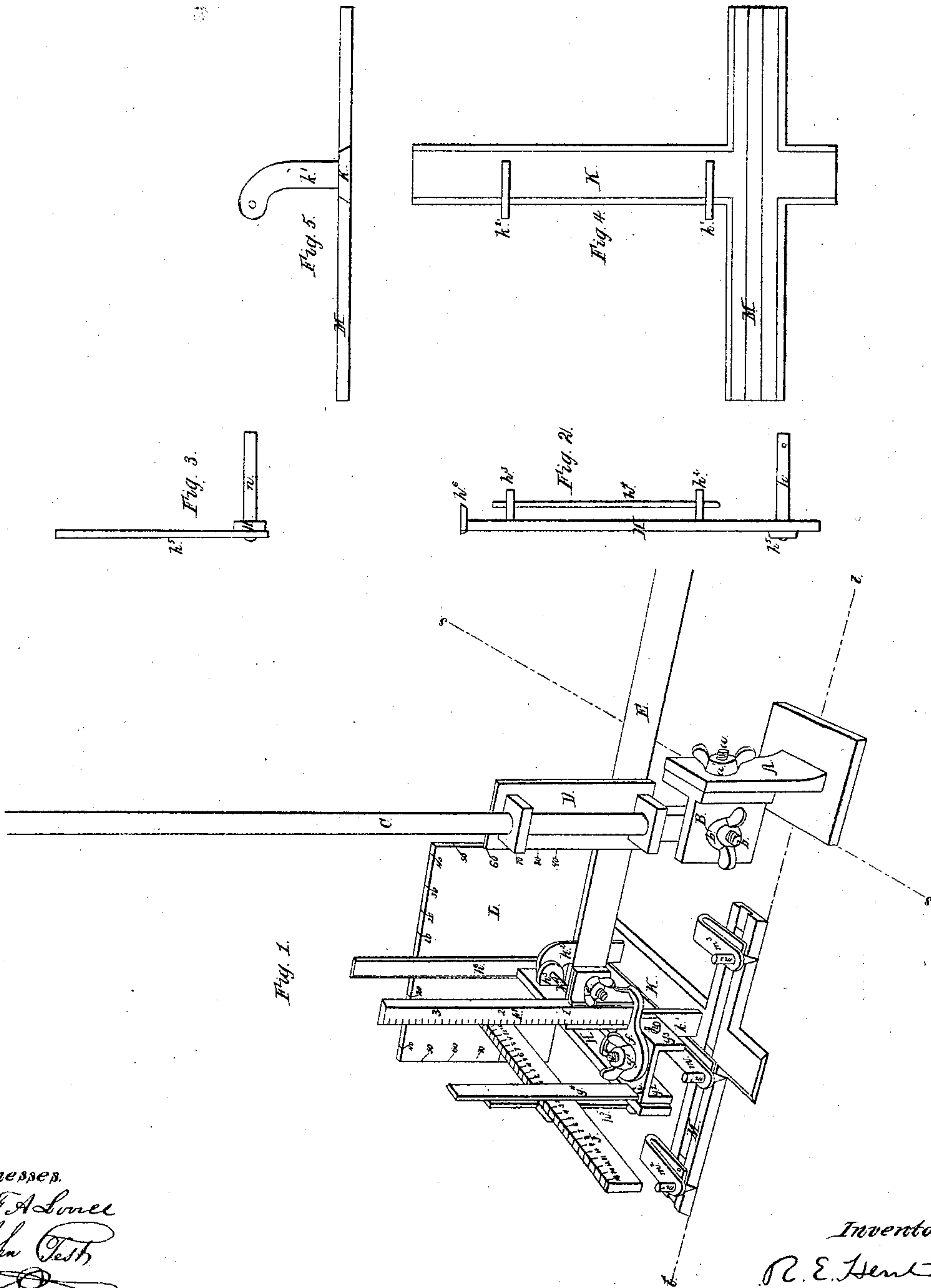


R. E. HARTE.
ELLIPSOGRAPH.

No. 30,816.

Patented Dec. 4, 1860.



Witnesses.
F. A. Lowe
John Test

Inventor.
R. E. Harte

UNITED STATES PATENT OFFICE.

R. E. HARTE, OF MARIETTA, OHIO.

ELLIPSOGRAPH.

Specification of Letters Patent No. 30,816, dated December 4, 1860.

To all whom it may concern:

Be it known that I, R. E. HARTE, of Marietta, in the county of Washington and State of Ohio, have invented a new and useful Mathematical Instrument, for drawing parallel ellipses and the tangent and normal lines to any point in the elliptic curve and for determining the angles which such tangent and normal lines and other lines in the plane of the ellipse make with certain other lines in other planes; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings, making a part of this specification, in which—

Figure 1 is a perspective view of the instrument. Fig. 2 a plan or horizontal section of certain designated parts. Fig. 3 a corresponding elevation of the same. Fig. 4 a plan of certain other designated parts. Fig. 5 a corresponding elevation of the same.

Similar letters of reference indicate corresponding parts in the several figures.

The instrument is constructed of metal, wood or other suitable material.

(A) represents a standard attached to the drawing board, (or plane surface upon which the drawing is to be made,) by means of a clamp, wood screws, or other equivalent device, and having a plane surface, or face perpendicular to the surface of the drawing board.

B represents a plate having plane surfaces at right angles to each other, of which one face, by means of pivot (a) and thumb screw (a') is attached to the perpendicular face of the standard (A), and the other face by means of pivot (b) and thumb screw (b') is attached to the roll or spindle (c) so that the axes of the spindle (c) and the pivot (b) and the axis of the pivot (a) continued, will coincide in the same point, whereby the spindle (c) is allowed to turn on the pivot (b) in a plane at right angles to the plane of the standard (A), and the plate (B), and spindle attached, is allowed to turn on the pivot (a), the axis of which pivot is parallel to the surface of the drawing board and at right angles to the plane surface of the standard (A). Thus by means of the thumb screws (a') and (b') the spindle (c) may be held with its axis at any required angle with the surface of the drawing board.

D represents a collar which is allowed to move along and around the spindle (c).

E represents a graduated bar movable longitudinally in a groove in the collar (D) at right angles to the axis of the spindle (c) and by means of a thumb screw or equivalent device is held firmly to the collar (D) having its extremity at any required distance from the axis of the spindle (c).

F represents a graduated bar or stem movable longitudinally in a groove at the extremity of the bar (E) at right angles to that bar and parallel to the axis of the spindle (c) and by means of thumb screw (e) or its equivalent is held firmly to the bar (E) with its extremity at any required distance from that bar. This stem (F) is attached firmly to a plate (f) perpendicularly to the face of such plate, which is perforated for the reception of the pivot (g) from the index bearer (G).

G represents an index bearer consisting of a plate (G) which by means of pivot (g) and thumb screw (g') or equivalent, is attached to the head plate (f) of the stem (F) and by loosening the thumb screw (g') may be turned on such pivot. Projecting from the plate (G) are the ears (g^2) and (g^3) which are perforated for the reception of the short shaft (h) (or equivalent pivots), so that the axis of that shaft is parallel to the face of plate (G). Attached to the index bearer (G) is the tangent index (g^4) having its indicating edge perpendicular to the face of plate (G) and in a plane passing through the centers of the perforations in the ears (g^2) and (g^3).

H represents a shaft-bearer, or bar, to which at right angles is attached the short shaft (h) which passes through the ears (g^2) and (g^3) of the index bearer (G) and is allowed to turn in the same. Projecting from the bar (H) are the ears (h^2) and (h^3) which are perforated for a pin (h^4), so that the axis of such pin continued, will intersect at right angles the axis of the short shaft (h) to the bar (H), perpendicularly to the plane of the axes of the short shaft (h) and of the pin (h^4), is attached the graduated tangent bar bearer (h^5), longitudinally along which slides the graduated tangent bar (J), the graduated straight edge of which is parallel to the pin (h^4) and touches the indicating edge of the tangent index (g^4) and this tangent bar (J) by means of a thumb screw, or equivalent, is held to the tangent bar bearer (h^5) at any required distance from the plane of

the axes of the short shaft (h) and of the pin (h^4). To the bar (H) is also attached the normal index (h^6) having its indicating edge at right angles to the axis of the pin (h^4) and in a plane passing through that axis.

K represents a tangent ruler (to move on the drawing board) attached to which are the standards (h^1) and (h^2) which are perforated for the reception of the pin (h^4), which passes also through the ears (h^2) and (h^3) of the shaft bearer (H), so that the axis of this pin (h^4) is in a plane perpendicular to the face of the drawing board (or under surface of the ruler) and parallel to the directing edge of the ruler and at the same distance therefrom as is the axis of the pivot (a) in the standard (A) from the surface of the drawing board.

L represents a graduated protractor or plane table attached to the tangent ruler (K) having a plane surface in the plane generated by the revolution of the indicating edge of the normal index (h^6) which has for its axis of revolution the axis of the pin (h^4).

M represents a graduated normal ruler attached to the tangent ruler (K) having its directing edge at right angles to the directing edge of the tangent ruler, and in the same plane therewith, and in a plane perpendicular to the surface of the drawing board (or under surface of the ruler) and passing through the intersecting point of the axes of the short shaft (h) and of the pin (h^4). Attached to the normal ruler (M) are the pencil holders (m) (m^2) and (m^3) and the pencils (m') (m^4) and (m^5) arranged so as to allow the points of the pencils to press upon the surface upon which the drawing is to be made at points in the directing edge of the normal ruler, at any required distance from the directing edge of the tangent ruler.

The operation is as follows: Fasten the standard (A) to the plane surface upon which the drawing is to be made. By means of the thumb screws (a' and b') adjust the spindle (c) with its axis perpendicular to that surface. From the point where the axis of the spindle (c) in its perpendicular position would intersect that surface draw lines thereon one parallel with the face of the standard (A) as represented in Fig. 1 by the dotted line $s-s$, and another at right angles thereto as represented by the dotted line $t-t$. Adjust the directing edge of the normal ruler (M) to coincide with either of these lines and tighten the thumb screw (g'). The collar (D) now rests on the shoulder of the spindle (c). The bar (E) is parallel with the surface upon which the drawing is to be made, and is attached to the lower portion of the stem (F) and its graduation indicates at the collar (D) the

distance of the point of intersection of the directing edges of the tangent and normal rulers (K and M) from the axis of the spindle (c) the indicating edge of the tangent index (g^4) coincides with the zero (o) of the graduated tangent bar (J) and the indicating edge of the normal index (h^6) coincides with the zero (o) of the graduated protractor or plane table (L). Now, to describe an ellipse and draw the normal and tangent lines at any point of the curve, the major and minor axes of the ellipse being given, adjust the bar (E) to the required semi minor axis and tighten the thumb screw of the collar (D); set off on one of the lines (say the line $t-t$) from its intersection with the other line ($s-s$) the required length of the semi major axis; loosen the thumb screw (b'), raise the collar (D) along the spindle (c) until the point of intersection in the directing edges of the rulers (K and M) coincides with the point designating the extremity of the semi minor axis and tighten the thumb screw (b'); move the rulers along the plane surface on which they rest, and the collar (D) along the spindle (c) and the pencil (m'), having its point at the intersection of the directing edges of the rulers (K and M), will describe half the ellipse required, and the pencils (m^4) and (m^5) will describe semi ellipses parallel thereto. The pencil (m') resting at any point of the curve, a line drawn along the directing edge of the tangent ruler (K) will be a tangent to the curve at that point; and a line drawn along the directing edge of the normal ruler (M) will be a normal to the curves at the points of intersection. The other half of the ellipse may be described by adjusting the spindle to the same angle with the other semi major axis.

To describe the ellipse produced by the intersection of a plane with the circumference of a right cylinder having a given circular base, the plane cutting the cylinder at a given angle (say an angle represented by the base and hypotenuse of a triangle which has a base of 12 and a perpendicular of 8 equal parts) adjust the bar (E) to the radius of the circular base. Adjust the top of the tangent bar (J) to the 12 on the graduated tangent-bar bearer (h^5). The normal ruler (M) coinciding with one of the lines, drawn as before, (say the line $s-s$) and the spindle (c) being at right angles thereto, loosen the thumb screw (b') and incline the spindle (c) until the tangent index (g^4) coincides with the point 8 on the graduated edge of the tangent-bar (J), and tighten the thumb screw (b'). By moving the rulers the required ellipse and tangent and normal lines may be described as before, and the pencil (m') resting at any point of the curve the tangent index (g^4) will indicate on the

tangent bar (J) the angle which the tangent line drawn through that point makes with the base of the cylinder (or a plane at right angles with the axis of the spindle c), and the normal index (h^6) will indicate on the protractor (L) the angle which the normal line drawn through the same point makes with a line in the base of the cylinder produced by the intersection with such base of a plane passing through the normal line and perpendicular to the tangent line.

To describe an ellipse produced by the intersection of a plane with the circumference of a right cylinder having a given circular base, one diameter of the ellipse to cut the cylinder at a given angle (say an angle represented by the base and hypotenuse of a triangle which has a base of 12 and a perpendicular of 8 equal parts) and its conjugate diameter to cut the cylinder at a given angle with the base (say an angle represented by the base and hypotenuse of a triangle which has for its base the radius of the base of the cylinder and a perpendicular of one and a half inches). The instrument being adjusted as last afore mentioned, raise the bar (E) on the stem (F) the given distance ($1\frac{1}{2}$ inches) and tighten the thumb screw (e). Loosen the thumb screw (a') and allow the spindle (c) to turn on the axis of the pivot (a) until the collar (D) rests on the shoulder of the spindle (c), the directing edge of the tangent ruler (K) being parallel with the line ($t-t$), or the directing edge of the normal ruler being parallel with the line ($s-s$) tighten the thumb screw (a'). By moving the rulers, the required ellipse, and tangent and normal lines may be described and the angles they make with the base determined, as before. The normal line drawn when the tangent index (g^4) coincides with the zero (o) of the tangent bar (J) will be the transverse axis of the ellipse, and the normal line drawn when the normal index (h^6) coincides with the zero (o) of the protractor (L) will be the conjugate axis of the ellipse.

To determine the angle which a given straight line in a plane having a given inclination to another plane or base makes with such base. In the mode afore described adjust the spindle (c) so that the plane or base to which it is perpendicular will have the given inclination to the plane in which is the given straight line. Loosen the thumb screw in the collar (D) and the

thumb screw (g') and make the directing edge of the tangent ruler (K) coincide with the given straight line. The tangent index (g^4) will indicate on the tangent bar (J) the angle required.

The annexed drawings are on a full-size scale, but in the construction of the instrument it is not necessary to be confined to the forms, proportions and arrangements herein set forth, but others substantially the same may be adopted as convenience or fancy may suggest, and, if desired, a protractor or plane table (similar to the plane table (L) above described) may be substituted for, or combined with, the movable tangent bar (J), and a tangent bar (similar to J) may be substituted for, or combined with, the plane table (L), or the tangent bar (J) may be dispensed with, and the parts (h^5) and (g^4) have coinciding points marked on each at any length of radius (say two inches) from the axis of the short shaft (h), then, on any rotation of the part (g^4) on the axis of the short shaft (h), the point marked on (g^4) will diverge from the point marked on (h^5) and the degree of rotation or angle made by the radii drawn from the points to the axis of the short shaft (h) may be determined by measuring the length of the cord line extending from one point to the other, as accurately as the same angle is determined by means of a tangent line in the manner above set forth. A similar substitution and arrangement may be made for the protractor (L).

What I claim as my invention and desire to secure by Letters Patent is—

The construction and arrangement of a drawing instrument having the ruler or rulers or parts designed for holding or directing the pencil, attached by means of a universal joint, or joints or pivots equivalent thereto, to a bar which is movable around and along a rod or spindle held at any required angle to the plane surface upon which the drawing is to be made; and also, the combination therewith of the joint or pivot (g) the adjustable stem (F) the indices (g^4 and h^6) the graduated tangent bar (J) and protractor (L), constructed and operating substantially as above described and for the purposes above set forth.

R. E. HARTE.

Witnesses:

F. A. LOVELL,
JOHN TEST.