicated problems.

Readers familiar with the straight slide rule, may omit Chapter I, and apply themselves at once to the circular scales of the "Calculator" described in Chapter II.

For sake of simplicity, the discussion of the Logarithmic Scale and special rules for Location of Decimal Point as well as other technical features have been reserved for Chapters III, IV and V,—and although these last chapters are essential for a full treatment of the subject they need not be mastered by beginners who will find in Chapters I and II all that is necessary for the solution of simple problems.
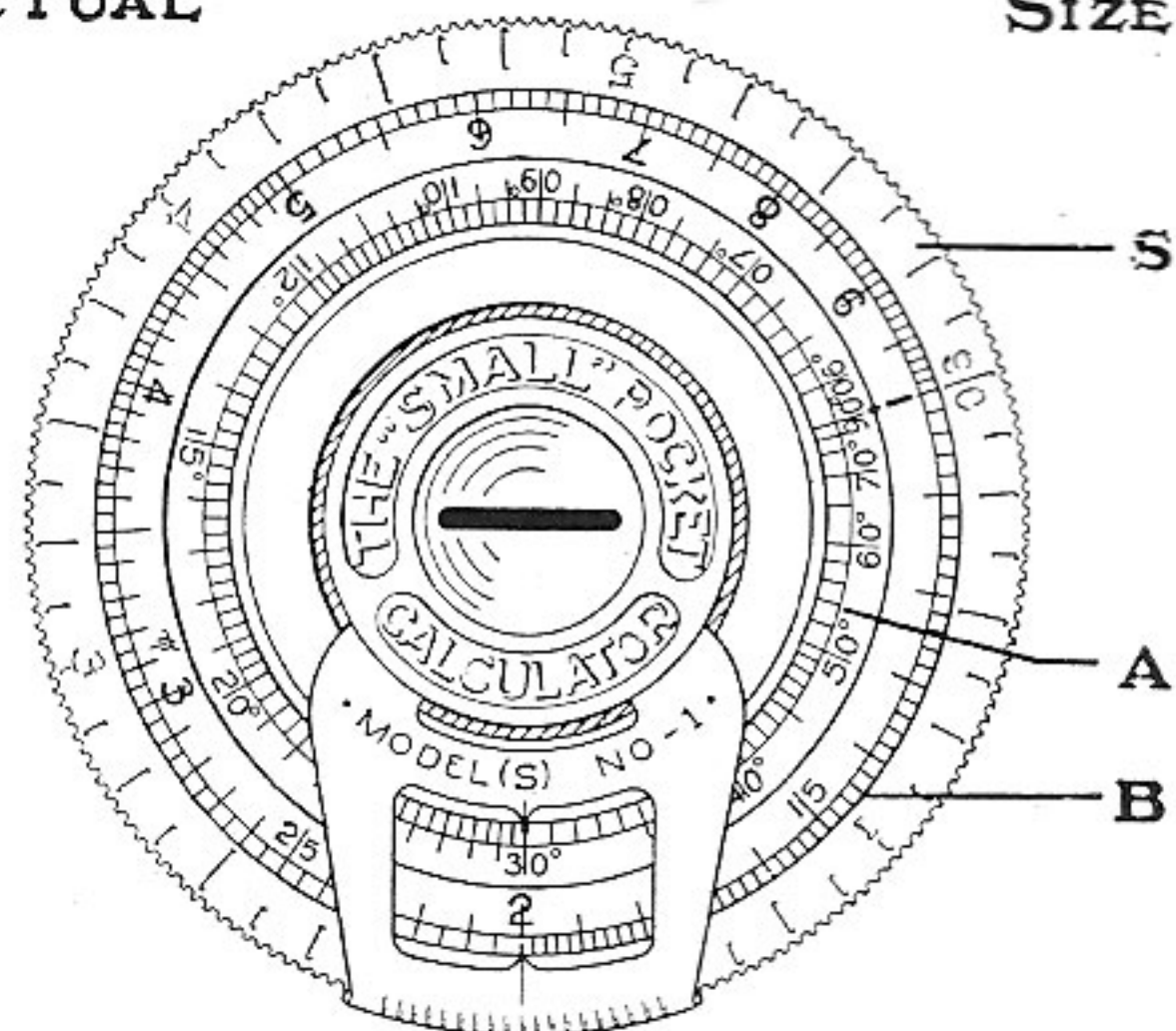
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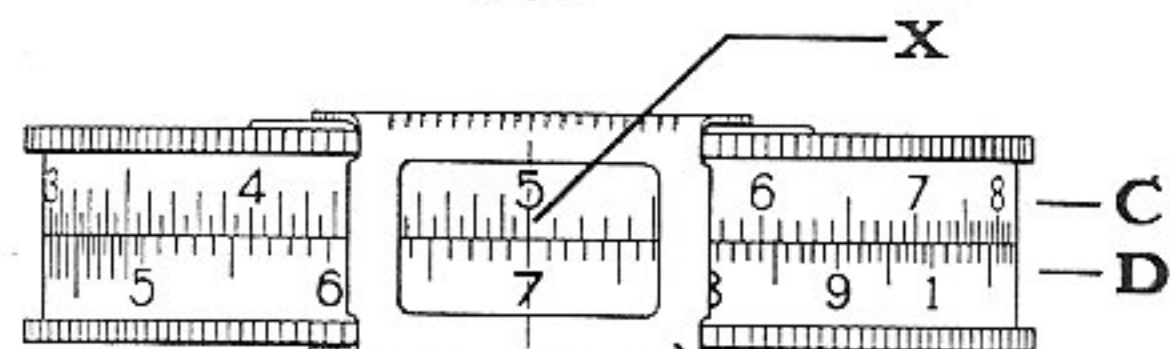Mem. Boston Soc. C. E.
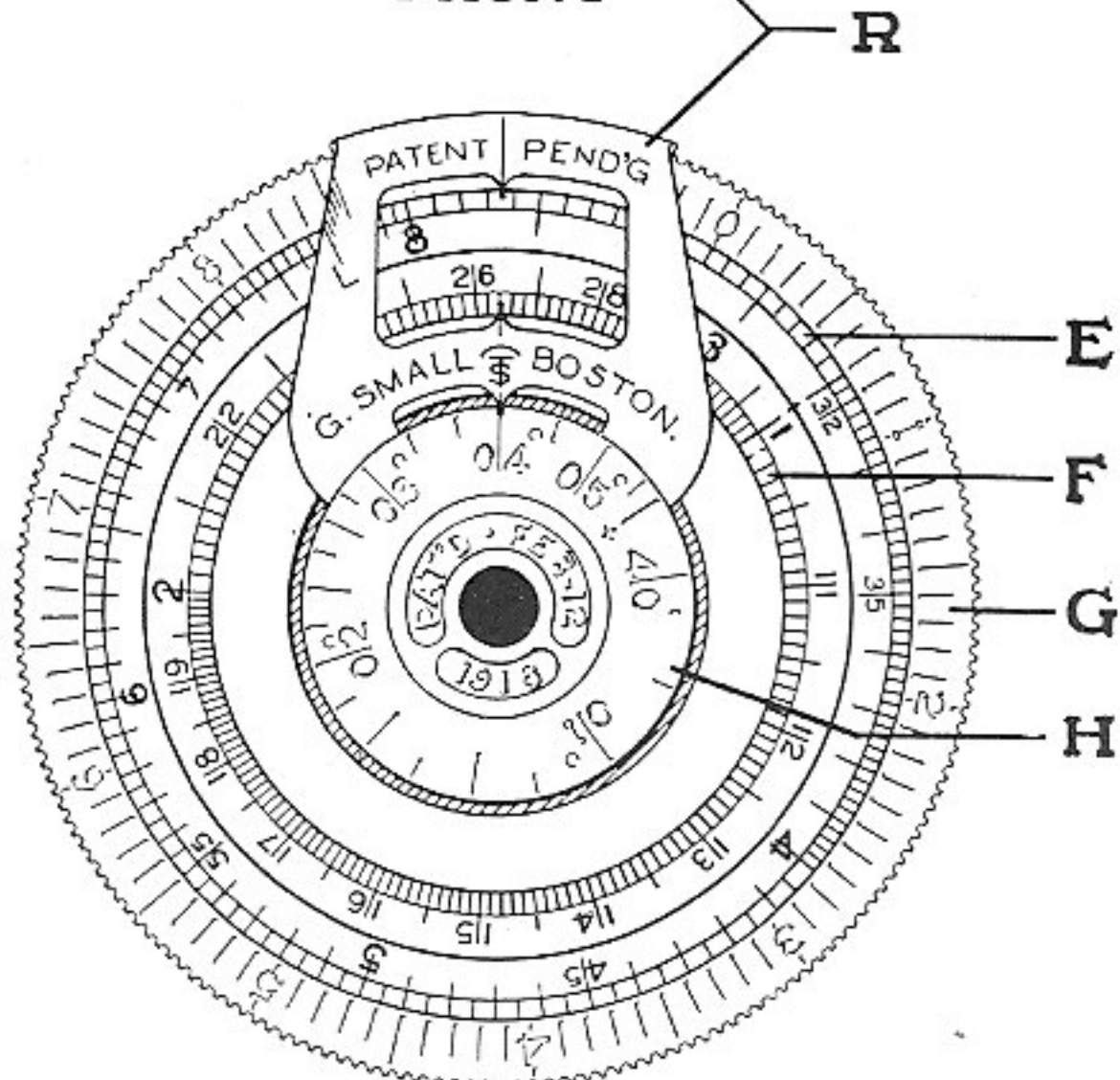Assoc. Mem. Am. Soc. C. E.

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MODEL NO. 1

ACTUAL   SIZE

TOP

FRONT

BOTTOM

PLATE·I

KEY TO PLATE I.

SCALE	USE

S — Six Inch Scale for distances on plans.

A — Sines of Angles greater than 05°—44′. Read values off on C Scale, or use in conjunction with D, E, F, G, or H. (Runner Pointer marked (S) meaning Sine.)

B — Reciprocals of numbers on C Scale (used to shorten complex problems).

C & D — Ordinary scales for multiplication and division; similar to C and D scales of straight slide rule.

E — Square Roots of numbers on D Scale having *even* numbers of digits.

F — Square Roots of numbers on D Scale having *odd* numbers of digits.

G — Logarithms of numbers on D Scale. Third significant figure read by means of five spaced interpolator at L. (See Runner bottom view.)

H — Sines and Tangents of Small Angles between 00°—34′ and 05°—44′. Read values off on D Scale, or use in conjunction with A, B, or C. (Runner Pointer marked ($\bar{S}$) meaning both Sine and Tangent.)

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Size

S
R
C
X
D
R
G

B

A

f

E

F

I

H
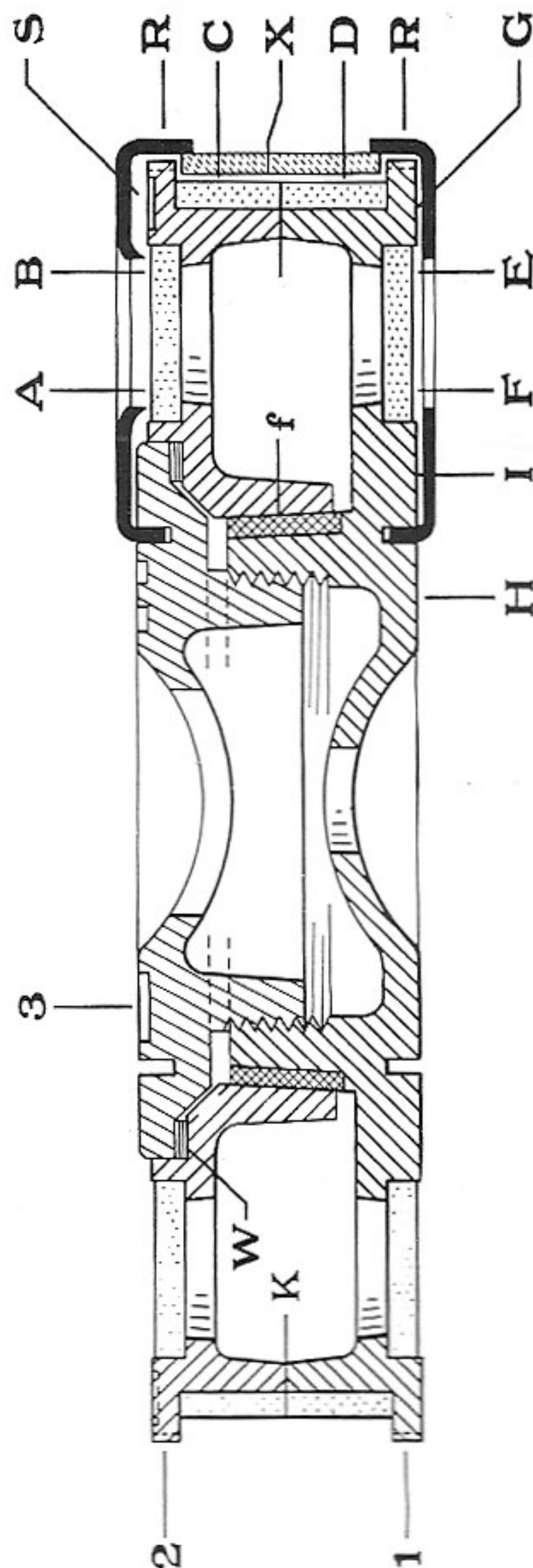
CROSS SECTION

PLATE·II

Double

3

W
K

2

1

KEY TO PLATE II

MARK	DESCRIPTION
1	Base Plate.
2	Rotor.
3	Hub Nut.

AB & EF	Annular Dials.
C & D	Circumferential Scales.
S, G, H, & I	Scales Engraved into Metal.
R-R	German-Silver Runner.
X	Cross Hair.
f	Tapered Bearing.
W	Spring Washer.
K	Contact Edges.

MODEL No. 2

ACTUAL   SIZE

TOP
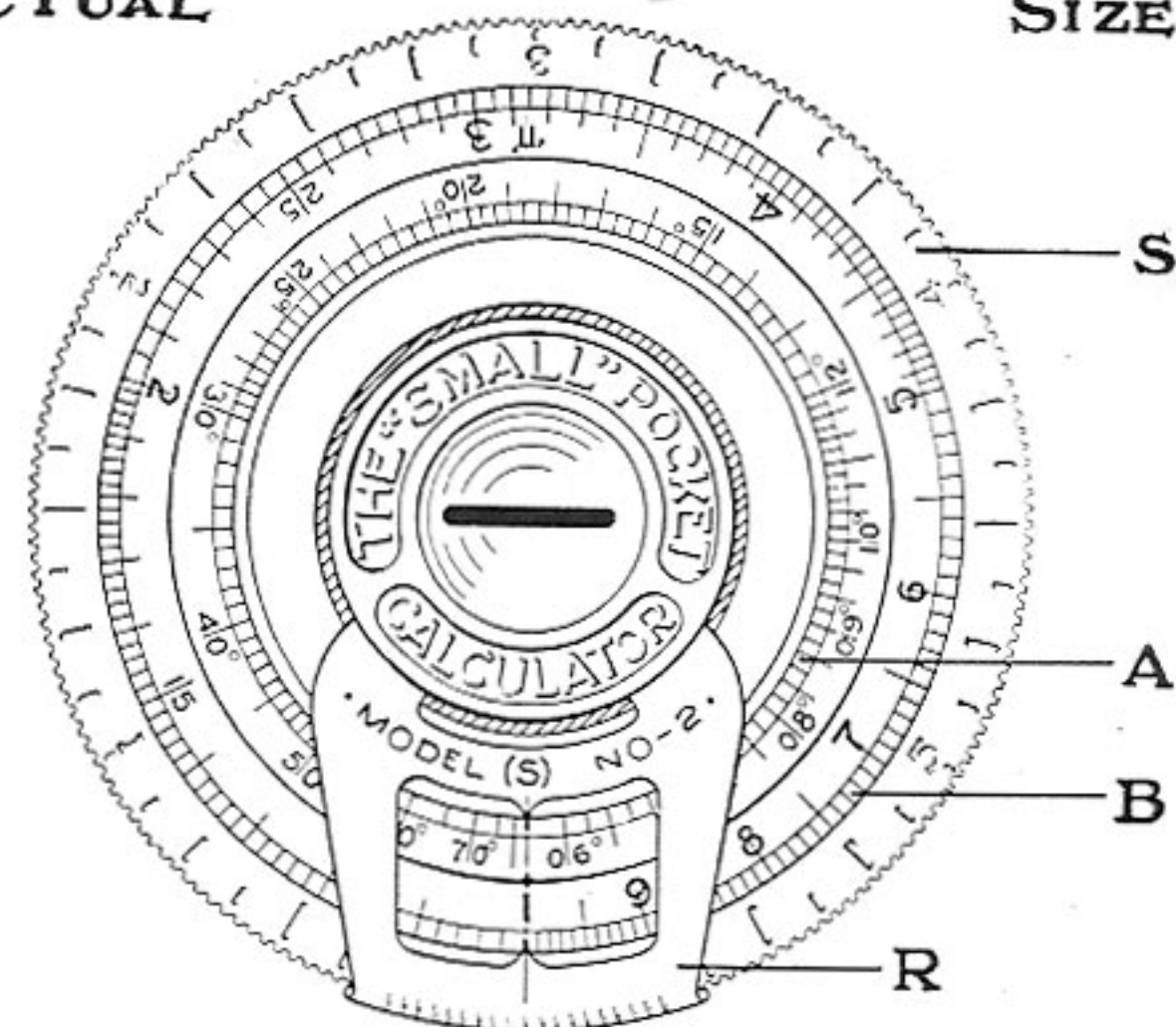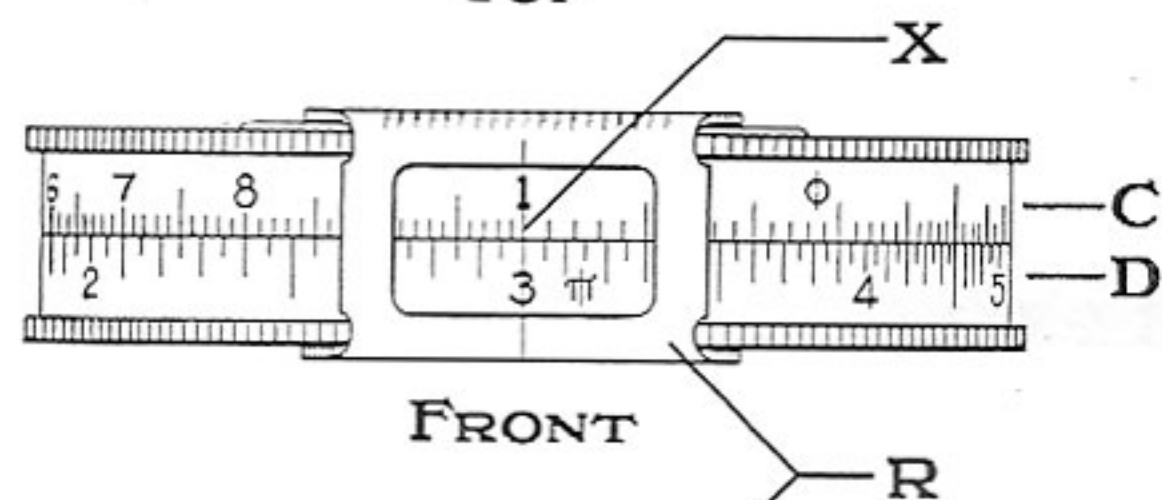
FRONT

BOTTOM

PLATE·III

KEY TO PLATE III

SCALE	USE

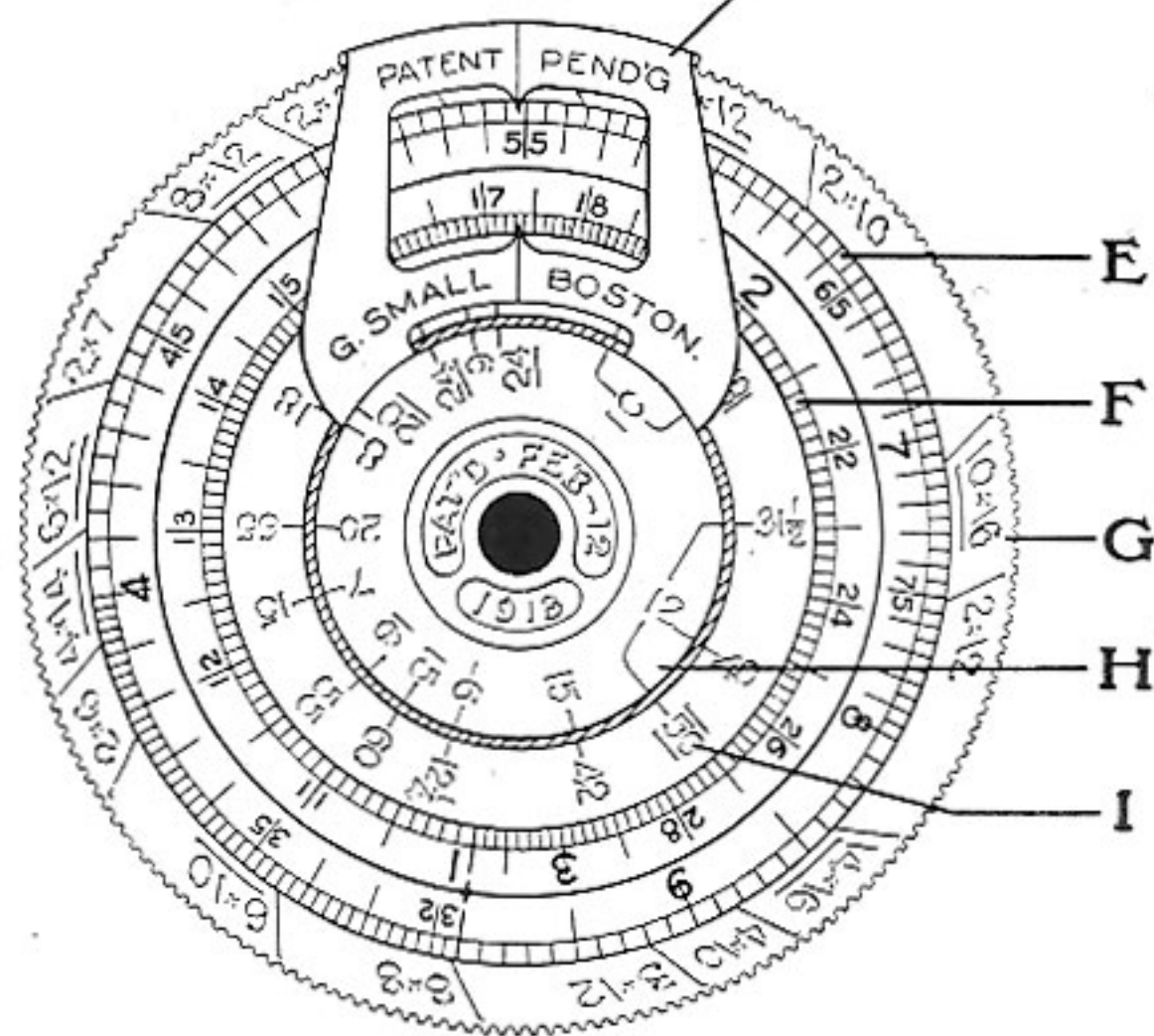S — Six Inch Scale for distances on plans.

A — Sines of Angles greater than 05°—44'.

B — Reciprocals of numbers on C Scale. Used for *short-cuts*.

C & D — Ordinary scales for multiplication and division; similar to C and D scales of straight slide rule.

E — Square Roots of numbers on D Scale having *even* numbers of digits.

F — Square Roots of Numbers on D Scale having *odd* number of digits.

G' — Rectangular Wooden Beams. When right hand edge of Runner coincides with slant line on Beam Scale, Cross Hair X is on corresponding Section Modulus on D Scale; and vice versa.

H' & I — Standard Steel I Beams:—H' giving the depth in *inches*, and I the weight in *pounds* per linear foot. Read Section Modulus in the same manner as for Wooden Beams.

Note that the majority of both Wooden and Steel Beams have Section Moduli of two digits, i. e. their values lie between 10 and 100. When the Section Modulus of a beam exceeds 99 and has three digits, the beam is *underlined*.

The only exception to the above is the 6" by 12¼ ℔. I Beam whose Sec. Mod. has only one digit, the Figure 6 being marked thus "-6." Two *special* beams have been added to the standards, and are specially marked by lines both above and below.

THE "SMALL" POCKET CALCULATOR.

This instrument is a circular slide rule which combines both the circumferential and disc principle. Its mechanical parts are:—

First. A circular Base Plate with continuous scales on its periphery and lower face.

Second. A Top Plate or Rotor to turn on the hub of the first member and carrying similar scales on its rim and top face.

Third. A slotted Hub Nut and Spring Washer to adjust the friction between top and bottom plates.

Fourth. A Runner with Cross-hair and Pointers to be used in conjunction with scales of the first two members.

Plates I and III each show Top, Bottom and Front views of the assembled Calculator,—Models No. 1 and No. 2 respectively,—while enlarged cross section is shown on Plate II.

As indicated, (1) is the Base Plate, (2) the Top Plate, (3) the Hub Nut, and "R" the Runner.

Shrunk upon the outer rims of (1) and (2) and protected by their flanges are two engine divided logarithmic scales C and D similar to the log. scales previously described except that they have been bent backwards until their "1" point and "10" point, coincide forming a single index.

Set into the panels of (1) and (2) are white annular dials with disc scales to be used in conjunction with the peripheral scales C and D.

The Runner is a bent metal frame carrying a transparent window. This frame embraces the outer portions of the Calculator, and by means of two pairs of feet, each running in a groove, is constrained to travel in a planetary path,—or if the Runner be held fixt in position, the instrument with all its scales may be rotated beneath it. The Window with Cross-hair "X" on its inner face is always close to the outer scales, thus eliminating errors of parallax when reading.

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Openings cut in top and bottom of the Runner provide a pair of pointers for each dial, and being in the same radial plane as the cross-hair, permit readings from one scale to any of the others.

CARE.

The construction of the Calculator is such that it will not be affected by moisture or ordinary changes of temperature, and is free from undue expansion of the parts, often a source of trouble with slide rules made of wood.

Every instrument is carefully oiled when assembled, and a new calculator should need no attention on this account for a year or so. If internal troubles should develop to such an extent as to warrant taking the instrument apart, proceed as follows:

Grasp the Runner near its feet between the nails of the thumbs and index fingers of both hands, and by spreading the sides of the runner slightly, allow the main instrument to drop out. Next, unscrew the Hub Nut by inserting the *wide* blade of a pocket knife in the slot, and remove the Rotor. Clean the main bearing, apply vaselene and replace the rotor. Screw the slotted nut against the wavy washer W until the rotor turns with the desired friction.

Should the runner be too loose, spring it off, press its sides together and replace it, taking care not to scratch the dials. The runner feet should be held apart until the grooves are engaged. The Runner is not symmetrical, and when replaced the rough edge must be at the top.

Both Runner and Rotor should move with equal friction,—if the rotor goes too hard, and the runner too easy, turn the hub-nut slightly counter clockwise. Correct the reversed condition by turning the nut right handed. For this adjustment do not remove the runner.

As shown in the Frontispiece, the leather pocket case furnishes protection to the instrument when not in use.

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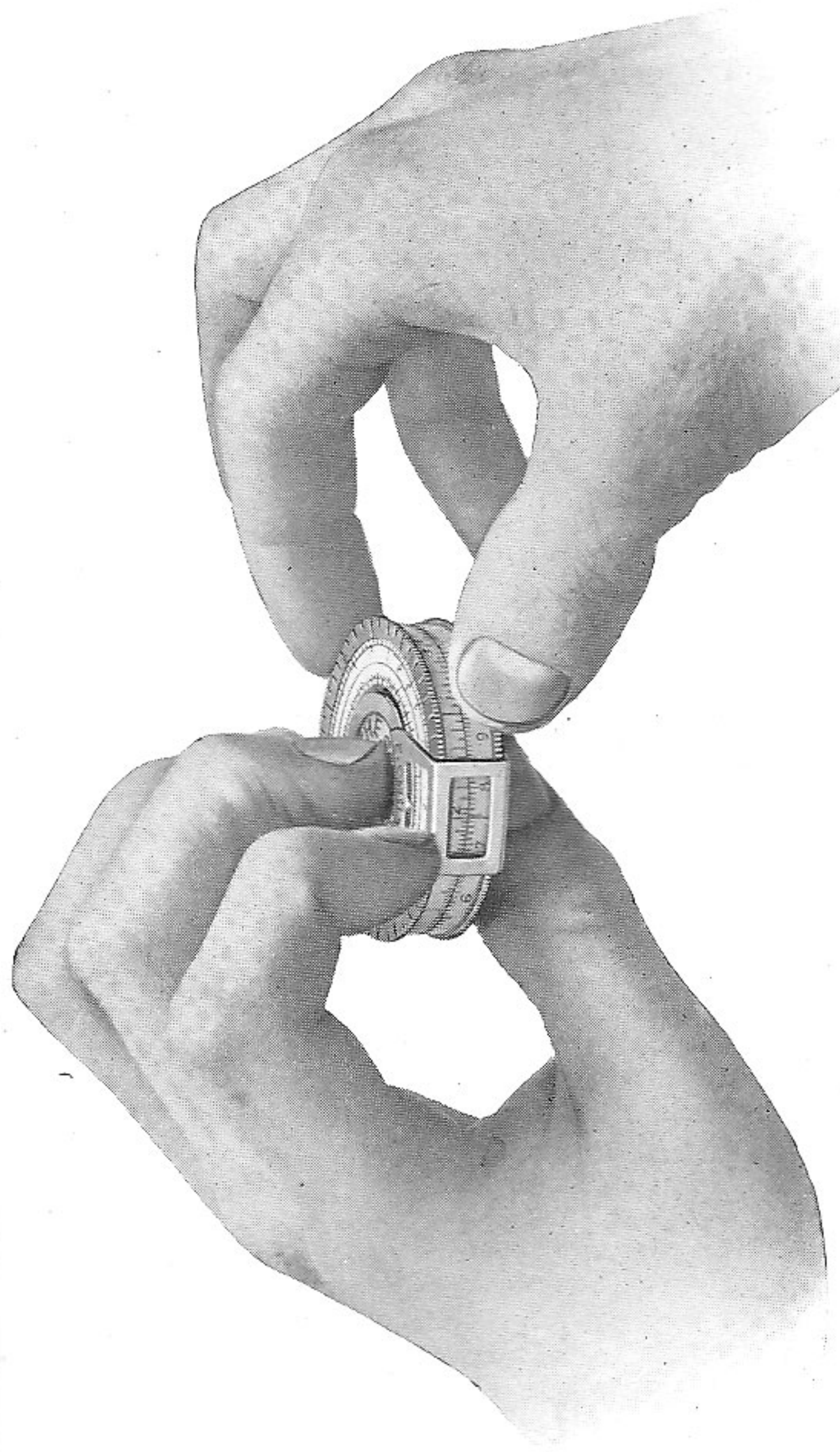
PLATE·IV

CORRECT METHOD OF HOLDING CALCULATOR

MANIPULATION AS A CALCULATOR.

Plate IV. shows the correct position for operating the Calculator. Proceed as follows:—

First. By means of the "dimples" hold the instrument right side up between the thumb and second finger of the left hand, leaving the index finger free to engage the milled edge of the Runner.

Second. Place the thumb of the right hand against the milled edge of the Base Plate to steady it, and by applying the right index finger to the upper milled edge, turn the Rotor and upper scales as desired. (This is the position shown in the cut.)

Third. To rotate the whole instrument beneath the runner, apply the right index finger and thumb to the lower milled edge only, thus turning all scales together in either direction, —making all settings and reading off all such answers as require interpolation by means of the Cross-hair.

As shown in the cut, the cross-hair can be held at a given point on the D Scale, then by a generous "wipe" of the right index finger against the rear edge of the upper flange, starting at finger base joint and terminating at its end, the Rotor can be given one complete revolution. Thus the C Scale can be made to pass to the left beneath the cross-hair for its entire length, or to stop at any desired setting, —and all with a single motion.

To make exact settings of one scale on the other, press the ball of the thumb against both milled edges simultaneously and twirl it slightly. By the resulting differential motion, the most accurate settings are easily accomplished.

AS A SCALE FOR LENGTHS.

The Calculator may be used to measure distances along straight or curved lines using scale "S" on the outer flange of the Rotor as a tracing wheel.

To operate, grasp the instrument in the right hand with the thumb in the upper dimple and the index finger in the lower and press the flange to the paper upon which is drawn the line to be measured. Apply the zero end of the scale, marked "0/6" to the starting end of the line so that after tracing the line its length may be read directly.

When applying the measuring scale, hold the instrument firmly allowing only the rotor to turn, for if the whole instrument rotate, the runner will interfere. Incline the instrument slightly out of vertical to raise the flange of the Base Plate clear of the paper, pressing the Rotor against the paper to avoid slipping at the point of contact.

If the line is longer than six inches, count the number of complete revolutions and the total length is then equal to the number of turns times six plus the reading at the end of the line. Note that the smallest divisions on the face of the scale are eighths of an inch, and the spacing of the milling at the edge is thirty-seconds of an inch.

MULTIPLICATION AND DIVISION.

Problems solved on slide rules are usually examples in simple Multiplication and Division. The beginner who has read Chapter I or one who is already familiar with the straight slide rule will find nothing new to learn in performing these operations on the circular slide rule.

Multiplication and Division are commonly done on the outer scales C and D. Holding D fixed and with C movable, graphically add and subtract portions of scales as for similar operations on straight scales. Note that when the straight scales are bent into the cylindrical shape, their "1" points coincide to form a single "Index" thus giving the equivalent of a series of logarithmic scales arranged end to end so that neither *runner* nor any *factor* or *divisor* can fall beyond the end of the rule.

MULTIPLICATION.

Practice again the examples given in Chapter I:—

Ex. (a). $3 \times 2 = 6$.
Procedure:—

(1st.) Find first factor 3 on lower D scale of Base Plate.

(2nd.) Turn Top Plate or Rotor with its C scale in either direction until its index is exactly over the "3" point of D. (This is the position shown in the Front View of Plate III.) The scales are now set for multiplying 3 by any number.

(3rd.) Without disturbing this setting, run the eye along C to the right to the second factor "2" on C, and find the required product "6" on D directly beneath.

Ex. (b). $3 \times 8 = 24$.
Procedure:—

Without changing the setting of scales C and D in the previous example, run eye along C to right or left and under 8 on C, find 24 on D. (Plate III, Front View shows setting for this example.)