(No Model.)

J. PAOLI.

ENGINEER'S TRANSIT.

No. 453,158. Patented May 26, 1891.

Fig: 1.

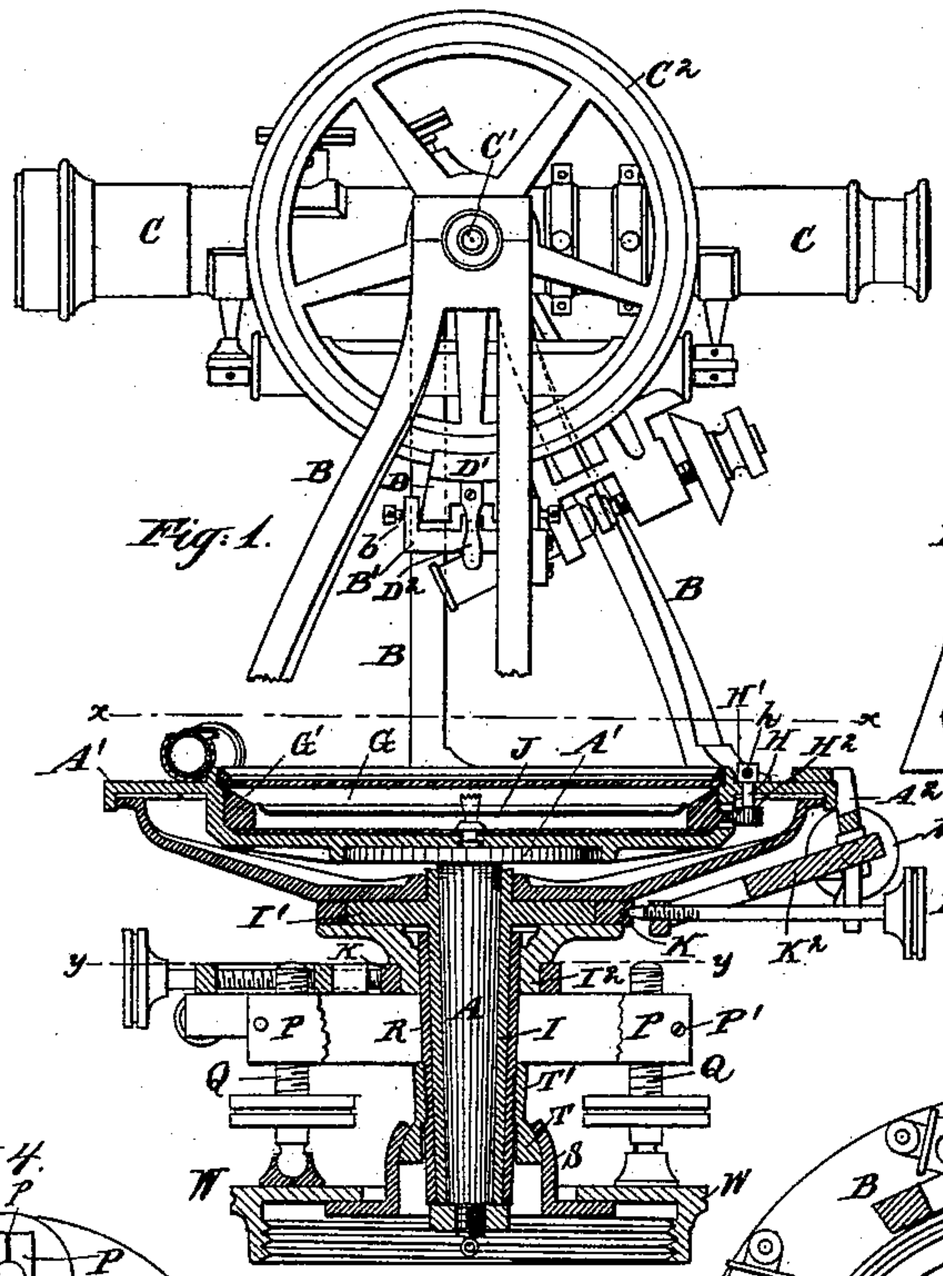


Fig: 2.

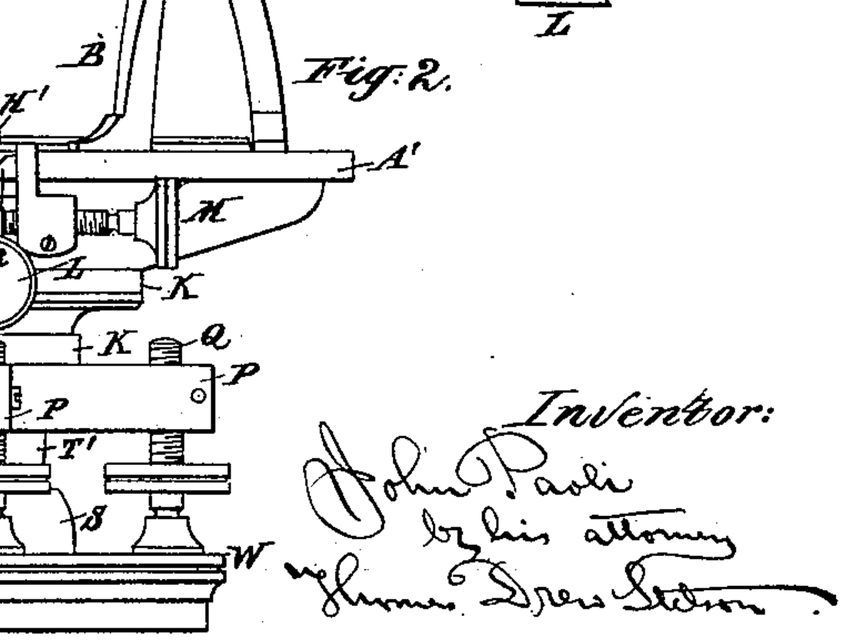


Fig: 3.

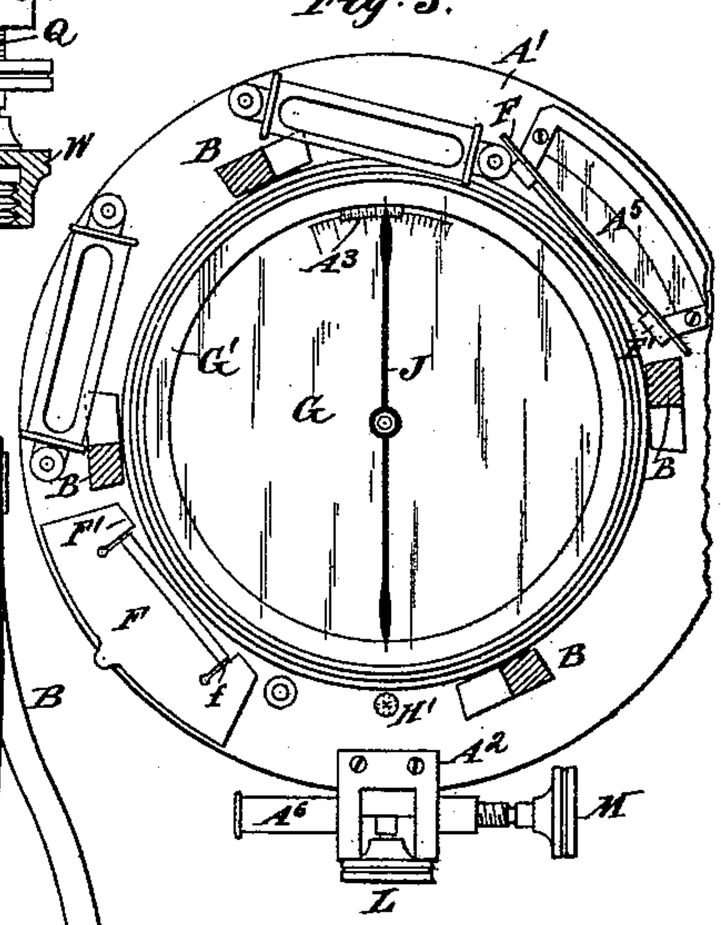


Fig: 4.

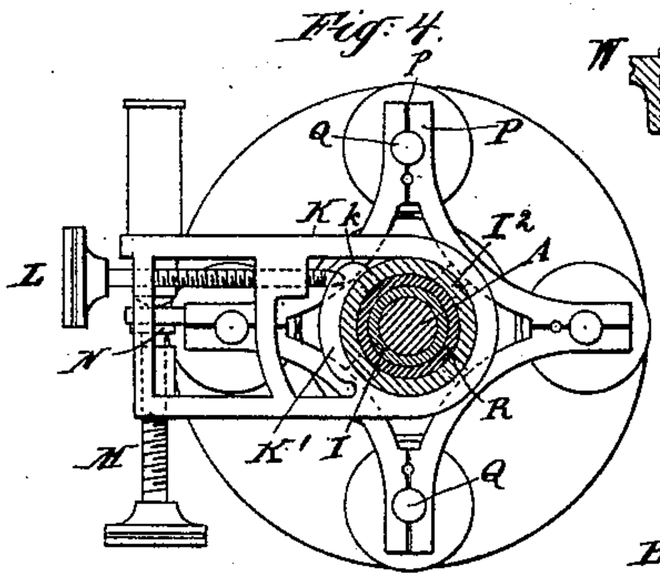


Fig: 5.

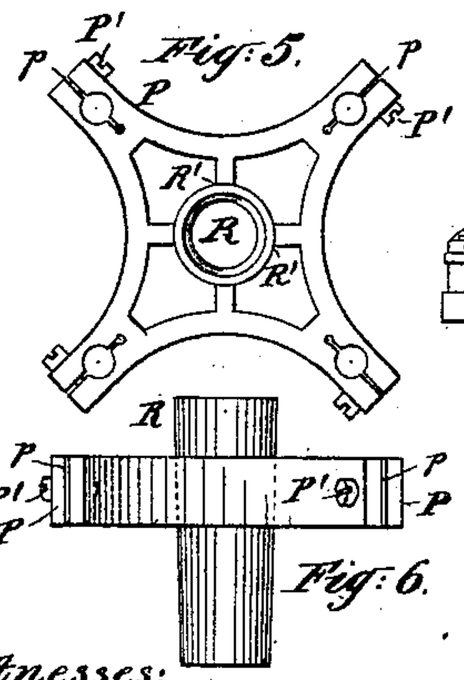
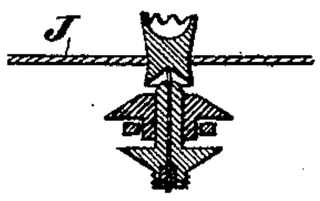


Fig: 6.

Fig: 7.



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UNITED STATES PATENT OFFICE.

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ENGINEER'S TRANSIT.

SPECIFICATION forming part of Letters Patent No. 453,158, dated May 26, 1891.

Application filed April 8, 1890. Serial No. 347,097. (No model.)

To all whom it may concern:

Be it known that I, JOHN PAOLI, a subject of the King of Italy, residing in Hoboken, in the county of Hudson and State of New Jersey, have invented a certain new and useful Improvement in Engineers' Transits, of which the following is a specification.

The elaborate instruments known as "transits," each embodying the capacity of several minor instruments, are in running lines and measuring angles transported on the shoulders of the engineer or of an assistant, and are set up and adjusted and again taken up and retransported at short intervals.

My improvement facilitates the transportation by its lightness, facilitates the rapid and correct setting up and the reading of the indications on the verniers, and contributes to enable the exact and delicate construction to withstand rough usage. I curve the standards which support the bearings of the telescope and complete the form by twisting. The form of the standard affords a wide base with both feet standing on the top plate close to the compass-ring, which may be a thick portion of said plate. The compass is sunk below the upper surface of the top plate, and the graduated rim of same is beveled toward the center. The needle is bent upward at each extremity. This allows the point of the needle to read directly into the lines, even when the needle is not perfectly balanced. The needle is heavier near the points than in the center, which makes it unusually sensitive, while holding the magnetism better than the ordinary shape. I employ two verniers, mounted on opposite sides of the horizontal circle, as usual, and provide each with a cover held by a spring. The cover is finished with a dead-white reflecting-surface, and is adapted to perform the three functions of throwing the light favorably on the graduations, shading the vernier when required under some conditions, and of being closed entirely down, so as to serve as a protection for the vernier-glass. I employ the ordinary spherical base for the outer sleeve; but instead of mounting it directly on the sleeve I connect it by an extra sleeve, which stands a little exterior to the main sleeve, being firmly connected at a higher point near the leveling-arms. The construction allows the instrument to be roughly treated without injury, the shocks being softened by the elastic springing of my extra sleeve. If extreme violence, as the falling of the instrument, shall induce a permanent set in my sleeve, the sleeve saves the true sleeve from distortion. I provide unusually long leverage and attain more accurate setting than usual for the variation-plate. The pinion which works this plate is set under the plate, so as to aid in defending against dust and dirt getting into this part of the instrument. The arms which receive the leveling-screws are split and receive those screws in adjustable holes, which allow the friction to be made uniform under all conditions of wear. The arms are peculiarly formed, and are joined to the sleeve not opposite to the arms, but intermediate between them. This divides the force when an arm is overstrained and avoids injuring the central point.

The accompanying drawings form a part of this specification and represent what I consider the best means of carrying out the invention.

Figure 1 is a central vertical section, partly in side elevation. Fig. 2 is an elevation quartering to the view in Fig. 1. Fig. 3 is a horizontal section on the line $x\,x$ in Fig. 1. Fig. 4 is a horizontal section on the line $y\,y$ in Fig. 1. Figs. 5 and 6 represent a portion detached. Fig. 5 is a plan view, and Fig. 6 an elevation. Fig. 7 is a vertical section of a portion on a larger scale, showing the center of the needle. Fig. 8 is an elevation on the same scale as Fig. 1, showing a modification of the form of the twisted standards.

Similar letters of reference indicate like parts in all the figures where they appear.

A is the inner center, and A′ the extended top thereof, which I will term the "top plate," and which, like the center, is of the ordinary construction, except as hereinafter stated, and performs, as usual, the important function of supporting the standards B, which carry the telescope C and its attachments.

C^2 is the vertical circle carried on the shaft C′. The graduations are made on a surface of silver or other fine metal, and not on the periphery, but on the outer face, of this circle.

D is a rocking piece carrying a vernier-scale D′, which latter reads in conjunction with the circle C^2. It is mounted between pivots *b*, set in brackets in a cross-piece B′, firmly fixed to one of the peculiarly-bent standards B. A spring E acts on the lever D^2, rigidly fixed to the piece D, and urges the edge of the vernier D′ gently against the graduations on C^2. In case of accident in the field or from any other cause, throwing the circle C^2 slightly out of truth, the spring E allows the vernier to yield, so as to accommodate the distortion. The pressure induced by the spring is slight, and the friction may be endured by the finely-graduated surfaces for a long period; but it is preferable that the operator shall touch the lever D^2 and spring the vernier away from the circle whenever the elevation of the telescope is to be much changed.

The triangular standards B are sufficiently spread at the bottom to afford a reliable support. One branch or leg is nearly vertical. The other branch or leg is inclined beyond the ordinary extent and is twisted, as shown. The feet or elongations at the base of each leg are planted on the inner and stout portion of the top plate A′ immediately adjacent to the compass and arranged circumferentially thereto. I have in my experiments produced these standards by casting and afterward twisting the legs to the required form. This mode of manufacture changes the arrangement of the particles and imparts firmness and rigidity to the standards. The form gives a clear space for the vernier at about forty-five dgrees relatively to the telescope in a position where it can be easily inspected.

The operator can examine the proper vernier A^5 without changing his position but little, if at all, from that required to look through the telescope. There are, as usual, two verniers A^5 on opposite sides of the instrument. Each vernier has a cover F turning on an axis *f* and provided with friction-springs F′, which press on the supports of the axis, making sufficient friction to reliably hold the cover at any angle in which it may be set. The cover thus equipped serves as a protection for the vernier when closed as a shade, if such shall sometimes be required, and as a reflector to reflect a mild and clear light upon the vernier. The under face is of celluloid or analogous dead-white material. The compass G is sunk in the top plate A′ and has a beveled rim G′, in which the divisions are engraved. The needle J is hung with the usual provisions for lifting and clamping when not in use. It is made light near the mid-length, heavy near each end, and again light at the extreme ends. The ends are bent upward, so as to approximately coincide with the beveled rim G′ and allow the position of the needle to be accurately read thereon. The compass G G′ is adjusted or partially revolved relatively to the top plate A′ by a pinion H^2, which is sunk below the upper surface of the top plate. The shaft H of this pinion extends above the top plate, and its small head H′ is provided with holes *h*, adapted to receive the removable lever, by which it may be turned when rquired, the lever being then immediately removed. The construction protects the pinion and the teeth with which it engages from dust and injury, and the small head H′, with the holes *h*, avoids a frequent source of error, due to the accidental hitting and changing of the large head or button necessary with the ordinary construction.

I is the nicely-finished intermediate sleeve, sometimes known as the "outer center." It is fitted around the inner center A and carries the important part, usually known as the "horizontal limb," which I make as a substantial casting. The graduations are made on silver or other white material firmly fixed on its upper face.

Collars I′ and I^2 receive each a clamp K. The connection in each of these cases is of the ordinary general character, the slow-motion screw M and the upper clamp taking hold by the bracket A^2 on the alidade or the parts mounted on the inner center, the lower clamp taking hold of the leveling-arms, which are fixed. These clamps perform their ordinary functions, the lowermost connecting the limb at will with the fixed foundation and the uppermost connecting the limb at will with the telescope, both being equipped with provisions for very delicately turning to small extents after the parts are firmly clamped. These clamps are peculiarly equipped to avoid lost motion. Each is constructed as a single casting, the part K′, which is to serve as the bearing-block, being formed integral with the main part of the clamp, but with a space at its back. It is adapted to be sprung slightly inward by the pressure of the corresponding clamping-screw L when required, and then to be stiffly clamped upon the inclosed collar.

In the manufacture of each clamp the inner edge or circular bearing-surface which applies on the corresponding collar I′ or I^2 is accurately bored while in the rigid condition. A radial saw-cut *k* may be made so as to more nearly isolate it.

The junction of the bearing-piece K′ to the clamp is reduced by mechanically removing some of the metal, as indicated, near one end or near each end, to enable it to better yield inward to a sufficient pressure impressed by the clamping-screw. This construction avoids all lost motion in the clamping-piece. The lower clamp has all these features. The greater size of the upper collar and the upper clamp allows sufficient spring in the bearing-block while it remains attached to the main body of the clamp at each end. The sawing at *k* is therefore omitted in the upper clamp. The slow-motion screws M act against shoes N of ivory. The upper clamp is formed with an arm K^2, which is seized between such shoe

and the spring carried in a proper case A^6 on the alidade. The lower clamp carries on itself an adjusting-screw and spring and takes hold of an arm or finger extending from one of the leveling-arms. The effect of each is the same.

The leveling-arms P each receive the corresponding leveling-screw Q in a threaded hole. A split *p*, produced by sawing with a fine saw, allows this portion of the arm to spring slightly, and a screw P′ adjusts the amount of opening of this split. The metal will yield elastically sufficient to allow the split to open and close, so that the contact of the arm P with the corresponding leveling-screw Q may be made just sufficiently frictional for an indefinite period. The leveling-arms P are of more than the usual depth and are joined to the sleeve R at the points R′. These points are not radially within the several arms, but within the spaces between the arms. Each arm is made open, as shown. The construction is light and strong. In case one of the leveling-arms is overstrained it may be permanently set; but the distribution of the points of union to the sleeve R avoids any risk of distorting the latter, and consequently of possibly injuring the delicate centers A and I within.

I provide for the ordinary horizontal movement of the instrument upon the bottom plate W, employing the usual partially-spherical bearing T, mounted within the semi-spherical case S, with the usual liberty to rock as far as ever shall be required in practice by the rolling of the part T within the part S, and with the usual liberty to adjust in all directions horizontally by the movement of the parts S upon the fixed bottom plate W; but instead of mounting the partial sphere T directly on the sleeve R, I attach it by a false sleeve T′, which is larger than the exterior of R, so that there is a slight annular space between.

The capacity of the false sleeve to spring and bend allows the instrument to endure rough usage without injuring the centers—that is to say, a sufficiently violent blow may change the position of the spherical bearing to one side or the other of the proper axial line, the false sleeve T′ yielding to allow such distortion, while the true sleeve R will remain unaffected. The false sleeve is connected to the true sleeve by screw-threads and may be removed for repairs or renewal.

Modifications may be made without departing from the principle or sacrificing the advantages of the invention. I can cast the standards flat and afterward bend and twist both legs. I prefer to cast the most upright leg in the curved form required and to cast the other and more inclined leg with the proper degree of curvature, but without being twisted. Then the considerable twist required being forcibly impressed with the metal cold or nearly cold, the best condition of the particles is obtained.

The leveling-screws Q may have the ordinary caps or shields. (Not shown.) Parts of the invention may be used without the other. I can use the vernier-covers F with the proper reflective under surfaces and the provisions for holding them at various angles without the peculiar standards.

In the modification shown in Fig. 8 the standard has both legs inclined and both twisted. I prefer the form shown in Fig. 1.

I do not in this patent claim the peculiarities at the mid-height of the instrument, the shades with provisions for holding them in various positions relatively to the horizontal verniers, the compass sunk and beveled and the needle therein, and the variation-plate and means for operating it, such being made the subject of a separate application for patent as a division marked B, filed September 20, 1890, Serial No. 364,610. Neither do I in this patent claim the peculiarities in the base of the instrument—the leveling-arms, with their mode of taking hold of the instrument, the false sleeve, and the spherical bearing—such being made the subject of a separate application as a division marked C, filed September 20, 1890, Serial No. 365,610.

I claim as my invention—

1. In a transit or analogous instrument, the standards B, cast with the proper dimensions, but false form, and afterward twisted to the correct form, so as to hold the particles in a strained condition, substantially as herein specified.

2. In a transit or analogous instrument, the standards B, formed each with one leg more inclined than the other and bent as shown, bolted upon the stout inner portion of the top plate A′, in combination therewith and with verniers A^5, arranged adjacent to the upright leg of the standard and with the telescope C, as herein specified.

3. In a transit or analogous instrument, the combination, with the vertical circle C^2, of the rocking piece D, carrying the vernier D′ and lever D^2, and with the spring E, arranged for joint operation as herein specified.

4. In a transit or analogous instrument, the combination of the sleeve or outer center I and a collar I′ thereon with a clamp K, having a bearing-block K′ formed integral therewith and with the operating-screw L, and provisions, as M M′, for fine adjustment of the clamp, all arranged for joint operation substantially as herein specified.

In testimony whereof I have hereunto set my hand, at New York city, this 1st day of April, 1890, in the presence of two subscribing witnesses.

JOHN PAOLI.

Witnesses:
CHARLES R. SEARLE,
CHAS. S. BARBER.