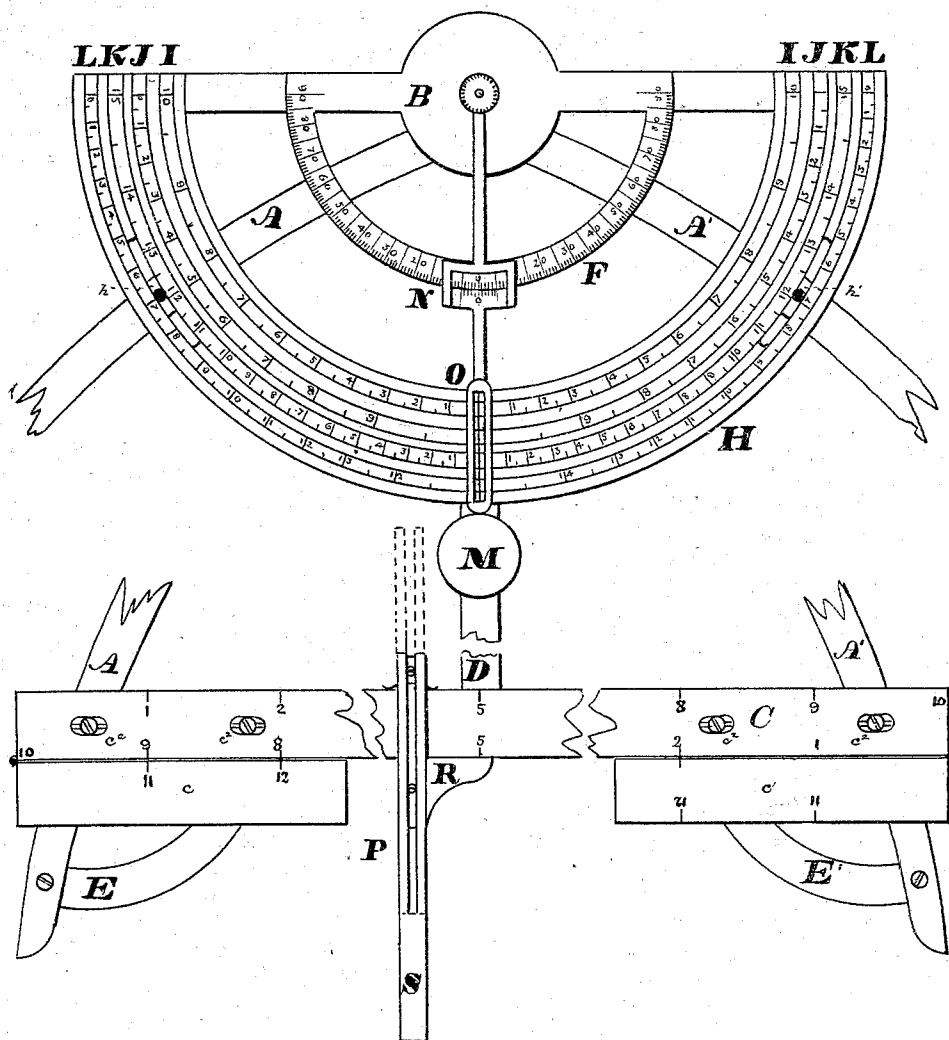


J. L. BOGY.

Surveying Instruments.

No. 147,472.

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WITNESSES

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JOHN L. BOGY, OF ST. GENEVIEVE, MISSOURI.

IMPROVEMENT IN SURVEYING-INSTRUMENTS.

Specification forming part of Letters Patent No. **147,472**, dated February 17, 1874; application filed September 2, 1873.

To all whom it may concern:

Be it known that I, JOHN L. BOGY, of the city and county of St. Genevieve, State of Missouri, have invented new and useful Improvements in Surveying-Instruments, of which the following is a full, clear, and exact description, reference being hereby had to the accompanying drawing making a part of this specification.

Parts of the legs and of the main brace are broken away. The dotted lines indicate the position of the vertical limb of the square when moved up.

The object of the present invention is to provide means by which vertical and horizontal distances can be readily measured. It consists, mainly, in the combined leveler and measurer, constructed and operated substantially as is hereinafter described.

In the drawing, A A' represent legs, preferably of a curved shape, as shown. At their upper ends they are pivoted similarly in a head, B. These legs are opened to the desired span, and there fastened by suitable braces and screws. In the present case the span is ten feet. C represents a main brace, that serves to hold the lower ends of the legs apart. Its length is equal to the distance between the outer faces of the legs. The brace is also properly marked off into feet and subdivisions thereof, for the purpose of measuring fractional distances, in the manner hereinafter described. The main brace is provided with an extension, $c c'$, at either end. These extensions can be opened out horizontally, so as to lengthen the main brace C, when it is desirable to measure distances slightly longer than the length of the main brace. D represents another brace, extending from the head B to the center of the main brace C. For the more perfect adjustment of the legs A A' to the desired span, the main brace is provided, at the places of connection with the legs, with slots $c^2 c^2$. There are additional braces E E', running from the lower ends of the legs to the main brace C, which, in practice, is preferably arranged eighteen inches from the lower ends of the legs. H represents a semicircle or limb, that is fastened to the brace D and head B, its center coinciding with that of the latter. It also rests against the legs A A', and, at the points of

contact therewith, is provided with slots $f f'$, in which studs, with which the legs A A' are provided, engage. The limb H has marked on its face four series of divisions—viz., I, J, K, and L. The first two mentioned—I and J—have reference to a span or opening between the outer faces of the lower ends of the legs of the instrument of ten feet, and are, respectively, what I term the sine and the cosine series. The last two mentioned—viz., the K and L divisions—have reference to a span of fifteen feet, and are also, respectively, a sine and a cosine series. For different spans of instrument, the divisions of the different series are made to correspond. The positions of the lines constituting the several series mentioned—viz., I, J, K, and L—are determined as follows: Beginning at o , at the center of the limb, for the two sine series I and K, and proceeding either to the right or to the left to the extremities of the limb, respectively, the spaces between the lines marked 1, 2, 3, &c., constantly increase toward the extremities of the limb in the same ratio as a series of natural sines; and for the cosine series J and L, beginning at the extremities of the limb, respectively, and proceeding toward the center of the limb, the spaces between the lines marked 1, 2, 3, &c., constantly increase toward the center in the same ratio as a series of natural cosines; and the actual measurements shown in the sine and cosine series in present application correspond to the actual sines and cosines in circles whose radiuses are, respectively, ten and fifteen. M represents a pendulum, pivoted at the center of the head B, and swinging freely against the face of the semicircle H, and opposite thereto, being provided with a hair-line, O, for the purpose of more accurate reading. P represents a square, that is detachable from the main portion of the instrument. It is composed of two parts or links, R and S, arranged to slide vertically in each other. The vertical limb S is graduated. The horizontal part R embraces and slides upon the main brace C.

The operation of the invention is as follows: Resting either leg upon the initial point, and holding the instrument plumb, laterally considered, and in the direction of the objective point, let the other leg fall upon the ground.

Then note the position of the pendulum. The difference of level between the positions of the feet of the legs, and also the horizontal distance between them, is determined by a reference to the semicircle H; and in the following manner: The position of the hair-line O is noted in the I, or sine, series. The number covered denotes the actual difference in level between the feet of the two legs. Its position in the J, or cosine, series denotes the actual horizontal distance between the feet of the legs. The other, lower, series—viz., K and L—are used when the span of the instrument is opened to a distance of fifteen feet. In the event it is desired to measure a fractional distance or portion of a span, the procedure is as follows: From the last station before reaching the objective point, and also from the objective point, describe with the legs of the instrument, either to the right or to the left, intersecting arcs. From the point of intersection determine with the instrument the levels of the first two mentioned points, compared with the said point of intersection. The difference in these two levels is the difference in level between the objective point and the last station before the objective point. Having ascertained the difference in level, the horizontal distance is de-

termined as follows: The square P is slipped on the main brace until over the final point, one leg of the instrument resting on the last station before the final point. The square is then adjusted vertically, so as to bring the point of the main brace where it is fastened the same distance above the ground, or final point, that the main brace is above the end of the leg. Then as the difference in level of the two legs is to the horizontal distance between them, so is the difference in level between the final point and the last station before the final point to the answer.

The extensions $c c^1$ can be used in measuring distances slightly greater than the span of instrument.

Having described my invention, what I claim is—

The hereinbefore-described instrument, consisting of the head B, legs A A', main brace C, semicircle H, pendulum M, and square P, all constructed, arranged, and operating substantially as described.

In testimony whereof I have hereunto set my hand.

Witnesses:

JOHN L. BOGY.

CHAS. D. MOODY,

FREDK. LEAR.