(No Model.) 2 Sheets—Sheet 1.

C. W. STICKNEY.

SURVEYING INSTRUMENT.

No. 272,494. Patented Feb. 20, 1883.

Fig. 1.

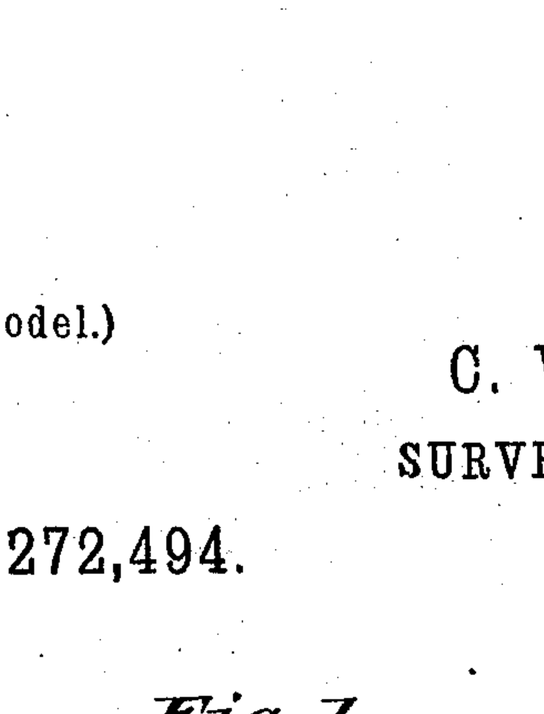


Fig. 2.

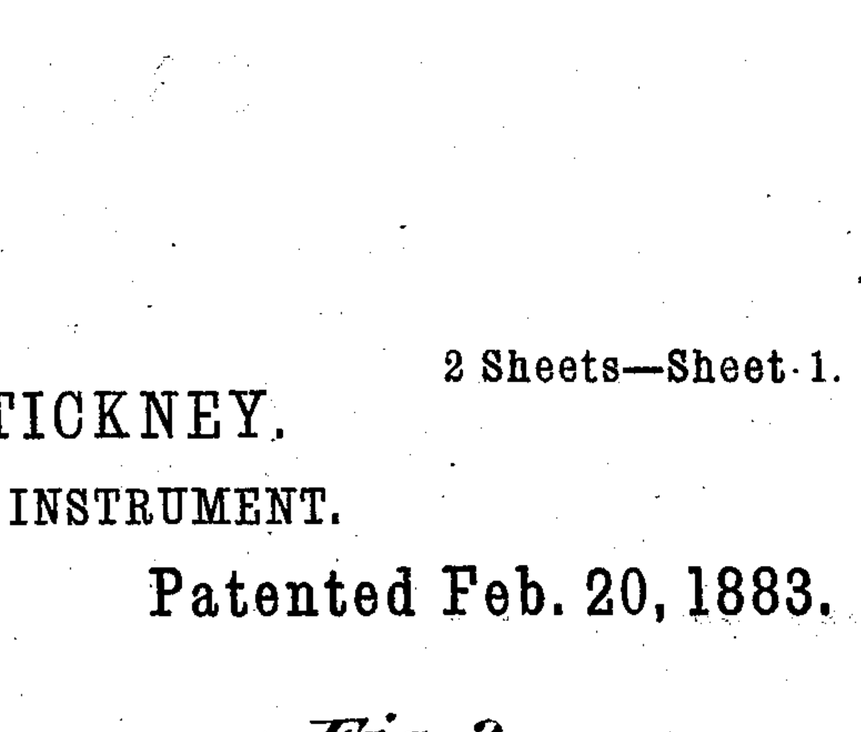


Fig. 3.

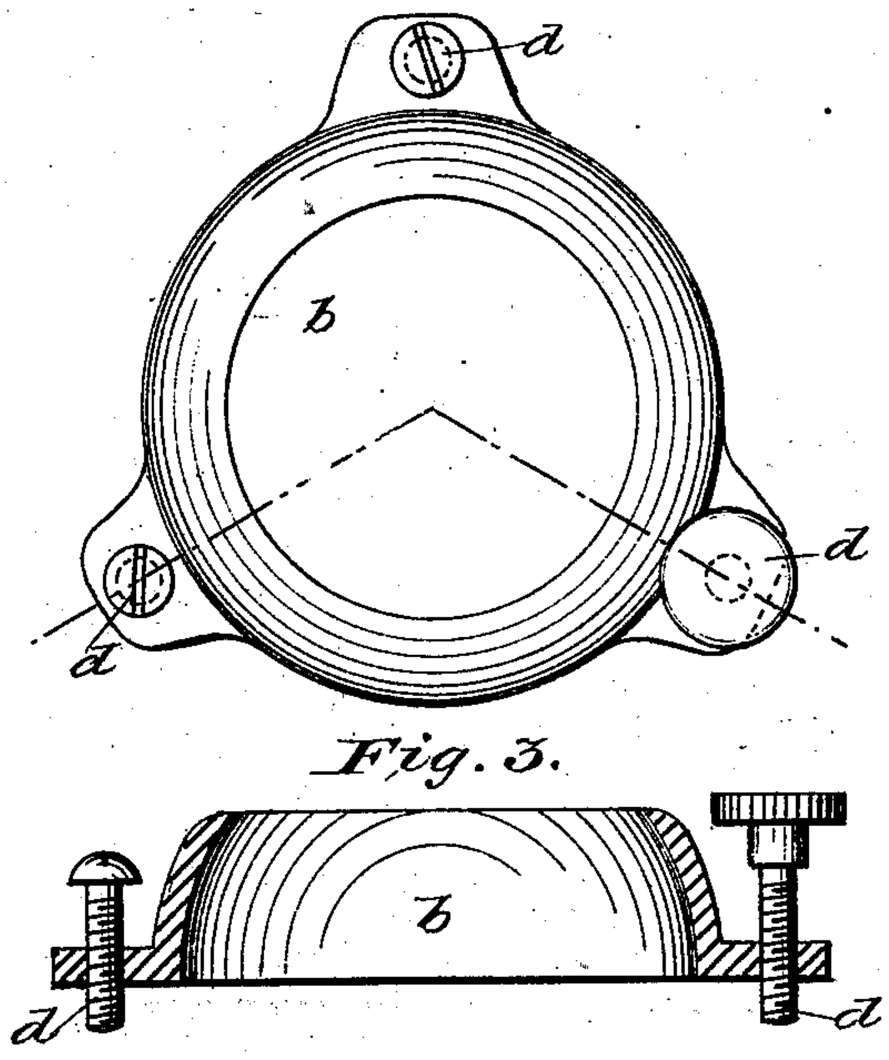


Fig. 6.

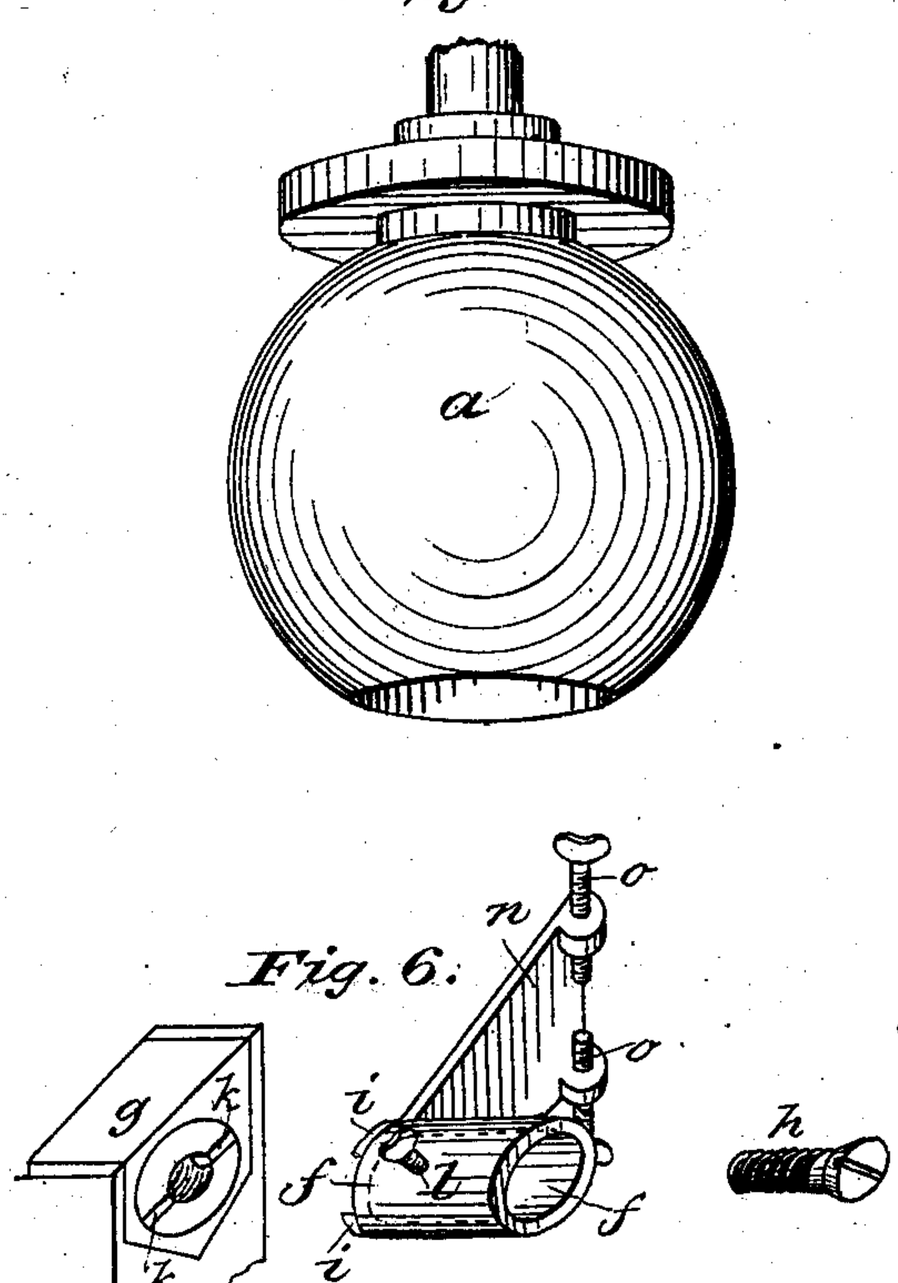


Fig. 9.

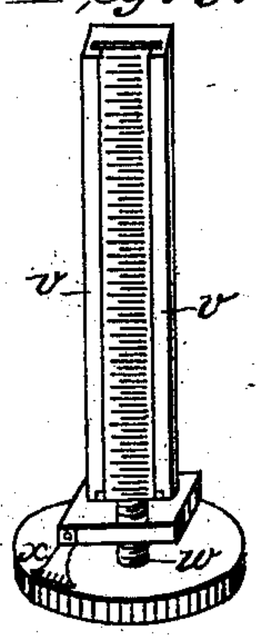


Fig. 7.

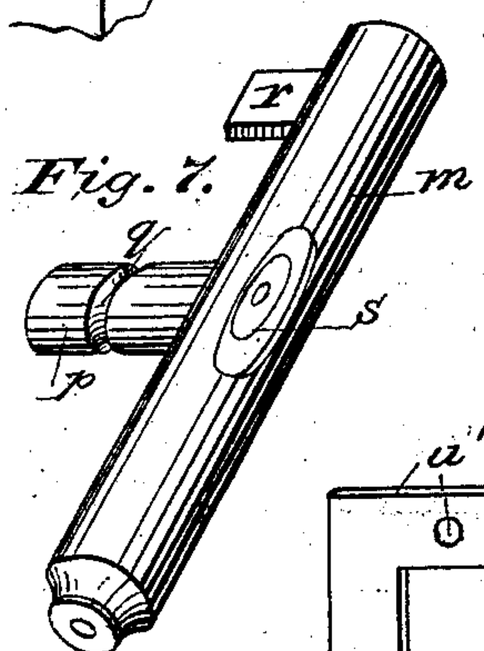


Fig. 8.

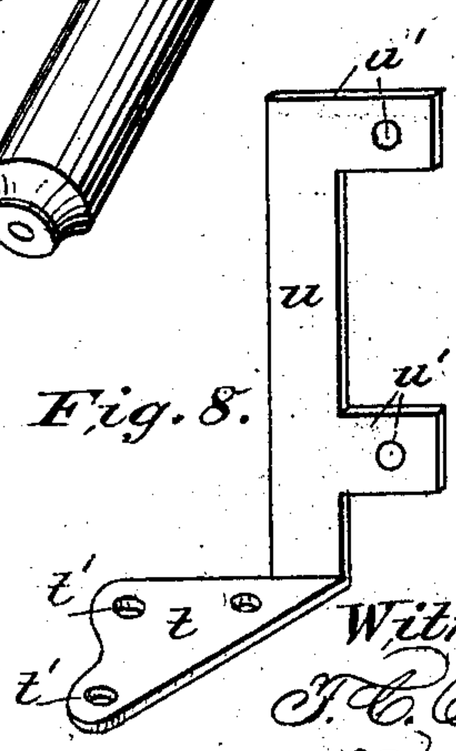


Fig. 4.

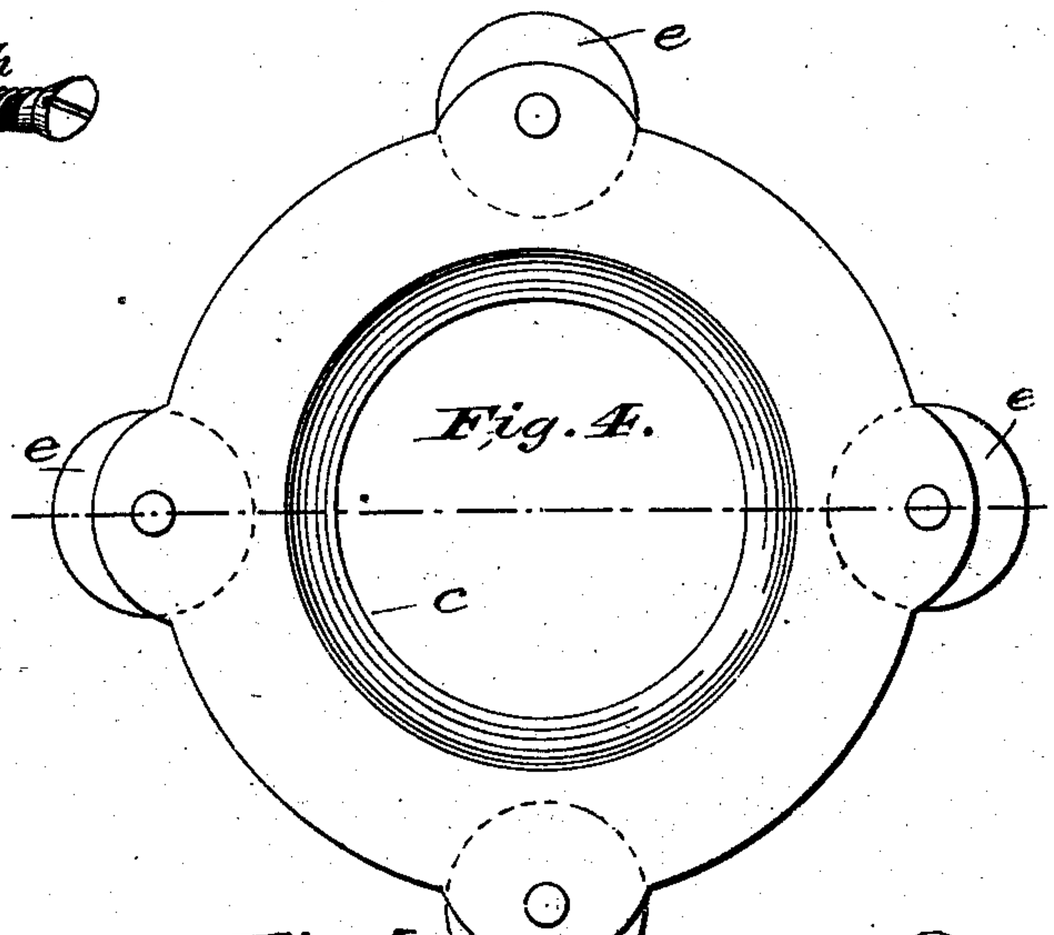
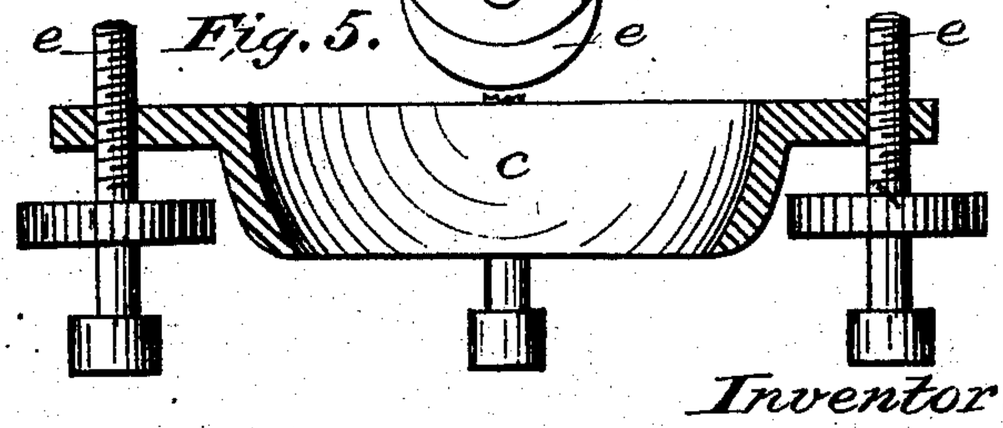


Fig. 5.



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Attorney.

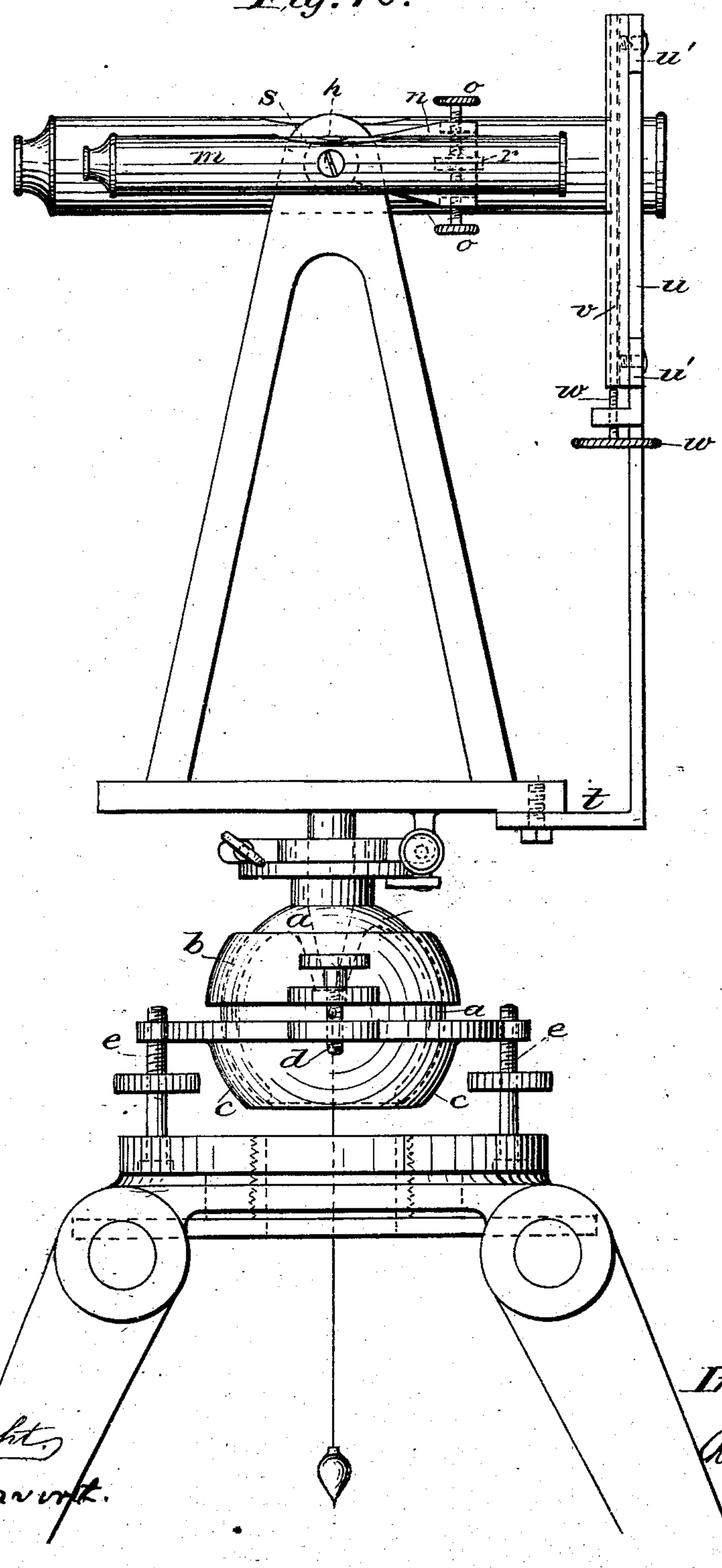
(No Model.) 2 Sheets—Sheet 2.

C. W. STICKNEY.

SURVEYING INSTRUMENT.

No. 272,494. Patented Feb. 20, 1883.

Fig. 10.



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Inventor:
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UNITED STATES PATENT OFFICE.

CHARLES W. STICKNEY, OF WASHINGTON, DISTRICT OF COLUMBIA.

SURVEYING-INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 272,494, dated February 20, 1883.

Application filed September 11, 1882. (No model.)

To all whom it may concern:

Be it known that I, CHARLES W. STICKNEY, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Surveying-Instruments, not hitherto known, invented, patented, or used in any country, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention consists of several attachments to an ordinary theodolite or level, and their combination with each other, or with unpatented features of ordinary surveying-instruments, all said attachments or combinations necessary to produce one result, the object of my invention. The object is to enable a surveyor the more easily to run lines of definite length over ground where the declivities and unevenness are so great that the instrument cannot readily be leveled and the chaining is impracticable or inaccurate, as in surveying mining claims in the Rocky Mountains.

I am aware that the ball-and-socket joint is old, and that a telescope, microscope, scale, micrometer, and vernier, in various combinations, have been tried many years in foreign countries, and are not now patentable in this.

The novelty of my invention consists in the peculiar construction of the ball and socket; in the method of attaching a microscope to a telescope, and the means for bringing them into the same horizontal plane of vision; in the method of attaching a microscopic scale with micrometer-screw and vernier to the base-plate of an ordinary instrument. The pieces and their combination by which these methods are rendered effective are novel, and are effective to adapt ordinary instruments to the object stated.

In the drawings, Figure 1 represents the ball; Figs. 2, 3, 4, 5 show the socket constructed of an upper and a lower jacket, to clasp the ball when clamped by the three screws. Fig. 6 shows the microscope-socket to be attached to the end of the axis of the telescope, with arm and screws for adjusting the microscope. Fig. 7 shows the microscope, with its cylindrical projection to fit the socket, and its level and adjustment-flange. Fig. 8 shows the scale-arm adapted for screwing to the base-plate or dial-plate of instrument, and to which arm is screwed (Fig. 9) the scale, micrometer-screw, and vernier. Fig. 10 shows an ordinary theodolite with the attachments as herein described and the combinations claimed.

Construction.—I make an ordinary theodolite; but it differs in this, that the ball *a* is made very large and hollow, and a hole is left in the lower portion of circumference that the plumb-line may be fastened at its center. The socket is made in two jackets, *b* and *c*. The upper jacket carries three screws, *d*, for clamping to the lower. The lower carries three or more screws, *e*, for the final adjustment, as does the upper parallel plate of ordinary instruments. The jackets are constructed so that they cannot quite meet, but when screwed together pinch the ball and hold it firmly in any desired position. I attach a socket, *f*, to the end of the telescope-axis *g*. This is a cup-shaped piece, having a hole in the center of its bottom to let a screw, *h*, through into the axis end *g*, and two projections, *i*, to fit into notches or holes *k* in the axis to prevent its turning, and a set-screw, *l*, to secure the microscope *m*. It has an arm projecting from one side, *n*, which carries two screws, *o*, to adjust the line of sight of the microscope parallel to that of the telescope by aid of their respective levels. I make a microscope (Fig. 7) having a cylindrical projection, *p*, on the center of one side to fit into the socket *f*, in which is a groove, *q*, to receive the securing-screw *l*, and a flange, (or flat projection,) *r*, on the same side to engage the adjustment-screws *o o*, and a level, *s*, on top. I make a scale-arm, Fig. 8, (or bracket,) having its horizontal projection *t* exactly at right angles to its upright *u*, with screw-holes *t'* and *w'*, for attaching horizontal limb to the base-plate of instrument and its upright limb to the scale. I make a microscopic scale, Fig. 9, sliding in a case, *v*, with a micrometer-screw, *w*, for sliding it, and a vernier, *x*, for finding the fractional parts of the screw-head.

To apply the parts to an ordinary theodolite, substitute the hollow ball for the solid one, and the two jackets for the upper plate of the two parallel plates, tap the end of the axis of the telescope, and cut a groove across its face. In the last, place the projections of the micro-

scope-socket, and pass a screw through the hole into the axis. Place the cylindrical projection of the microscope into the microscope-socket and secure it by the screw. Screw the scale-arm to the base-plate and the scale to the arm, so that the scale stands up before the microscope.

Purpose of essential parts.—First, the hollow ball and jackets are to readily bring the base-plate to the horizontal, in whatever position the nature of the ground may necessitate placing the tripod-legs; also, in connection with the ordinary level and vertical arc, to bring the base-plate, and consequently the attached scale, to a known incline, when a horizontal position of base-plate, while sighting a high elevation, would bring the microscope too far from the scale to get a focus on it. No American or foreign device has ever before been invented for, or which would be effective for, this purpose. Second, the hole, screw-thread, and screw in end of telescope-axis are to connect same with the microscope-socket. Third, the microscope-socket, cylindrical projection, and flange, with their respective screws *l* and *h*, are to properly connect the telescope and microscope and to regulate their parallelism. Fourth, the level on the microscope is to determine when its line of sight is parallel with that of the telescope. Fifth, the scale-arm is to erect the scale at right angles to the base-plate.

Use of the theodolite with my attachments.—It is proposed to set out a piece of ground so full of chasms, declivities, crags, and woods as to be practically unmeasurable with any accuracy by chain. The tripod-legs are set anyhow, the instrument approximately leveled by means of the hollow ball and jackets, and the final adjustment made with the usual screws. The telescope is directed to a convenient accessible point on the line to be run and the staff sent to it. Telescope is leveled by its own level and screw. The microscope is then brought into the same plane by its own level and screw and the mark of the scale on its cross-hair read. If the cross-hair is not directly on a mark, it is brought to the nearest by sliding the scale with the micrometer-screw, and the result set down in micrometric numbers, by which is meant the smallest fractions of the scale which can be determined by the micrometer-screw and its vernier. These smallest fractions are treated as units, and all scale-numbers are reduced to their equivalents in micrometric units, and the micrometer corrections added or subtracted, according as the scale is moved forward or backward by the screw. The staff, held perpendicular, (or sometimes at an incline, previously determined on by the surveyor, who regulates his base-plate to the same incline by means of the hollow ball and jackets,) is sighted, and the cross-hair of telescope placed on its lower mark, the scale-figure reduced to micrometric units and corrected by the micrometer, as before, is recorded. The like is done with the upper mark. By previous experiment similarly conducted with known measurements on level ground the distance from the axis of the telescope to the upright scale has been found in micrometric units. The problem is then one of similar triangles, two quantities in micrometric numbers being known, and one the length of staff in feet. With these three quantities the large triangle whose hypotenuse is the direct distance, and whose base is the horizontal distance from instrument to staff, is solved by the familiar rule of three proportionals.

I am aware that ball-and-socket joints in surveying-instruments are old; but I am not aware that a hollow ball has ever been used. I am aware that universal joints have been constructed using a ball and two jackets, as in Bruno's United States Patent, No. 85,787, Wheeler's, No. 79,168, and Troxel's, No. 137,578. I do not claim these; but

I claim—

1. In an instrument used for surveying, the ball-and-socket joint composed of a hollow sphere and two jackets, in combination with the leveling-screws, substantially as and for the purpose described.

2. In a surveying-instrument, the level on the microscope, in combination with the telescope and its level, substantially as and for the purpose described.

3. The combination of the telescope of a surveying-instrument and a microscope joined to the telescope-trunnion by means of a cylindrical projection on one adapted to fit into a socket on the other, substantially as described.

4. The scale-arm, in combination with the scale, micrometer, and base-plate of a surveying-instrument, substantially as and for the purpose set forth.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES W. STICKNEY.

Witnesses:

LLOYD F. KELEHER,

C. C. PUFFER.