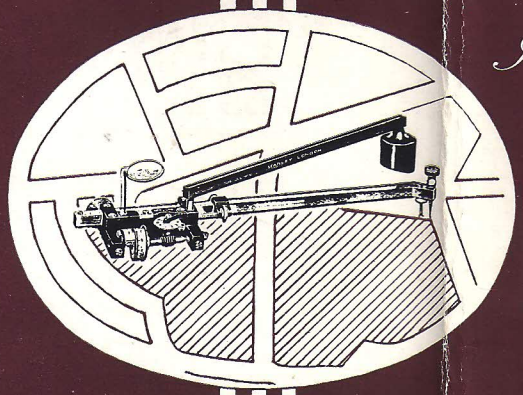
Instructions for the use of the



ALLBRIT

PLANIMETER

THE

ALLBRIT

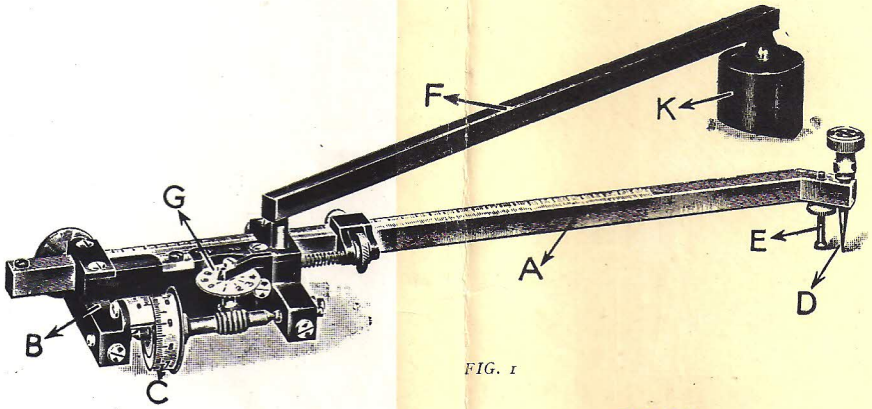


FIG. 1

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COMPENSATING PLANIMETER

THE Planimeter described herein is an entirely British product, and is an extremely accurate, and yet robust, instrument, which, with ordinary careful treatment, will yield consistently good results.

1. *DESCRIPTION OF THE INSTRUMENT*

FIG. 1 (opposite) is a general view of the instrument, showing the following essential features :

A.—**THE TRACER ARM,** which is suitably divided.

B.—**THE CARRIAGE,** which is adjustable to various positions on the tracer arm.

C.—**THE MEASURING WHEEL** to which is attached a divided drum and to which is geared a counting dial (G) for recording the number of revolutions of the measuring wheel.

D.—**THE TRACER POINT,** for circumscribing the area to be measured.

E.—**THE ADJUSTABLE SUPPORT,** to maintain the tracer point just clear of the surface.

F.—**THE POLE ARM,** which carries at one end a **needle-pointed weight or fulcrum** (K) which forms the centre of rotation and at the other a small sphere which rests in a socket on the carriage (B), and thus partly controls its movement when an area is being traced by the pointer (D).

SCALE	Vernier Position On Tracer Bar	Area for One Revolution of the Measuring Wheel		CONSTANT	SCALE	Vernier Position On Tracer Bar	Area For One Revolution of the Measuring Wheel		CONSTANT
		SCALE	ACTUAL				SCALE	ACTUAL	
1 : 1	33·33	100 Sq : Cms:	100 Sq: Cms:	23·254	1 : 1	21·51	10 Sq : Ins.	10 Sq: Ins:	26448
3"=1' (1 : 32)	30·24	100 Sq: Ft:	14.06 Sq: Ins:	23·617	1½"=1' (1 : 48)	13·44	100 Sq : Ft.	6.25 "	
1½"=1' (1 : 48)	26·88	200 "	12.5 "	24·319	1"=1' (1 : 96)	"	400 "	" "	
¾"=1' (1 : 24)	"	50 "	" "	"					
6"=1mi (1 : 10560)	24·19	200 Acres	11.25 "	25·196					
1 : 2500	21·58	10 "	10.04 "	26·404	Nov. 1947.	INST: No. 9792.			
1 : 500	"	2 "	" "	"				REF. W30/600/F/7481/3.000	

FIG. 2

2. *TABLES SUPPLIED WITH THE INSTRUMENT*

With every instrument is supplied a table (see FIG. 2). In Column 1 is a number of scales such as are in common use. In Column 2 is given the position to which the carriage (FIG. 1B) must be set on the tracer arm (FIG. 1A), in order to measure areas to the scale required. Column 3 gives the area recorded by the instrument for every revolution of the measuring wheel. This column is sub-divided to show the area in terms of the scale, and also to read the actual area traced in square inches or square centimetres. In this column are numbers by which the reading on the measuring wheel must be multiplied in order to find the required area.

In the last column there are numbers called " constants," and these numbers are used when the instrument is disposed with the " pole " *inside* the area, and their use will be explained later.

3. *TO READ THE INSTRUMENT*

The carriage must first be set in accordance with Column 2 of the table to read to the desired scale (see FIG. 3). In the figure the setting shown is 21·15.

The reading for measuring the area consists of two parts :

(*a*) *The complete revolutions shown by the counting dial* (G, FIG. 1) ;

(*b*) *The partial revolutions shown by the measuring wheel itself. The figures and sub-divisions giving tenths and hundredths of a revolution respectively, and finally the vernier reading to thousandths.*

The complete reading, therefore, consists of four figures (if less than ten revolutions have been made), *i.e.*, whole number and three decimal places ; thus, in the diagram the carriage setting is 21·15, and the reading is 9·125 (see FIG. 3).

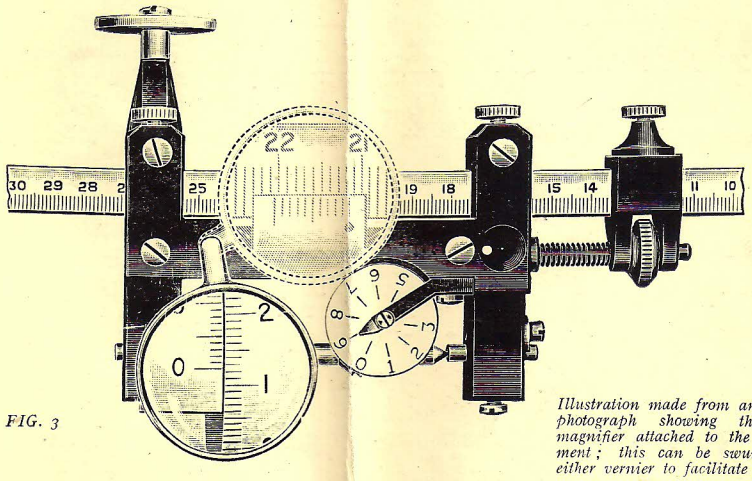


FIG. 3

Illustration made from an actual photograph showing the new magnifier attached to the instrument; this can be swung over either vernier to facilitate reading

4. *TO USE THE INSTRUMENT*

The Planimeter can be used with the pole needle point either inside or outside the area to be measured, as shown in diagrams FIG. 4 and FIG. 5, but wherever possible it should be used with the needle point outside, as this is the more accurate and less complicated method.

FIG. 4

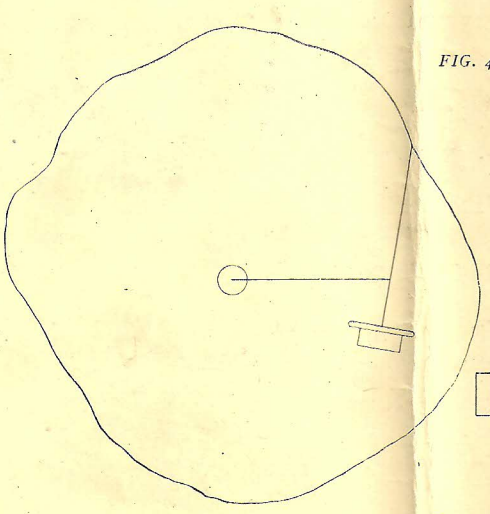
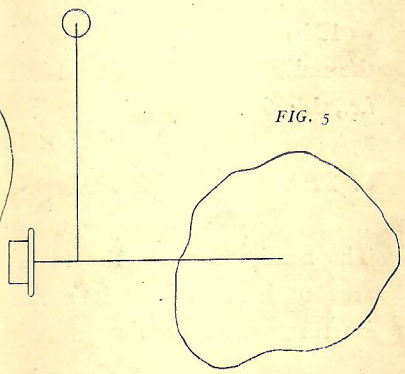


FIG. 5



5. *THE EXTERIOR POLE METHOD*

With the needle point OUTSIDE *the area*

Place the instrument on the area to be measured in such a way that with the tracer point in the middle of the area, the pole arm is approximately at right angles to the tracer arm (see FIG. 5). Lightly circumscribe the area to see that its size is within the capacity of the instrument and if not, the pole must be placed in another position. If the area is very large it can be divided into sections, and each section measured separately.

Having set up the instrument, find a point on the area at which the measuring wheel is at a dead point; that is, it does not revolve with a small movement of the tracer point. This point forms a useful starting point for measuring the area, and should be marked; then, with the tracer point on this mark, carefully note the reading of the measuring wheel as before described. Circumscribe the area carefully in a clockwise direction by means of the tracer point, and again read the measuring wheel; subtract the first reading from the second and the result will be a value from which can be calculated the area desired.

Example I (with needle point outside the area).—Suppose the scale of the plan is $\frac{3}{8}$ in. = 1 ft. Set the carriage on the tracer bar to the setting for this scale obtained from the tables (see *par.* 2). Dispose the instrument correctly about the area (see FIG. 5). Lightly trace the area and find a good starting-point. Note the reading (say, 1·225), circumscribe the area and again note the reading (say, 2·572)

$$2{\cdot}572 - 1{\cdot}225 = 1{\cdot}347$$

Multiply this result by the appropriate "area per revolution of the measuring wheel," taken from the tables, *i.e.*, 100 sq. ft. $1{\cdot}347 \times 100 = 134{\cdot}7$ sq. ft. If it were desired to know the actual area of the plan, the multiplier will be found in the "actual area" column of the tables, *i.e.*, 14·06 sq. ins.

$$1{\cdot}347 \times 14{\cdot}06 = 18.{\cdot}94 \text{ sq. ins.}$$

6. *THE INTERIOR POLE METHOD*

With the needle point INSIDE *the area*

The manipulation of the Planimeter with the needle point inside the area to be measured is a little more complicated, but enables the instrument to cover a much larger area at one setting up. The constant

in the last column of the tables, FIG. 2 enters into this, and we will first consider how this is arrived at.

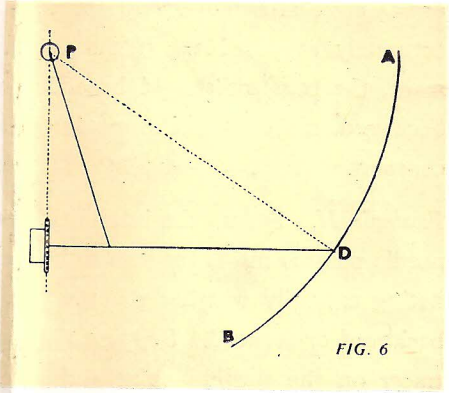


FIG. 6

Dispose the Planimeter as in Fig. 6. Take a drawing compass and with a centre P describe an arc A B. Now, if the arc be traced with the tracer point D (FIG. 1) it will be observed that the measuring wheel makes no movement whatever, and a whole circle could be described in this manner without the measuring wheel making any movement. This circle is known as the Zero Circle and the CONSTANT is the area of this circle expressed in revolutions of the measuring wheel. If the area to be measured is greater than the zero circle, then the drum will move forward and record the amount by which the area exceeds that of the zero circle ; therefore, the CONSTANT must be added to this reading to give the true area. If the area is less than that of the zero circle the instrument will record the difference between the two areas, this reading must therefore be subtracted from the constant.

The first step with the interior pole method is to find out whether the area is greater or less than that of the zero circle. This is done by circumscribing the area roughly, in a clockwise direction, and noting the total movement of the measuring wheel. This operation is simplified if the dial and vernier are first set to zero. Frequent readings of the counting dial will reveal whether the instrument is making a forward or a backward movement.

If while the figure is being traced the counting dial makes one or two complete revolutions, then the values of these revolutions must be accounted for and added to the reading. Note that each complete revolution of the counting dial represents ten revolutions of the measuring wheel.

Having ascertained whether the measuring wheel makes a forward

or a backward movement, proceed to circumscribe the area as accurately as possible. If the instrument records a forward movement, the constant should be added to the reading; if it records a backward movement, the reading should be subtracted from the constant.

Example II. Set up the instrument as in Example I, except that the needle point is inside the area to be measured. Roughly trace the area, noting carefully whether the total movement of the counting dial is backward or forward. Suppose the movement is backward: place the tracer on the starting point and note the reading of the measuring wheel, say 9·468. Trace the area, and again note the reading, say 3·488. Subtract this from the first reading, and then subtract this difference from the constant, thus:

9·468	Constant	23·617
3·488		5·980
5·980		17·637

Had the reading been **forward** the **difference** would have been added to the constant instead of subtracted. In either case the result must be multiplied by the appropriate number taken from the tables as before.

7. *INTERIOR POLE—SECOND METHOD*

There is another method of interior pole measurement which combines the advantages of both interior and exterior pole methods. The area to be measured is either inscribed with, or circumscribed by, a figure of known area (see FIGS. 7 *and* 8).

The surrounding strip is then measured as if it were cut at X Y, and added to, or subtracted from, the **known** area.

This method is somewhat longer than the ordinary interior pole method, but it is considered to be more accurate, and it is certainly

speedier than dividing up the area to be measured into a number of small areas to be measured separately.

The procedure is to trace the outer contour in a clockwise direction from X to X, then move the tracer along the line XY and trace the interior contour in the reverse direction from Y to Y; finally retrace the line YX. The result is the required reading.

8. *CORRECTION OF SETTING OF ALLBRIT PLANIMETERS FOR USE WITH SHRUNK PLANS*

Let m = percentage shrinkage in horizontal direction,
„ n = percentage shrinkage in vertical direction,
„ s = setting that would be used had the plan not shrunk,
„ s^1 = corrected setting to give true value when used on shrunk plan.

Then $$s^1 = s\left(1 - \frac{m+n}{100}\right)$$

Example :

s = 24·20
m = 2
n = 3

Then

$s^1 = 24{\cdot}20\left(1 - \frac{2+3}{100}\right)$
$= 24{\cdot}20 \times 0{\cdot}95$
$= 22{\cdot}99$

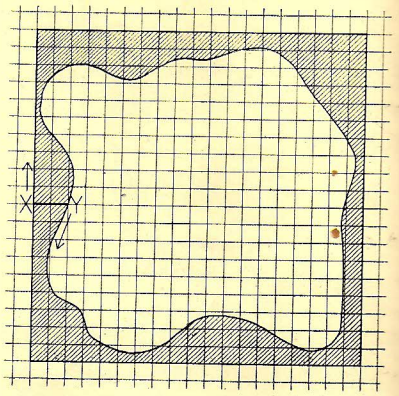


FIG. 7

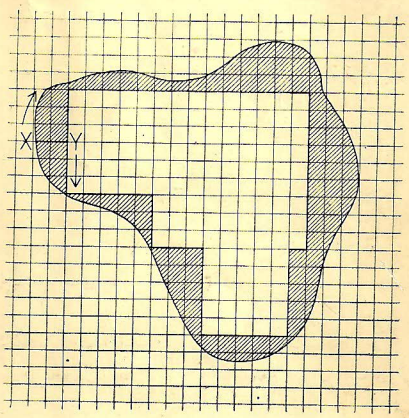
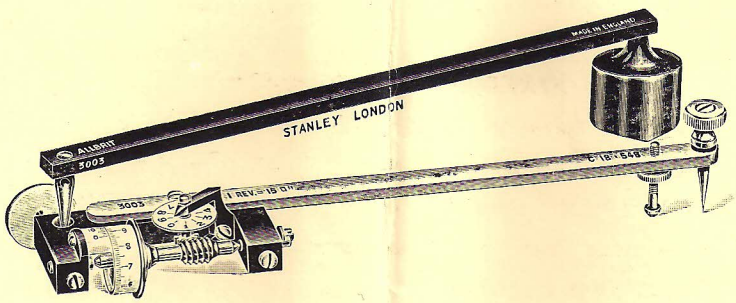


FIG. 8


STANLEY LONDON
ALLBIT
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5003
1 REV. = 15 CM.

FIG. 9

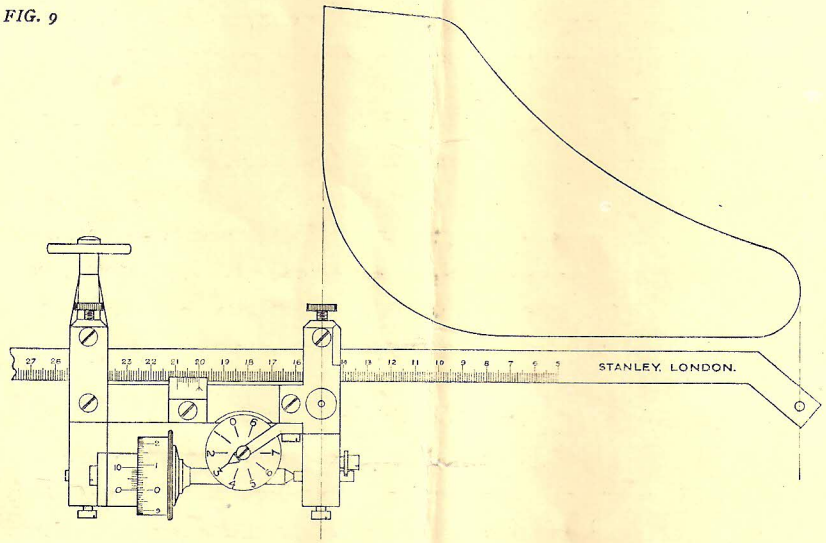
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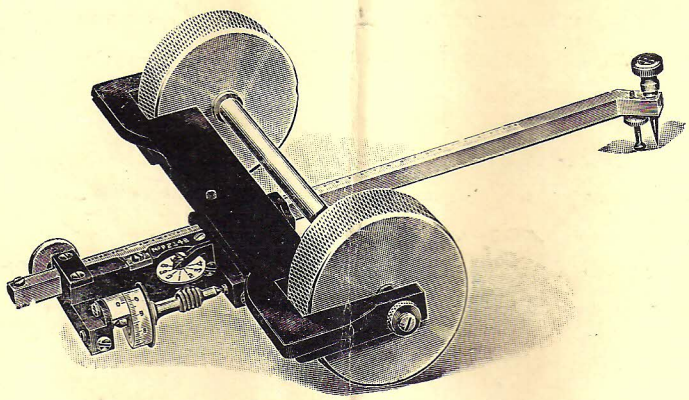
FIG. 10



THE ALLBRIT FIXED ARM PLANIMETER

This Planimeter (*shown at top of opposite page*) is similar in construction to the Allbrit Sliding Bar Planimeter, but the carriage is fixed and the instrument records in square inches or square centimetres only.

For scales other than full size, conversion tables will be necessary to find the true area

A booklet giving Area Conversion Tables for scales in common use is supplied with each instrument.

All the directions for using the Standard Polar Planimeter apply, except those for setting the carriage. The instrument reading in square centimetres can be supplied at the same price as the square inch model.

9. *TO FIND THE MEAN HEIGHT of INDICATOR DIAGRAMS*

Adjust the carriage on the tracer arm to the position where the area for one revolution = 10 sq. in. (see tables, FIG. 2). Then measure the area of the diagram in the usual way. Find the greatest length of the diagram, and the mean height can be obtained by dividing the area by this length. For example, in FIG. 9, if X is the area and Y is the length of the base, the mean height of the diagram is $\frac{X}{Y}$.

10. *INDICATOR DIAGRAMS—SECOND METHOD*

This is similar to the first method described, but the length of the base is measured directly on the tracer arm. Measurement is made between the tracer point and the socket in which the end of the pole-arm usually fits ; this socket terminates in a small hole through which the end of the base line of the indicator diagram can be seen. With the carriage set in this position on the tracer arm, the area is measured and the mean height will then be the reading of the measuring wheel multiplied by 60 if the height is to be read in millimetres ; by 2·36 if the height is to be read in inches.

11. *POLE WAGON*

When readings have to be taken from continuous diagrams for the purpose of ascertaining the mean height, a Pole Wagon can be employed. This accessory is illustrated in FIG. 10, and consists of a pair of heavy knurled rollers connected together by an axle with a

central pivot. The pole-arm is removed from the Planimeter and the pivot of the pole wagon is inserted in the socket hitherto occupied by the pivot of the pole-arm.

The Planimeter can now be towed in a straight line along the diagram. The use of the pole wagon eliminates much tedious work and calculation, as without it the diagram would have to be divided up into a number of sections and the areas added together.

The procedure is : Adjust the carriage on the tracer-bar to the position where the area for one revolution = 10 sq. in. (see tables, FIG. 2) ; dispose the Planimeter and pole wagon so that the latter can be towed as nearly as possible parallel with the base line of the diagram ; measure the area of the diagram in the usual way. To calculate the mean height, divide the area thus ascertained by the length of the base line.

12. *THE CHECKING-RULE*

A checking-rule is supplied with each instrument. This contains centre marks between which and the centre needle are known lengths, which form radii of circles, the areas of which are engraved on the rule, and its use is to test the accuracy of the instrument should this be questioned at any time.

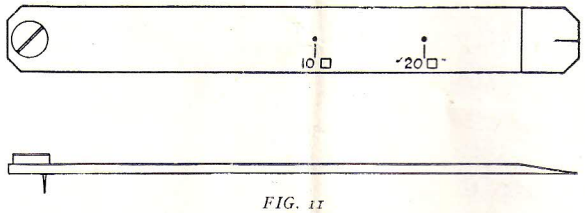


FIG. 11

To use the checking-rule press the needle point into the paper, regard this needle point as the centre of an area to be measured and dispose the Planimeter accordingly, having first adjusted the carriage to the position where the area for one revolution = 10 sq. inches obtained from the tables (FIG. 2). Place the tracer point in the centre mark on the rule, having first adjusted the tracer support so that it allows the tracer point free access to the centre mark. Then describe a complete circle and from the resulting reading calculate the area of the circle in the usual way. If this corresponds with the area engraved

on the checking-rule the instrument is correct. If not, either the carriage is incorrectly set upon the tracer-arm or the axis of the measuring wheel is not parallel to a line drawn between the tracer point and the pole-arm socket.

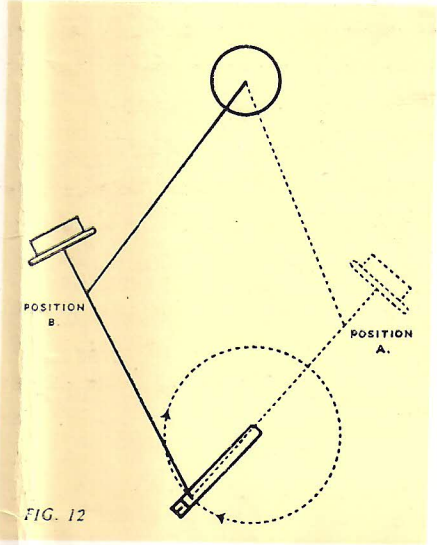


FIG. 12

This parallelism is a very necessary condition and can be best tested by circumscribing the area given by the checking-rule with the Planimeter disposed in the two different ways, which may be described as right hand and left hand (see FIG. 12). If the instrument does not read the same in both these positions it indicates a lack of parallelism. At the same time the **mean** of these readings will give the correct result. This is a very important feature of the Compensating Planimeter as it automatically eliminates errors due to lack of parallelism, and when any great exactitude is required this method of '**meaning**' should always be resorted to. It should, however, be remarked that in the instructions for the use of the checking-rule given above, the instrument is disposed in the most favourable position, *i.e.*, the pole-arm at right angles to the tracer-arm when the tracer point is in the centre of the area.

To make the test for parallelism the pole-arm should be so disposed that the angle it makes with the tracer-arm is as acute or as obtuse as possible. This will reveal any lack of parallelism.

13. *THE CARE OF THE INSTRUMENT*

It is hardly necessary to point out that continued accuracy of the Planimeter depends on its being treated with reasonable care, although the instrument is of simple construction and is robust enough to stand ordinary intelligent use.

The tread of the measuring wheel is a very important part of the instrument, and must be carefully guarded against careless handling, or being injured by contact with hard substances. It is best never to touch this tread with the bare fingers, and when resting on the paper it should certainly never be turned by the hand. The correct way to make the adjustment, if, for instance, one wishes to set the vernier to zero, is to lift the wheel off the paper with the right hand, which can easily manipulate this from the tracer-point end of the tracer-bar. Then the thumb of the left hand can speedily revolve the spindle, utilising the **worm** for this purpose (**not** the tread).

When the counting dial is at zero the fine adjustment to the zero on the drum can best be made by slowly moving the pole-arm centre, which in its turn will revolve the wheel. The construction of the weighted end of the pole-arm enables one very easily to lift the needle from the paper to give the necessary movement.

The measuring wheel should always revolve very freely, and the spindle should have, therefore, a very slight end shake. The graduated edges of the drum and vernier must not touch. Any dust that might accumulate between the drum and the vernier must be removed in case it interferes with the free movement of the wheel. Although it may be helpful to put the tiniest drop of clock oil on the end of the axle, this must be the smallest possible quantity, as excess of oil is worse than no oil at all for impeding the wheel movement.

It is of the utmost importance that the tracer-arm should not be bent, and any danger of this should be carefully guarded against, care being exercised in placing the instrument into its case and removing it therefrom.

Should the needle in the checking-rule get broken, another needle point can be inserted by removing the screw, carefully pressing out the broken needle from its hole and then inserting a fresh needle point, replacing the screw and gently screwing it down into contact with the large end of the needle point.

If the centre needle of the pole-arm gets broken, this can be removed by loosening the clamp screw at the side; the broken needle can then be removed and replaced.

WEIGHTS AND SIZES

	Fixed Arm	*Sliding Bar*	*Pole Wagon*
Weight of Instrument	8 ozs.	10 ozs.	2 lbs. 8 ozs.
Ditto, in case ..	14 ozs.	1 lb. 3 ozs.	3 lbs. 1 oz.
Overall size of case	8″ × 3″ × 2″	10″ × 3½″ × 1¾″	8¼″ × 3½″ × 2¾″

Ref. 349/J.&S./2500