2 Sheets—Sheet 1.

J. CLARK.

Leveling-Instrument.

No. 218,710. Patented Aug. 19, 1879.

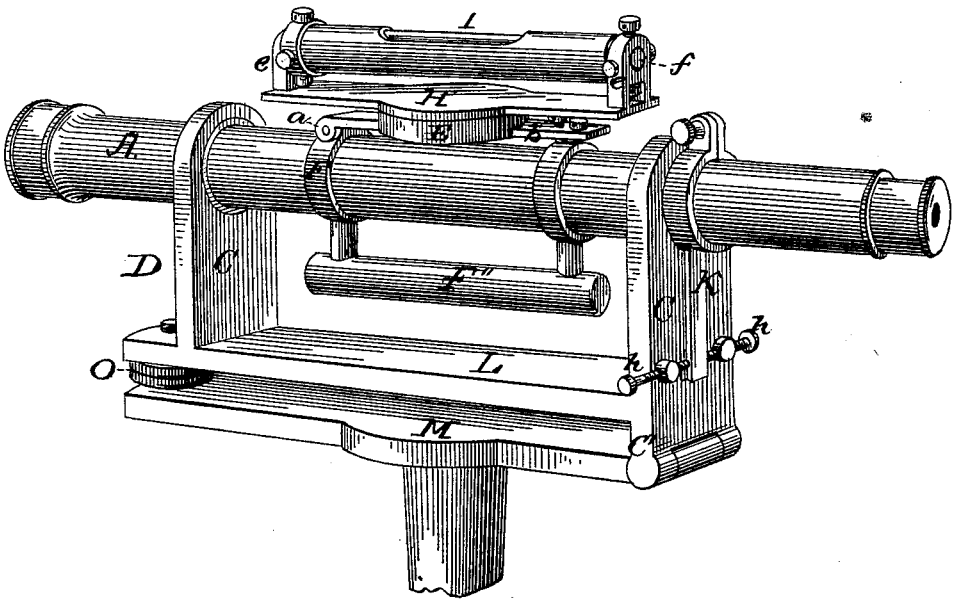

Fig. 1.

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Fig. 2.

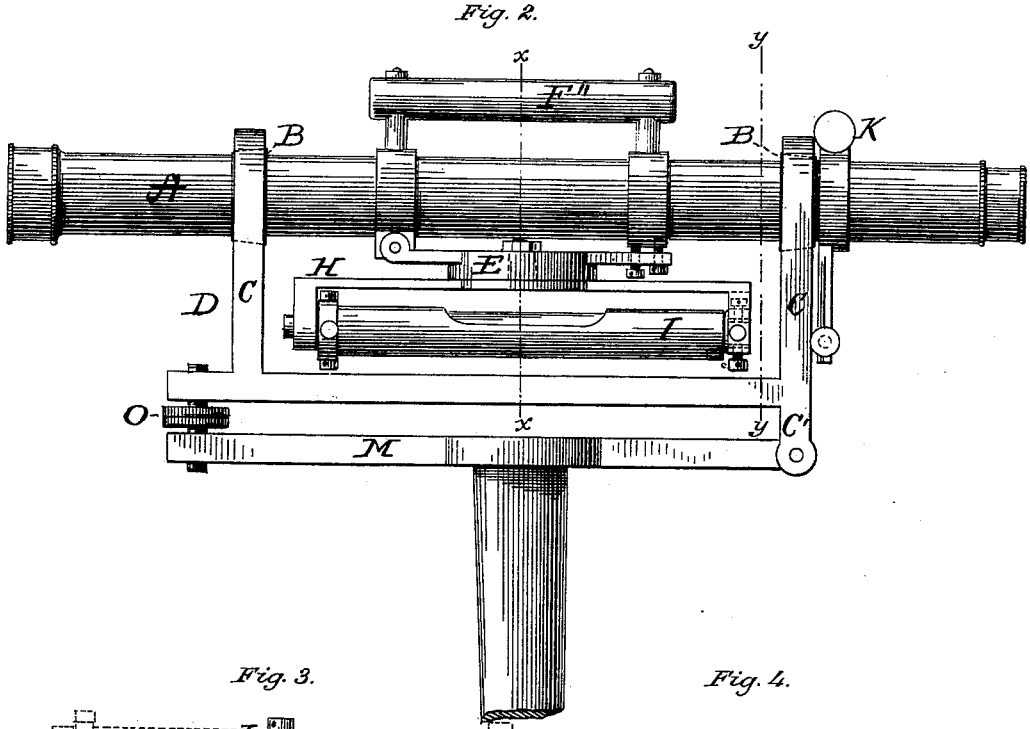


Fig. 3.

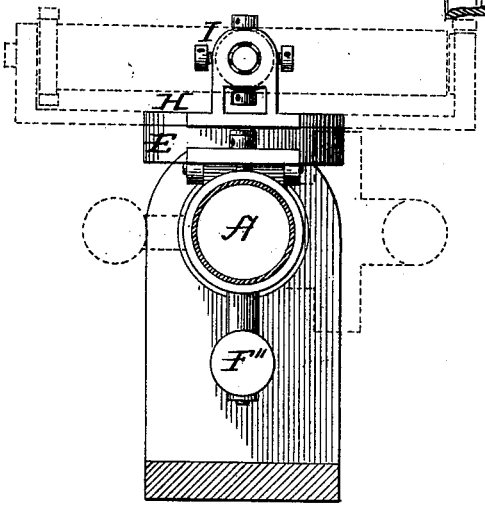
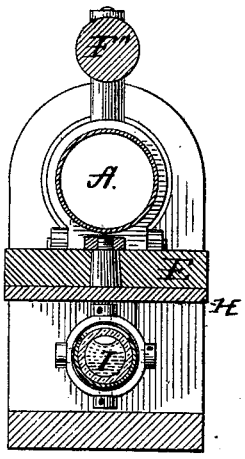


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOHN CLARK, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN LEVELING-INSTRUMENTS.

Specification forming part of Letters Patent No. **218,710**, dated August 19, 1879; application filed July 10, 1879.

To all whom it may concern:

Be it known that I, JOHN CLARK, of Washington, in the county of Washington and District of Columbia, have invented a new and valuable Improvement in Leveling and other Instruments; 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, and to the letters and figures of reference marked thereon.

Figure 1 of the drawings is a representation of a perspective view of a leveling-instrument with my improvements applied. Fig. 2 is a side view of the same. Fig. 3 is a transverse sectional view taken through the line *y y* of Fig. 2. Fig. 4 is a transverse sectional view taken through the line *x x* of Fig. 2.

This invention relates to leveling and other instruments where it is necessary to determine the horizontality of an axis.

The method now in use of determining the horizontality of an axis, where accuracy is sought, is to turn two attached collars as nearly the same as possible, and rest them on prongs, technically called "Y's," and then apply a striding-level, resting on both collars at the same time, and, by alternately reversing the level and the collars end for end, to get the axis of the collars as nearly horizontal as possible.

It is well known to experts that this method is liable to inaccuracies arising from the collars being exposed to dust, abrasion, and imperfection of construction from the impossibility of making the collars absolutely of the same size, thus leaving corrections to be made for irregularities and differences in size of the collars and other causes. These inaccuracies and causes are not incident to my method.

Therefore, my invention consists, first, in attaching an adjustable reference-plate carrying a spirit-level to a telescope or an axis, which is intended to be turned on its axis when in a horizontal position, whereby, by turning said telescope or axis half-way round, said reference-plate may be turned face upward or face downward and tested and adjusted for horizontality in both directions; second, in the combination, with the reference-plate attached to a telescope, of a spirit-level which is capable of being made reversible and revoluble; third, in a clamping and adjusting device for holding the telescope in a desired position; fourth, in the method of determining the horizontality of an axis by moving a reference-plate carrying a spirit-level concentrically with the horizontal axis of the instrument; and, finally, in the novel combination and arrangement of parts, as will be hereinafter more fully set forth.

To those skilled in the art I will now describe my invention as applied to the determination of the horizontality of the telescope of a level of precision, reference being had to the annexed drawings, showing one practical way of carrying out the invention.

The letter A represents a telescope of a leveling-instrument, to which are attached two collars, B B, turning in sockets in the standards C of a frame, D, of any suitable construction.

The object of the collars in the standards is to permit the turning of the telescope for fixing the intersection of the cross-wires or spider-line in line of collimation.

The collars fixed to the telescope, working in sockets, having the advantage over the Y's in excluding the dust on the bearings, are not exposed to floating foreign substances in the air, and the collars need not be made of the same size, and, their peripheries being made tapering, are readily and easily, as well as tightly, fitted to their sockets in the standards.

The letter E represents a reference plate or platform attached to the telescope at one end through the instrumentality of a yoke, F, and pivotal screws or pivot *a*, forming a joint, and at the other end by counteracting adjusting screw or screws *b;* and centrally pivoted to the reference-plate E is a frame, H, carrying a spirit-level, having its vertical axis passing through the reference-plate and secured to the under side thereof by means of a washer and nut, *d*. The frame H is provided at its ends with vertical posts or supports *e*, each provided with a centering device, *f*. One of these centering devices (designated by the letter *f'*) is to be adjustable both vertically and horizontally by means of set-screws.

The spirit-level I has a center at each end. One of these centers, being adjustable, is adjusted to the supports *e*, having the centering devices, so that the centers of the supports shall fit the centers of the spirit-level in such a manner that the level shall revolve on its centers or axis, as may be required. Attached to the axis or telescope, and on the opposite of the reference-plate, is attached a counterpoise, F″, to balance the weight of the reference-plate and spirit-level.

At one end of the telescope is arranged a combined clamping and adjusting device, K, provided at its lower end with side adjusting-screws, *h h*, for the purpose of retaining the telescope in a fixed desired position. This clamping and adjusting device K is important in setting the telescope properly when the spirit-level is turned at right angles to the telescope, as shown by dotted lines in Fig. 3 of the drawings.

The standards C, carrying the instrument, are connected to the cross-bar L, and the cross-bar M is pivoted or hinged to the extended end C′ of the standard, and the free ends of the cross-bars are connected together by means of a differential screw, O, whereby they are brought together or separated for the purpose of adjusting the telescope at right angles to the vertical axis as found by the spirit-level.

All the adjusting-screws are provided with capstan-heads.

The mode of adjusting the instrument is by the following rule which I have adopted:

Let the telescope be turned until the reference-plate and spirit-level are above; then raise the frame carrying the instrument proper until the bubble of the spirit-level is in the center; then turn or reverse the frame H, carrying the spirit-level, end for end upon the reference-plate, and if the bubble does not remain in the center, then adjust one half of the difference by the set-screws attached directly to the spirit-level, and the other half by the differential screw, until the spirit-level will revolve and the bubble remain in the center while turned around horizontally on its axis; then the spirit-level is brought to the under side by revolving the telescope, and if the bubble should not be in the center, the frame is raised or lowered by the differential screw until the bubble is presented at the center; then the frame H is turned upon its axis end for end, and if the bubble does not now remain in the center, then adjust half of the difference by means of the set-screws attached directly to the post of the frame, and adjust by the differential screw until the bubble is in the center of the level. Repeat the operation above and below until the spirit-level is true to itself in both positions.

The spirit-level is presented on top or above with the bubble at the center; now turn the telescope on its axis until the spirit-level is below, and if the bubble should not be in the center, then adjust the reference-plate one half the difference, and the other half by the differential screw, until the bubble remains in the center. The telescope is again turned so as to present the spirit-level above, and if the bubble should not be in the middle, adjust one half on the reference-plate and the other half on the differential screw until the bubble is in the center. Repeat this operation of adjusting the reference-plate above and below until the bubble will remain in the center in both positions, thus causing the reference-plate to be parallel with the axis of the telescope, whereby the horizontality of the axis is accurately determined.

It will also be seen that the spirit-level moves concentrically with the telescope, whether the adjustment be above, below, or on opposite sides, and the spirit-level has a revolving motion in itself. This latter motion may be automatic, if deemed advisable, by weighting the lower portion of the spirit-level, so that it will automatically present the upper surface of the spirit-level and show the bubble.

I wish it distinctly understood that I claim the right to vary the construction and change the parts as circumstances may present themselves without departing from the spirit of the invention.

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

1. The combination of a telescope of a leveling-instrument, a reference-plate capable of being made horizontal and parallel with the axis of motion, and a reversible and revoluble spirit-level applied to the surface of the reference-plate, substantially as described, and for the purposes set forth.

2. An adjustable reference-plate attached to an axis, the surface of the plate to be tested in reversible positions upward and downward by means of a spirit-level, for the purpose of determining the horizontality of the axis of motion, substantially as described.

3. In combination with a telescope of a leveling-instrument, a reference-plate capable of being made horizontal and parallel with the axis of motion, and a frame carrying a spirit-level having its vertical axis passing through the reference-plate, substantially as and for the purpose set forth.

4. The combination of a telescope of a leveling-instrument, a reference-plate, a reversible and revoluble spirit-level, and a counterpoise, substantially as described, and for the purposes set forth.

5. The combination, with a telescope of a leveling-instrument, carrying a spirit-level working on a vertical axis, of a combined clamping and adjusting device, substantially as and for the purpose set forth.

6. The method of determining the horizontality of an axis, which consists in moving a reference-plate carrying a spirit-level concentrically with the horizontal axis of the instrument, substantially as set forth.

7. A spirit-level provided with adjustable centers, and connected to an axis by supports having centers, when used in connection with

a reference-plate, for the purpose of determining the horizontality of the axis by turning the spirit-level to reverse positions, substantially as set forth.

8. A telescope of a leveling-instrument carrying a reference-surface, having attached thereto two collars, in combination with standards having sockets adapted to receive the collars of the telescope, substantially as described.

In testimony whereof I have hereunto subscribed my name.

JOHN CLARK.

Witnesses:

J. TYLER POWELL,

T. D. D. OURAND.