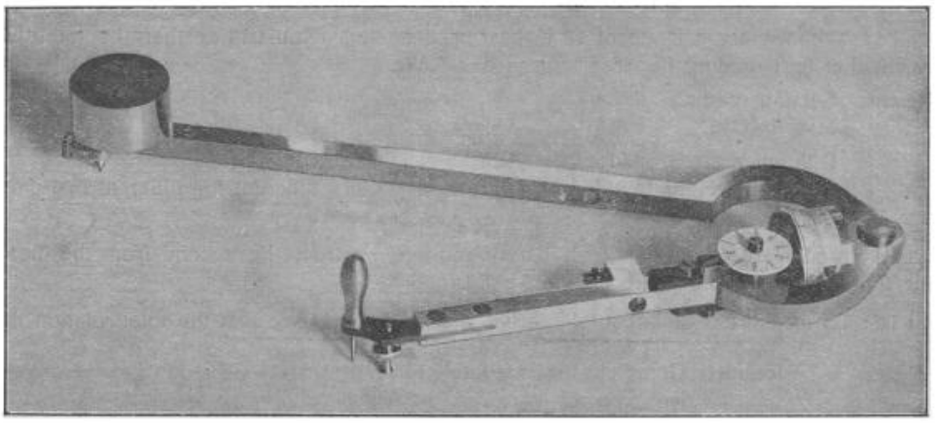
INSTRUCTIONS
FOR USING AMSLER'S PLANIMETERS.

No. 1 PLANIMETER (brass) and No. 2 PLANIMETER (electrum)

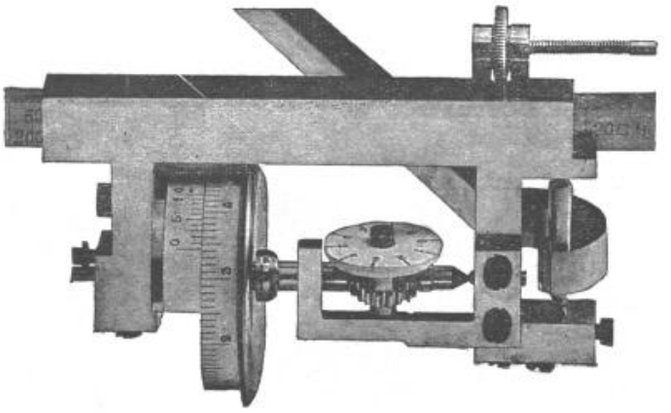
arranged for measuring areas in square inches (or other unit if specially desired).



RANGE: CIRCLE OF 18 INS. IN DIAMETER.

Needle-point outside the diagram. Put the instrument on the drawing surface, set the tracing point **F** at any mark on the outline of the area, press the needle-point **E** slightly into the paper outside the curve, and read off the roller **D** and the counting disc **G** taking the whole circumference of the recording roller as unit of reading (the roller need not be set to zero).

Readings. The drum of the roller is divided into 100 parts. The tenths of a part are read on the vernier. The complete turns of the roller are read on the counting-disc which advances one line at every such turn. The counting-disc performs one revolution at every 10 turns of the roller.



Each complete reading is a figure of 4 digits, the units being read on the counting-disc, the thenths and hundredths on the drum, and the thousandths on the vernier.

The reading of roller and disc, shown for example in the adjoining figure, is 5.343.

When O of the roller is opposite O of the vernier, a mark of the counting-disc should be opposite the index-mark. This is never exactly the case in consequence of the imperfection of the worm-wheel gear, and this should be accounted for in taking readings in the same way as with a watch, when the minute-hand points to 12, whilst the hour-hand fails to indicate the exact hour.

Then move the tracing-point **F** round the area in the direction of the movement of the hands of a watch till it reaches again the starting point. Now take another reading and subtract the first from the second reading. The difference multiplied by 10 will then be the area of the curve in sq. ins.

Example: To measure the area of a square of 4 in. side, supposing first reading to be 1.473 and second reading 3.073.

Result:	Second reading	3.073
	less first „	1.473
		1.600 × 10 = 16 sq. ins.

If the reading before starting had been 9.521, then the reading after circumscribing the same square as before would be 1.121. As the travel of the roller is in both cases the same, it is evident that the zero mark of the wheel has passed the fixed index-mark and that, consequently, the second reading has now to be supplied with one more digit on the left before subtracting the first reading. Thus:

Complete second reading	11.121
less first „	9.521
	1.600 × 10 = 16 sq. ins.

Needle point inside the diagram. Circumscribe the diagram roughly with the tracing-point in the direction of the movement of the hands of a watch, watching at the same time the counter in order to see whether the total rotation of the roller is a forward or a backward motion.

This preliminary rough operation being completed, proceed as before explained, now following the curve carefully with the tracing-point. If the total rotation of the roller has been a forward motion, subtract the first from the second reading and add the difference to the figure engraved on the top of the small weight used for keeping the needle-point in its place. The sum multiplied by 10 will then be the area of the curve in sq. ins.

Example: To measure a circle of 18 inches in diameter. (You will se that the total rotation of the roller is forward.) Let first reading be 0.868 and second 9.884.

Result:	Second reading	9.884
	less first „	0.868
	Difference	9.016
	+ Figure on weight	16.431 (This figure is slightly different for different instruments.)
		25.447 × 10 = 254.47 sq. ins.

If the total rotation of the roller is a back motion, subtract the second from the first reading and subtract the difference from the figure on the weight.

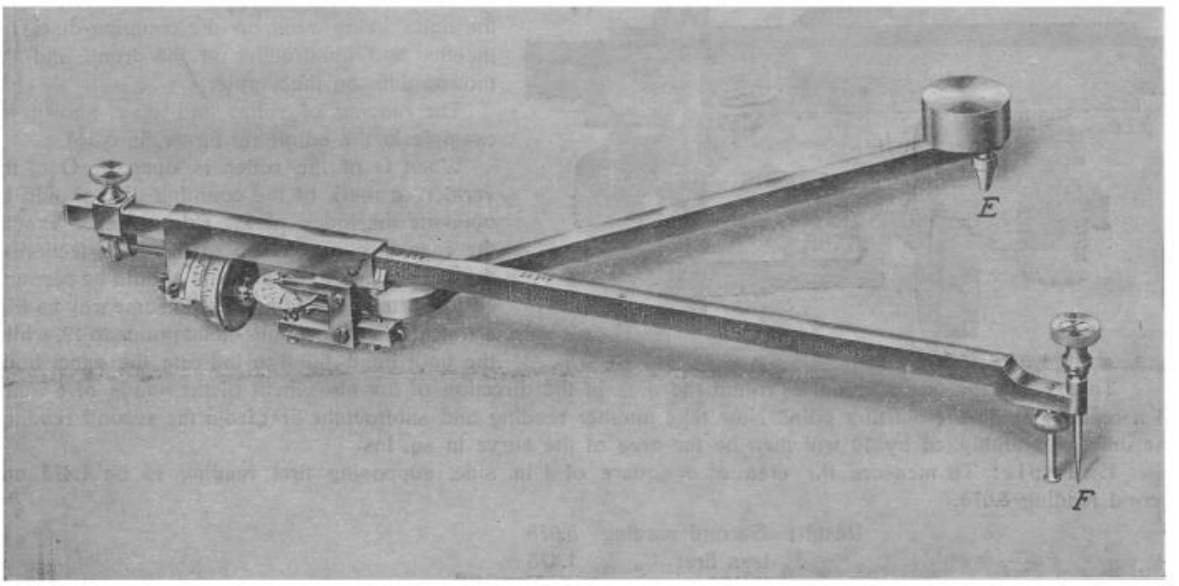
Example: To measure a square of 11 inches side. (You will see that the total rotation of the roller is backward.)

Result:	Complete first reading	13.009
	less second „	8.678
	Difference	4.331
	Figure on weight	16.431
	less Difference of readings	4.331
		12.100 × 10 = 121 sq. ins.

The area corresponding to a total revolution of the roller — 10 sq. ins. in the above example — is engraved on the weight along with the figure before mentioned.

No. 3 PLANIMETER (brass) and No. 4 PLANIMETER (electrum)

arranged for measuring areas in several units and scales (English or Metric or both).



RANGE: CIRCLE OF 24 INS. IN DIAMETER.

Set the index-mark **J** on the bevelled edge of the slide to a convenient division on the bar. There is a clamp and fine adjustment to get this position exactly. The number of units of area per unit of reading and the nature of unit or scale are marked to the right of each division.

The divisions on the bar are the following:

on back			200 ac 6" = 1 mi	10 ac 1 : 2500 0.4 ac 1 : 500	5 ac 1 : 2500 0.2 ac 1 : 500
on top	20.811	20.818	21.440 21.042	22107 22.122	
on front	100 □ cm	100 □′ 3/8" = 1′	200 □′ 1/4" = 1′ 50 □′ 1/2" = 1′	10 □ in	100 □′ 1/4" = 1′ 400 □′ 1/8" = 1′

(The figures on the top of the bar are slightly different for different instruments. The denotation □′ means square foot, □ cm = square centimeter, □ in = square inch, ac = acre, mi = mile).

The slide being set on the bar, place the instrument upon the drawing and measure the diagram as with No. 1 or No. 2 planimeter.

Example: To measure a circle of 5 inches in diameter on a 1/4" plan.

Set the index-mark **J** on the slide to the division 200 □′ 1/4" = 1′, press the needle-point **E** outside the circle into the paper, set the tracing-point **F** to any mark of the circle, read off the counter — the reading may be 1.322 — follow the circle with the tracing-point until you arrive at the starting point and read off again the counter. The reading will then become 2.893.

Result: Second reading 2.893
less first reding 1.322

1.571 × 200 = 314.2 sq. ft.

(The multiplier 200 is identical with the figure close to the right of the division used.)

For measuring small diagrams drawn on the 1/4" or 1/2" scale, the slide may conveniently be set to the last division on the bar marked 100 □′ 1/4" = 1′ 400 □′ 1/8" = 1′.

If the needle-point **E** be placed inside the diagram to be measured, then one of the figures on the top of the bar must be used in the same way as the figure on the weight of No. 1 or No. 2 planimeter.

Example: To measure a square of 12 inches side on an ordnance map (scale 1 : 2500).

Set the index-mark on the back of the slide to the division 10 ac 1 : 2500.

Suppose that the counter reads 2.482 before starting the tracing-point.

In following the outline of the square you will see that the total rotation of the counter is backward and that the zero-mark of the couting-wheel passes once the fixed index.

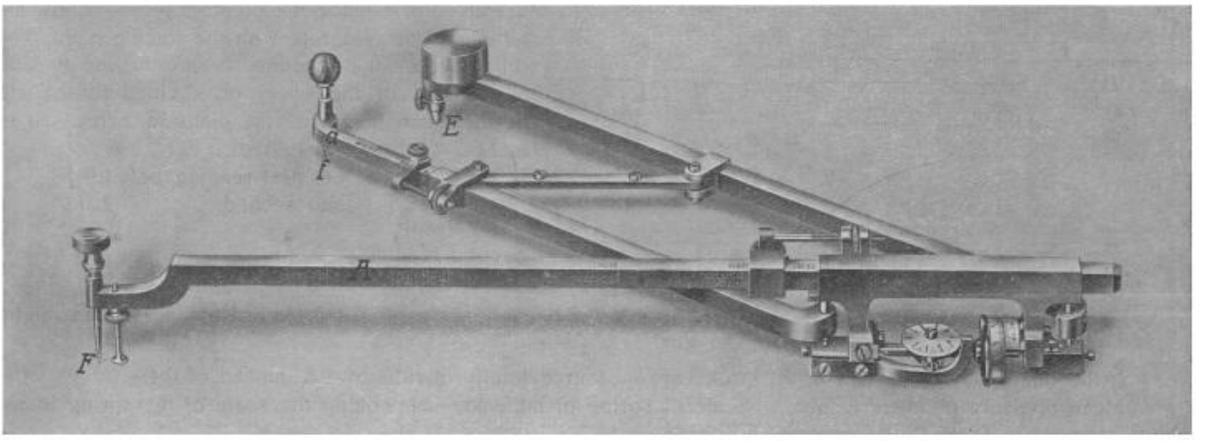
Result: Complete first reading 12.482
less second reading 4.725
difference 7.757

Figure on top of bar just over the division 22.107
less difference of readings 7.757

14.350 × 10 = 143.50 acres.

No. 5 PLANIMETER (electrum)

arranged for measuring very large and very small areas.



RANGE OF TRACING-POINT F: CIRCLE OF 38 INS. IN DIAMETER.

1. For measuring **large areas** set the slide to the proper division on the bar **A.** For doing this, hold the bar **A** with the right hand and shift the slide with the left whilst the parallelogram hangs down.

Then place the instrument upon the drawing and proceed exactly as with No. 3 or No. 4 planimeter.

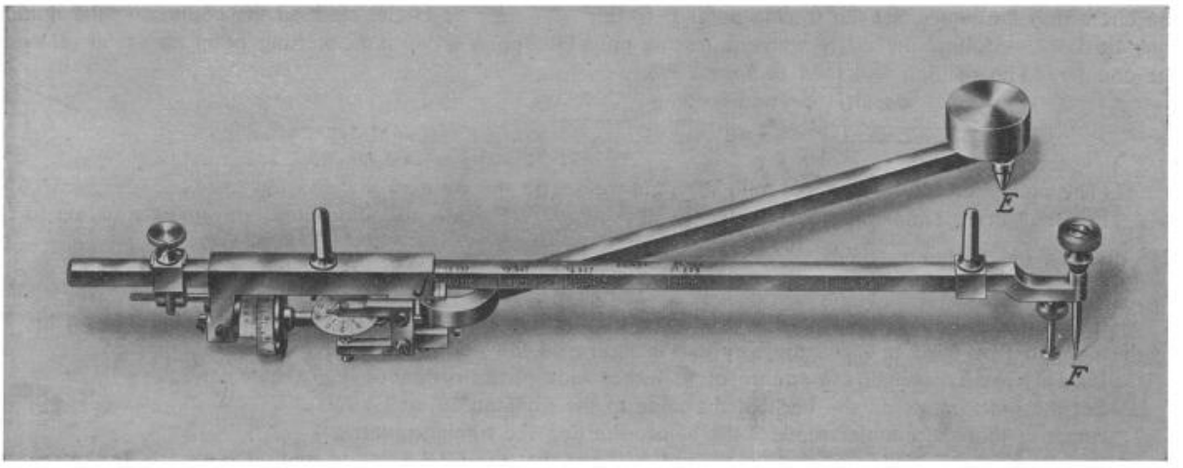
The sliding-point **f** is of no use now and may be taken off.

2. For measuring **small areas,** the smaller sliding-bar **a** is to be adjusted so that the proper mark on the bar comes even with the end-face of the tube in which the bar slides (the bar **A** need not now be adjusted). Then let the point **f** travel round the diagram by leading the point **F** with the hand, but following the point **f** with the eye. This can be done with great ease and accuracy, the two points **f** and **F** describing nearly similar paths. The area will then be expressed in the unit shown at the mark on bar **a.**

Small areas can be measured in this way with the same accuracy as large areas.

No. 6 PLANIMETER (electrum)

same as No. 3 or No. 4, but with special arrangement for finding rapidly the mean height of indicator diagrams.



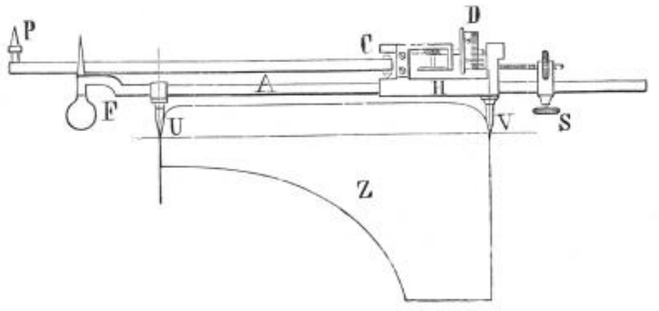
No. 6 PLANIMETER. LARGE SIZE.
RANGE: CIRCLE OF 25 INS. IN DIAMETER. LENGTH OF DIAGRAMS: 2 to 8 INS.

No. 6 PLANIMETER. SMALL SIZE.
RANGE: CIRCLE OF 14 INS. IN DIAMETER. LENGTH OF DIAGRAMS: 2 to 5 INS.

No. 6 planimeter can be used for measuring areas in exactly the same way as No. 3 or No. 4 planimeter.

For measurements of areas the large size bar is provided with the same divisions as that of No. 3 or No. 4 planimeter.

For finding the mean height of an indicator diagram take, by shifting the slide on the bar and keeping the planimeter upside down, the diagram lengthwise between the steel points on the upper side of the instrument as shown in the figure below. Then place the planimeter without altering the relative position of slide and bar in the usual way upon the drawing — needle-point outside the diagram — and follow the outline of the diagram with the tracing-point. The difference of the readings at the beginning and at the end of the operation divided by 0.4 will be the mean height of the diagram, expressed in inches.



Example: Let first reading be 1.913
and second 2.361

Result:

Second reading 2.361
less first reading 1.913

0.4) 0.448 = 1.12 ins. = mean height.

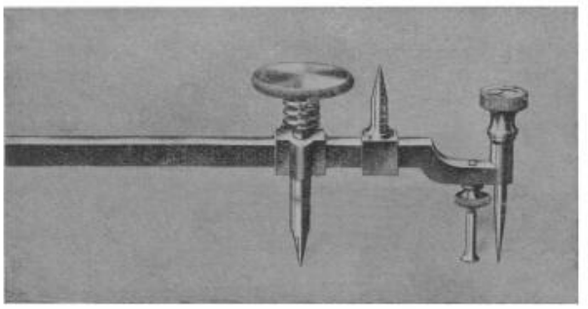
If the diagrams for up and down stroke are measured jointly, divide by 0.8 instead of 0.4.

Mean pressure = Mean height × Scale of spring of indicator. Supposing the scale of the spring in the above example is 1" = 80 lbs. per sq. in., then

$$\text{Mean pressure} = \frac{0.448 \times 80}{0.4} = 89.6 \text{ lbs. per sq. in.}$$

The number of lbs. per inch of height being usually a multiple of 4, the arithmetical work is thus extremely simple.

Auxiliary Screw: This lifting screw is supplied only on special request with No. 6 planimeter for lifting sliding foot and tracing point from the paper, so as to allow of an exchange of diagrams without disturbing the reading of the roller. This auxiliary screw is very convenient when a great number of diagrams of equal length are to be computed. During the travel of the tracing-point the auxiliary screw should not touch the paper. For exchanging diagrams the screw must be lowered a little. — This operation does not affect the roller, and the final reading obtained on the first diagram may be used as the intitial reading for the measurement of the second diagram. In this way the roller is to be read off but once for each diagram.



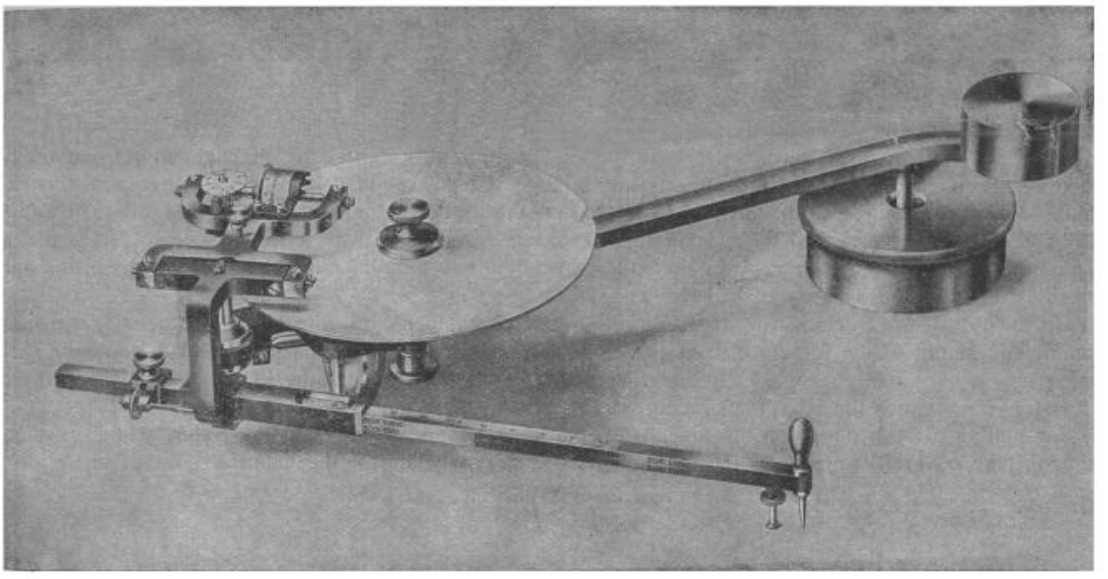
No. 7 PLANIMETER (electrum)

RANGE: CIRCLE OF 42 INS. IN DIAMETER.

Similar to No 4, but considerably larger.

No. 8 PLANIMETER (brass or electrum)

with roller working on a revolving disc. The instrument swings on a vertical pivot (pole).



RANGE: AREA ENCLOSED BETWEEN TWO CONCENTRIC CIRCLES OF 31 INS. AND 13 INS. IN DIAMETER RESPECTIVELY.

Place the planimeter on the drawing as shown in the above figure. Adjust the bar so that the index-mark on the slide coincides with one of the divisions on the bar. The unit of area is engraved to the right of the corresponding division. Shift the center-plate into such a position that the tracing-point can go round the whole outline of the area. Now proceed as with No. 3 or No. 4 planimeter.

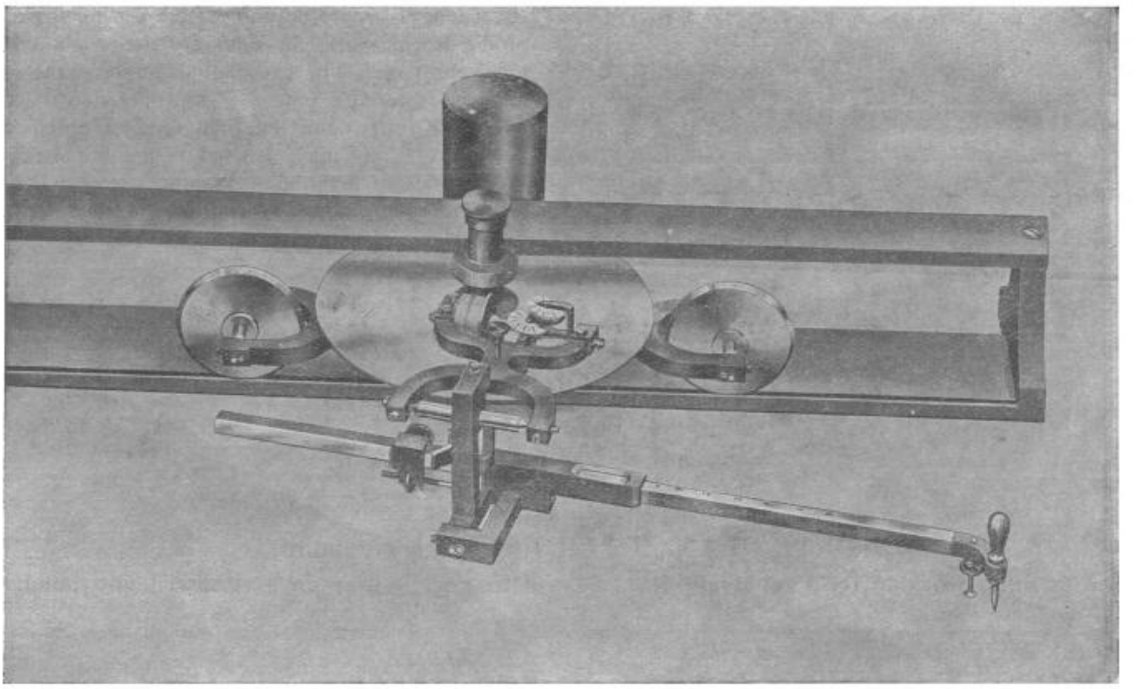
For putting a fresh paper on the disc, withdraw disc from the instrument and unscrew nut on top of disc.

On the top of the tracing bar there is a fine scale showing the distance between tracing point and pivot axis of tracing arm (length of tracing arm). This scale is useful for compensating the shrink of the diagram paper by shortening the length of the tracing arm at the same rate as the paper has shrunk. If for example the shrink of the paper lengthwise amounts to $^1/_2\,^0/_0$, reduce the length of tracing arm also by $^1/_2\,^0/_0$. If in addition the shrink amounts to $^1/_3\,^0/_0$, reduce the length of tracing arm by another $^1/_3\,^0/_0$.

No. 9 PLANIMETER (brass or electrum)

with revolving disc.

The instrument runs on a rail and its working is in no way affected by the condition of the drawing surface.



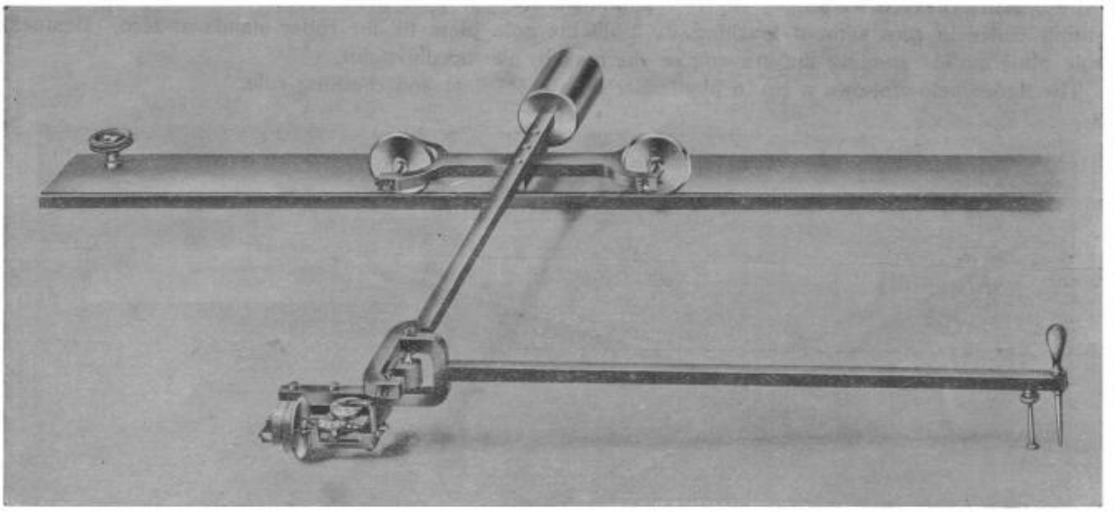
Place the rail on the drawing board as shown in the above figure, put the carriage upon the rail in such a way that the two wheels run in the groove on the lower straight-edge and that the pinion on the top of the disc gears into the rack of the upper straight-edge. The disc and part of the carriage will then lie between the two straight-edges. Put the counter-weight into the arm standing out behind the rail. The adjustment of the length of tracing arm and the measurement is done in the same way as with No. 3 or No. 4 planimeter. No. 9 planimeter reads up to 100 turns of the roller, an additional counting disc being provided for this purpose: The reading is therefore a figure of 5 digits instead of 4.

On the top of the tracing arm there is a fine scale for compensating the shrink of the diagram paper by shortening the length of the tracing arm at the same rate as the paper has shrunk. If for example the shrink of the paper lengthwise amounts to $^1/_2$ %, reduce the length of tracing arm also by $^1/_2$ %. If in addition the shrink amounts to $^1/_3$ %, reduce the length of tracing arm by another $^1/_3$ %.

For putting a fresh paper on the disc, swing back the little frame carrying the roller, withdraw disc from instrument, take off the screw-nut at the bottom of the disc and withdraw the axle.

RANGE LENGTHWISE: 17 INS.
CROSSWISE: 9 INS.

No. 10 PLANIMETER (brass or electrum).



Place the instrument on the drawing as shown in the above figure. The length of tracing arm cannot be altered, and the instrument is used in the same way as No. 1 or No. 2 planimeter.

RANGE LENGTHWISE: 51 INS.
„ CROSSWISE: 16 INS.,

according to length of rule asked for.

GENERAL REMARKS ON MECHANISM.

Avoid touching the rim of the measuring roller. It is made of hardened steel and is liable to be spoiled by rust. Mind that the roller and the pivot-points of the axle are particulary subject to injury.

Therefore do not attempt to set the roller to zero, the more so as this would involve more time and trouble than taking the reading as it stands.

The roller must rotate very easily and should have very little shake between the pivot-centres. The edge of the roller should not touch the vernier. The vertical axle of the pole-arm should turn without back-lash.

Oil the pivot-centres occasionally with fine oil and avoid bending of tracing arm and tracing-point, as this would disturb the adjustement of the planimeter.

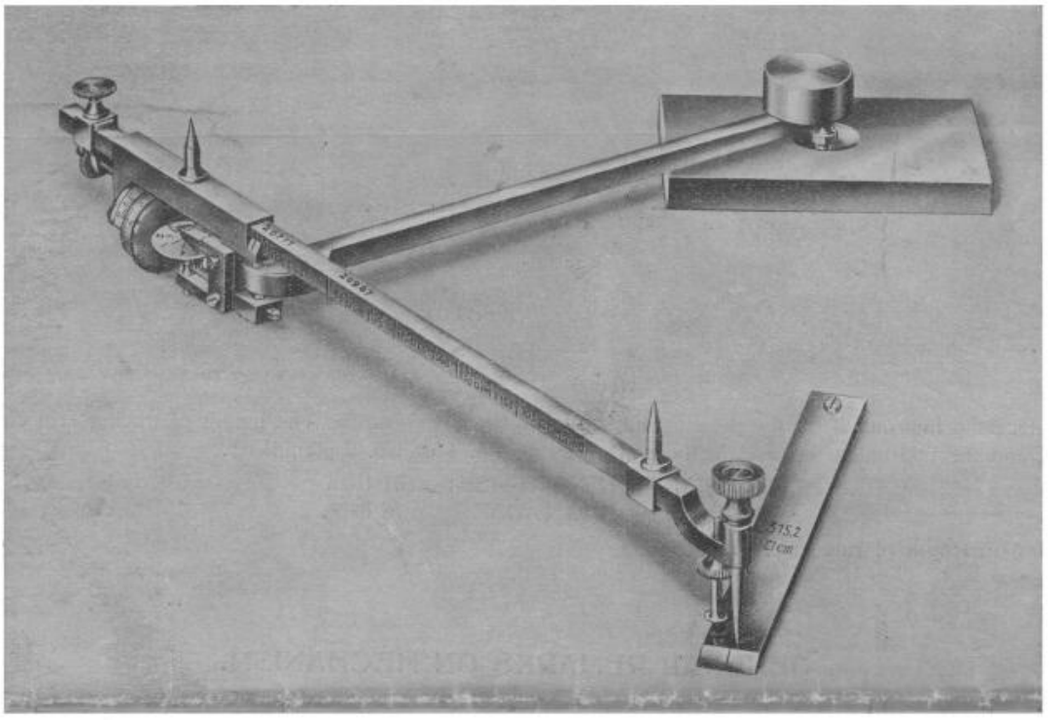
For replacing a broken needle-point, slacken the little clamp screw at the holder, press the broken needle backward, put another at its place, clamp it and break off the portion standing out on the top of the bar. Suitable needles are R. Hemming & Son's blunts 7.

The sliding foot near the tracing point should be adjusted in height, so that the tracing point is just clear of the diagram paper.

POLE-PLATE.

If specially ordered we supply No 1—7 planimeters with a pole-plate, which is convenient for setting the measuring roller to zero without touching it. Shift the pole-plate till the roller stands at zero. Besides this, the pole-plate avoids spoiling the drawing or the map by the needle-point.

The figure below shows a No. 6 planimeter with pole-plate and checking rule.



CHECKING RULE.

Any planimeter may be provided with a rule having at one end a pivot point, at the other end a small hole upon which the tracing-point of the planimeter is to be set for checking. The rule represents the radius of a standard-circle the area of which is engraved on the rule.

Press the pivot point into the drawing surface, set the index mark at the bevelled edge of the rule to a pencil line drawn on the paper, read the roller, move the rule once round the pivot point till the index mark coincides again with the pencil line, and read again the roller.

The area obtained thus should be the same as that engraved on the rule.