No. 800,590. PATENTED SEPT. 26, 1905.

J. MORRIS.

ALTOMETER AND LEVEL.

APPLICATION FILED MAY 1, 1905.

2 SHEETS—SHEET 1.

Fig. 1

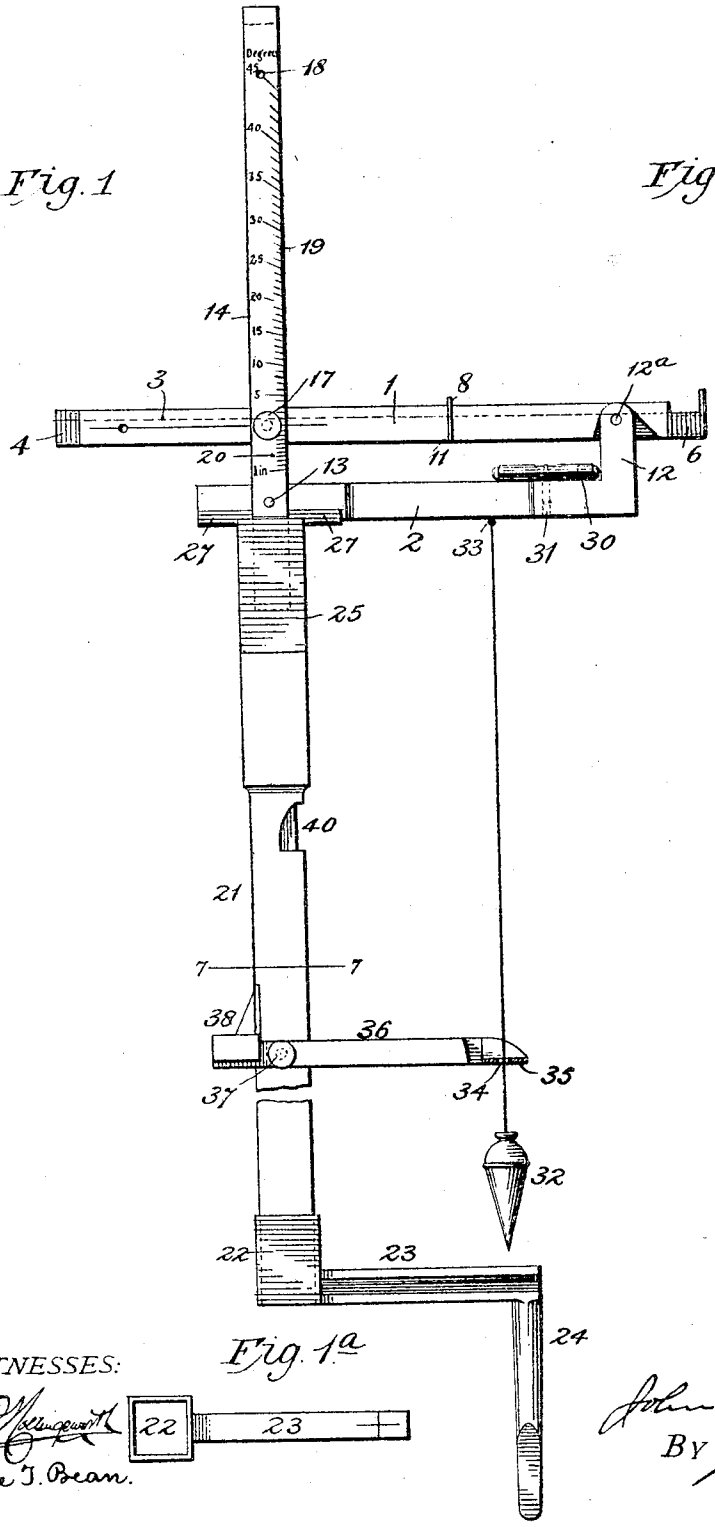


Fig. 2

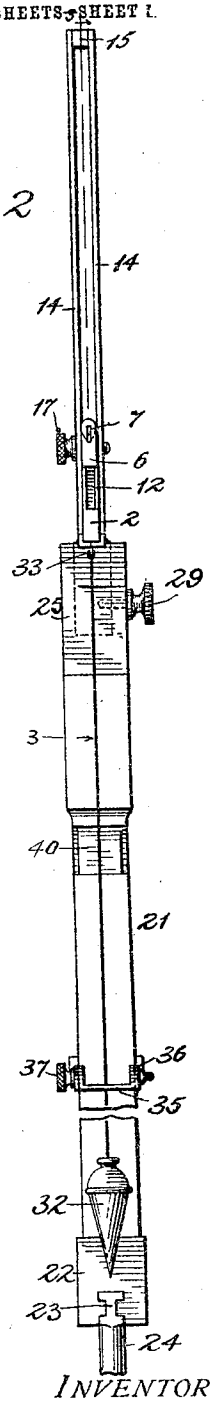


Fig. 1a

WITNESSES:

George T. Bean.

INVENTOR

John Morris,

By [illegible]

Attorney

No. 800,590. PATENTED SEPT. 26, 1905.

J. MORRIS.

ALTOMETER AND LEVEL.

APPLICATION FILED MAY 1, 1905.

2 SHEETS—SHEET 2.

Fig. 3.

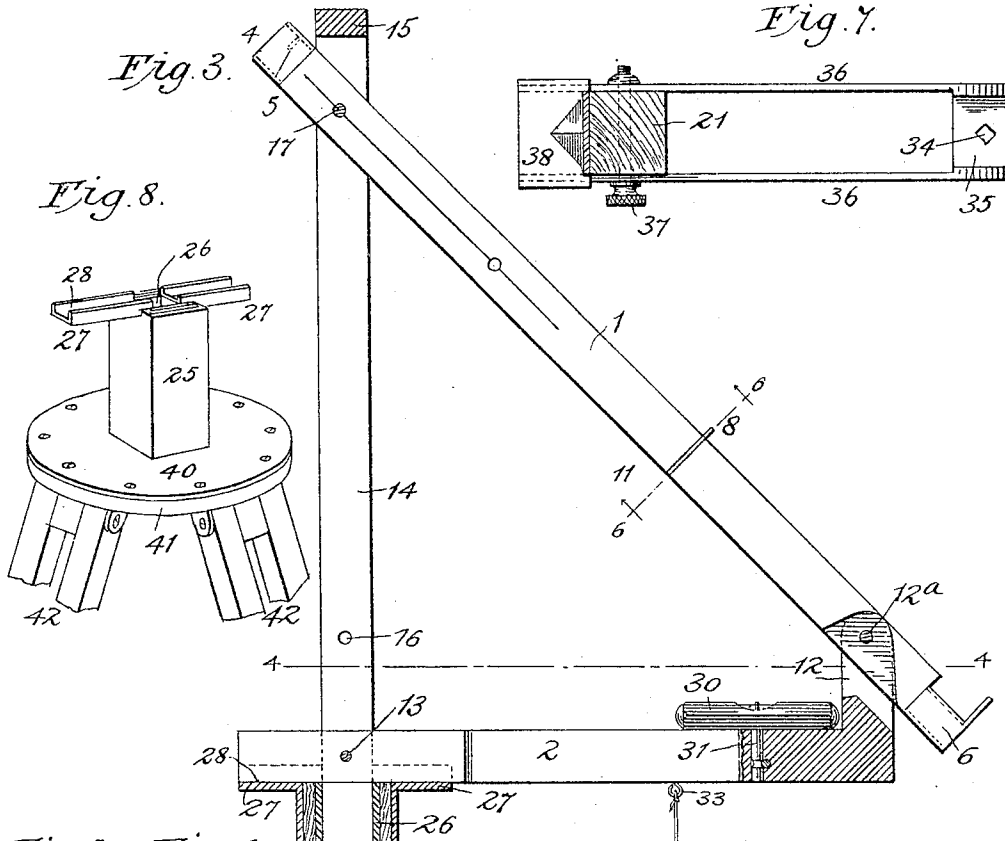


Fig. 7.

Fig. 8.

Fig. 5.

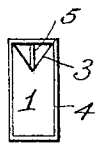


Fig. 6.

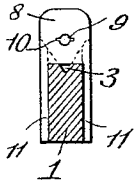


Fig. 4.

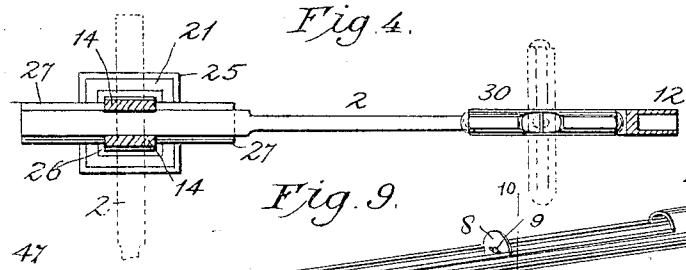


Fig. 9.

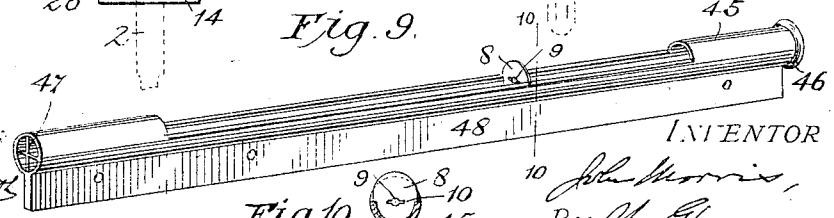
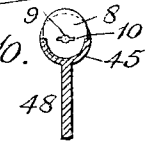


Fig. 10.



WITNESSES:

Sidney P. Hollingsworth

George T. Bean.

INVENTOR

John Morris,

By Munn & Co.

Attorney

UNITED STATES PATENT OFFICE.

JOHN MORRIS, OF COVINGTON, KENTUCKY.

ALTOMETER AND LEVEL.

No. 800,590. Specification of Letters Patent. Patented Sept. 26, 1905.

Application filed May 1, 1905 Serial No. 258,220.

To all whom it may concern:

Be it known that I, JOHN MORRIS, a citizen of the United States, residing at Covington, in the county of Kenton and State of Kentucky, have invented certain new and useful Improvements in Altometers and Levels; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

The invention relates to a combined altometer and level, and has for its object to provide such an instrument which can be used for either or both of the purposes mentioned and which can be readily adjusted for the various uses to be made thereof and accuracy insured in the results sought.

To the accomplishment of the foregoing and such other objects as may hereinafter be made to appear the invention consists in the combination of parts and also in features of construction, which will be hereinafter fully described and then sought to be clearly defined by the claims, reference being had to the accompanying drawings, forming a part hereof, and in which—

Figure 1 is a side elevation of the instrument; Fig. 1ª, a plan view of the metal socket at the base of the staff; Fig. 2, a front elevation of the instrument; Fig. 3, a vertical section through the upper portion of the instrument; Fig. 4, a cross-section on the line 4 4 of Fig. 3; Fig. 5, an end view of the true base; Fig. 6, a cross-section through the true base on the line 6 6 of Fig. 3; Fig. 7, a cross-section through the staff just above the stirrup on the line 7 7 of Fig. 1; Fig. 8, a perspective of the tripod form of support for the instrument; Fig. 9, a perspective of the tubular form of true base, and Fig. 10 a cross-section through the same on line 10 10 of Fig. 9.

The instrument comprises a triangle, a staff, and a leveling device. For the triangle portion any right triangle of which the ratio of the base to the perpendicular is known may be used; but the isosceles right triangle is preferred and will be selected for illustrating the invention. The legs of the triangle may be any convenient length—for instance, eight inches, more or less. The triangle is formed with a true base 1 and an apparent base 2. The true base is formed with a groove 3 in its top face about one-fourth of an inch in depth and of suitable shape in cross-section—for instance, either semicircular, rectangular, or triangular—and such base is capable of being shifted, so as to form the hypotenuse of the triangle, and for illustration may be three-eighths of an inch in width by three-fourths of an inch in depth by fourteen inches in length, more or less, and at one end is provided with a ferrule 4, which crosses the groove 3 on a level with the top of the groove, forming a bridge, and through the middle of this bridge there is a pin 5, which is driven into the middle of the groove beneath. The opposite end of this base is reduced in thickness to receive a ferrule 6, which is formed with a slot 7 and serves as an eye-guide in sighting. About five inches from this ferrule there is placed a thin metal plate 8, filling the groove 3 and formed with a circular hole 9 about one-eighth of an inch in diameter, with the horizontal diameter of the hole on a level with the top of the groove, the opposite walls of the hole at the horizontal diameter thereof being formed with notches 10, designed to serve as guides for the eye in taking levels. The notches 10 in the plate and the top of the bridge formed by the ferrule 4 coincide with each other, and the pin 5 coincides with the center of the hole 9. The plate 8 may be held in place by its legs 11, straddling the base and fitting in recesses formed in the side of the base to receive the same.

The apparent base 2 is about ten inches long, three-fourths of an inch in depth, and three-eighths of an inch in width, except at its central portion, which may be reduced in width for lightness of weight, and is made with an L-shaped end formed by a vertical extension 12, which is about two inches high and otherwise of the same cross-dimensions as the apparent base, and the top of the extension is notched or forked to receive the true base, which is pivotally connected thereto by a pivot 12ª, and when so connected the two bases will be about one inch apart when parallel with each other, the pivot 12ª being so located that the distance from it to the center of the apparent base measured on the perpendicular will be one and three-fourths inches, or thereabout. Eight inches from the foot of this perpendicular a hole is bored through the center of the apparent base, and at this point the base and the perpendicular of the triangle are pivotally connected together by

a pivot-pin 13, passing through said hole. The perpendicular of the triangle consists of two parallel bars or strips 14, spaced apart by blocks 15, or otherwise, at the ends of the bars, between which bars extends the end of the apparent base, whose pivot-pin 13 is about two inches above the spacing-block 15 at that end of the perpendicular and the bars of the perpendicular extending about two inches below the apparent base, thus permitting such extension of the perpendicular to be used for the purpose hereinafter indicated. The apparent base also extends beyond the bars of the perpendicular, so that such extension and the extension of the bars form a cross when the instrument is adjusted for use. One and three-quarter inches from the center of the pivot-pin 13 another hole 16 is made through the two bars of the perpendicular, so as to receive a thumb-screw 17 to hold the true base 1 parallel to the apparent base, and when so connected a rectangle is formed whose sides are made up of the true base, the apparent base, the L extension, and the bars of the perpendicular. It being eight inches from the center of the pivot 12^a of the L extension to the center of the set thumb-screw 17 and a rectangle being formed, the perpendicular is at right angles to both the true and the apparent bases. Eight inches above the hole 16 another hole 18 is formed through the bars of the perpendicular, and the end of the true base fitting between said bars being free to be moved such end of the true base may be moved from the hole 16 to the hole 18 and secured at that point by a thumb-screw, the perpendicular, however, still remaining at right angles to the apparent base. This will form the isosceles triangle, which has for its sides the distance from one hole 16 to the other hole 18, (eight inches,) the distance from the hole 16 to the pivot-pin 12^a of the L extension of the apparent base, (eight inches,) and the distance from the pivot-pin 12^a to the upper hole 18 in the perpendicular bars, (eleven and thirty-one one-hundredth inches.) The instrument with its parts thus positioned is adjusted for use as an altometer, and when the parts are positioned with the true base secured to the perpendicular bars by a thumb-screw passing through the lower holes 16 the instrument is adjusted for leveling. The bars forming the perpendicular will be marked with a scale 19, indicating various heights to which the true base may be raised to indicate angles of elevation, the scale shown representing angles of elevation between one degree and forty-five degrees. The bars of the perpendicular below the holes 16 may be provided with a scale 20, divided, say, into tenths of inches, so that if the true base be lowered one-tenth of an inch it will indicate a fall of three inches in twenty feet, thus adapting the instrument to be used in getting the grades for ditches.

Description will now be made of the staff for use with the triangle. The staff 21 may be made of light wood or other material and will be about four feet ten inches long and one and one-fourth inches square, except that the last six inches of the top will be one and one-half inches square. The lower end of the staff fits in a metal socket 22 and is held therein by any suitable means. From one side of the socket there extends a bar 23, preferably an I-bar, on a level with the base of the socket, and from this bar a finger or pin 24 projects downwardly about five inches, so that when the staff is set in position and the weight of the body is thrown upon the bar 23 over the pin 24 and guiding the staff with the hand the instrument may be fixed in the ground and at the same time leveled. The lateral bar 23 assists in leveling and also insures the top of the staff always being a certain and fixed distance from the ground, inasmuch as said bar prevents the body of the staff from being forced to a greater or less extent into the ground, and this is of material advantage in the use of the instrument as a level. Around the top of the staff is fitted a metal ferrule 25, which is one and one-half inches square, and into this end of the staff is inserted a square socket 26, which is three-fourths of an inch square on the inside and about two inches deep. From the top of this socket two arms 27 extend in opposite directions, each about one and one-fourth inches. Each of these arms has formed in its top a groove 28, which is one-half of an inch wide and one-fourth of an inch deep, the bottom of each groove being on a level with the top of the staff. The socket 26 is designed to receive the end of the bars of the perpendicular of the triangle projecting below the apparent base, which is about two inches, and the apparent base will rest in the grooves of the arms 27, and thus the connection between the base and the triangle will be made rigid and firm. If desired, a set-screw 29 may also be passed through the socket into the extension of the perpendicular.

The instrument may be leveled in either of two ways, although both ways may be employed whereby one will serve to verify the other. For instance, a spirit-level 30 may be attached to the apparent base by a pivot-pin 31 near the L extension of the base, the pivot permitting the spirit-level to be turned into different positions, so that it may serve the purpose of two spirit-levels. Instead of the spirit-level, or in connection therewith, the instrument may be leveled by a plumb-bob 32, attached by an eye 33, or otherwise, to the under side of the apparent base about six inches from the center of the pin that fastens that base to the perpendicular. The line of this plumb-bob passes through a hole 34 in the plate 35 of a stirrup 36, which is pivoted by a thumb-screw 37, or otherwise,

to the staff about one foot below the top of the staff. The sides of the stirrup fit against opposite sides of the staff, and the end which carries the plate 35 extends about six inches beyond the side of the staff, so as to bring the hole 34 directly under the point of suspension of the bob-line from the apparent base, and the hole 34 is so cut, as illustrated, that the diagonals of its square are parallel to the sides of the plate in which the hole is cut. The sides of the stirrup extend at the opposite end about one inch beyond the staff and are adapted to fit into a grooved casting 38, secured to the side of the staff and so positioned that the stirrup will form a right angle with the staff when the stirrup is lowered and its sides bear against said casting. It is plain that any variation of the instrument from a true level will be indicated by the position of the bob-line in the hole 34. For the purpose of receiving the plate end of the stirrup when the stirrup is folded up a recess 40 may be formed in one side of the staff.

This instrument may be used to find the height of any object. Lumbermen by means of it can find the height of the trunks of trees while they are standing. Painters can determine the height of walls and buildings, and thus be enabled to ascertain the exact area to be covered with paint.

In order to get the height of any object, proceed as follows: Adjust the instrument into an altometer—that is, fasten the grooved side to the top of the perpendicular by the thumb-screw at that place. Now move the instrument away from the foot of the object to a point the distance of which from the base in your judgment is equal to the height of the object. Set and level the instrument, then sight along the groove. If the line of sight goes above the object, the instrument is too far from the object. If it fall below the point whose height is to be determined, the instrument is too near the base of the object. By moving the instrument back or forth the point is readily found from which the line of sights just strikes the top of the object to be measured. When this point is found, see that the instrument is level, and then lower the grooved piece to the thumb-screw below and sight again, marking the point where the line of sight strikes the object. This marking is essential, as its height above the ground is needed. Now measure the distance from the foot of the object to the center of the staff and add eight inches (the length of the base of the triangle) and the sum will be the height of the object above the mark made, as stated above. Next measure the height of the mark above the ground and add this to the height above the mark and you have the height of the object above the ground. Care should always be taken to select a position for setting the instrument which is not more than five feet lower than the base of the object to be measured. Otherwise it would be necessary to determine the height of the base above the position of the instrument; but with a little care this will scarcely ever be necessary. The reason why the height can be thus obtained is geometrical and is absolutely correct if the triangle is constructed accurately.

To use the instrument as a level, fasten the grooved side of the perpendicular by the lower thumb-screw. Then with the hand and foot set and level the instrument by the spirit-level or plumb-bob and it is ready as a level. As a level an essential feature of the instrument is that the top of the groove is always a definite height above the ground, (five feet.) Whenever and wherever set, the groove is always the same height, since the foot of the staff is never sunk in the ground. This is a material point of advantage in the instrument. The instrument as a level may be used to determine the difference of elevation between any two points. To do this, set the instrument at one of the points and measure off any convenient distance in the direction of the other point—say forty or fifty feet. Drive a pin in the ground here, set a leveling-rod on it, and take the reading. Place this reading in a column marked "Higher" or "Lower" as determined by the instrument. Now move the instrument to the place of the rod, set, and level it. Measure off again a distance of forty or fifty feet in the same general direction. Drive another pin and set the rod on it as before. Now take the reading of the rod and place in the proper column as above. Continue this process of removing and resetting the instrument and recording the readings until the point is reached whose level is to be compared with the starting-point. Now find the sum of the readings in each column, and the difference of the sums will be the difference of level between the points. Here again the permanency of the height of the groove is of advantage, as only forward sights are used in finding the difference of levels. This being the case, only one rodman is needed. Otherwise two would be needed. When long lines are measured, correction must be made for the curvature of the earth, which is only one one-hundredth of an inch in two hundred feet. This may be ignored in short lines. The moving of the instrument and the permanency of the height of the groove correct the difference that would otherwise result on account of the curvature of the earth.

Farmers who wish to drain their lands by means of tile drains put below the surface of the ground may make use of the "altometer and level" to determine just how deep they must dig the trenches to have the proper fall for the water to run off. Here is the plan of using it. It is customary to put the tile at least three feet below the surface of the ground, so as to have it below the frost-line.

Now set the level (for such it is now) at one end of the drain. If four inches is wanted in every forty feet as the proper fall for the water in running, the trench would have to be three feet four inches deep at the end of the first forty feet if the surface of the land be perfectly level between the instrument and the rod forty feet away; but if the rod showed the point to be one foot three inches higher the trench at that point would have to be dug three feet four inches plus one foot three inches, or four feet seven inches deep; but if the reading of the rod should show the point to be one foot three inches lower the farmer can readily see that it will be better to sink the trench deeper at the beginning to avoid too great a fall for the water.

Road builders and street graders may use the instrument and determine when they have the grades called for in their contracts. This is done with the instrument as a level and a leveling-rod and need not be described in detail, as it would be only a repetition of what has been said in describing the method of getting the difference of level between two points. Builders in laying out foundations may use it to lay off right angles at the corners. This is possible, since the perpendicular is square and set in a square socket in the top of the staff. If a line of sight is taken, the triangle may be taken out of the socket and turned so as to have the line of sight at right angles to the line of the former position. This is a very useful arrangement for builders and a point of advantage in the instrument. It may be used by students of astronomy to obtain the angle of elevations of any of the heavenly bodies when not above forty-five degrees. To do this, level the instrument and then raise the grooved side till the line of sight points to the body. Then read the angle of elevation by the scale on the side of the perpendicular.

If the instrument be used in places where it is not possible to set it in the ground, a tripod may be substituted for the socket and arm at the foot of the staff, as illustrated in Fig. 8 of the drawings. In such cases the ferrule portion 25 of the staff will by a plate 40 be secured to the top of a tripod 41, having folding legs 42, and the parts will be so proportioned that the height of the true base will be at the same height (five feet) as when the single staff form is used.

Instead of the grooved bar a tube 45, as illustrated in Fig. 9, may be used, and in such case the eye-guard 46 may be screwed into the tube and a cross 47, coinciding with the vertical and the horizontal diameters, placed in the opposite end of the tube. The bottom of the tube will have a bar 48 provided with holes corresponding to those in the other form of true base for supporting the true base as in the other form. The tube will also be provided with a plate 8, as in the other form first described.

I have described with particularity the dimensions and preferred details of construction and arrangement of the several parts, but do not thereby intend to limit myself to such particularities, as it is obvious that changes can be made and some of the features be omitted while others are retained.

Having described my invention and set forth its merits, what I claim is—

1. The combined altometer and level comprising the bar constituting the perpendicular, the bar extending therefrom and forming the apparent base, and the member forming the true base lying above the apparent base and connected therewith and to the perpendicular, the true base being arranged to lie parallel with the apparent base when used as a level and to be adjusted to an angle therewith when used as an altometer, substantially as described.

2. The combination of the bar constituting the perpendicular, the bar extending therefrom, constituting the apparent base, and formed with an upright extension at one end, and the member forming the true base pivotally connected to said extension and at its opposite end adjustably connected with the perpendicular, substantially as described.

3. The combination of the bar constituting the perpendicular, the bar extending therefrom, constituting the apparent base, and formed with an upright extension at one end, the member forming the true base pivotally connected to said extension and adjustably connected with the perpendicular, said member being formed with a groove provided with a cross and having at one end an eye-guide for sighting, substantially as described.

4. The combination of the bar constituting the perpendicular, the bar forming the apparent base, and the member forming the true base connected with the apparent base and to the perpendicular, said member being formed with a groove lengthwise thereof, a ferrule at one end of said member provided with a pin extending centrally to the bottom of said groove, a plate fitting the groove between the ends of the member and formed with a hole whose walls are notched on a central horizontal line drawn through the hole, and an eye-guide for sighting at one end of the grooved member, substantially as described.

5. The combination of the bar constituting the perpendicular, the bar extending therefrom, constituting the apparent base, the member forming the true base lying above the apparent base and connected therewith and to the perpendicular base, and the spirit-level pivotally connected to the apparent base, substantially as described.

6. The bar constituting the perpendicular

and having connected thereto the bar forming the apparent base and the member forming the true base, a portion of the bar of the perpendicular extending below the apparent base, in combination with the staff formed with a socket in its upper end to receive the portion of the perpendicular which projects below the apparent base, substantially as described.

7. The bar constituting the perpendicular and having connected thereto the bar forming the apparent base and the member forming the true base, a portion of the bar of the perpendicular extending below the apparent base, and a portion of the apparent base-bar extending to one side of the perpendicular, in combination with the staff formed with a socket in its upper end to receive the portion of the perpendicular which projects below the apparent base, and having a laterally-extending grooved arm to receive the portion of the apparent base-bar extending beyond the staff, substantially as described.

8. The bar constituting the perpendicular and having connected thereto the bar forming the apparent base and the member forming the true base, in combination with the staff to support the bar constituting the perpendicular, the stirrup pivotally connected to the staff and carrying a plate formed with a hole, the plumb-bob line suspended from the apparent base and passing through the hole in stirrup-plate, and means for supporting the plate in a horizontal position, substantially as described.

9. The combination with the staff supporting an instrument for ascertaining levels or elevations, of a stirrup pivotally connected to the staff and provided with a plate formed with a hole for the passage of a plumb-bob line, and a grooved casting secured to the staff and located to receive a part of the stirrup to maintain the stirrup in a horizontal position, substantially as described.

10. The combined altometer and level comprising the staff having a supporting-base for maintaining the staff always at a uniform distance above the ground, a bar constituting a perpendicular supported from the top of the staff, a bar forming an apparent base connected to the perpendicular, and a member forming a true base connected with said apparent base and to the perpendicular, said true base being arranged to lie parallel with the apparent base when used as a level and to be adjusted to an angle therewith when used as an altometer, substantially as described.

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

JOHN MORRIS.

Witnesses:
WM. A. BYRNE,
JNO. B. READ.