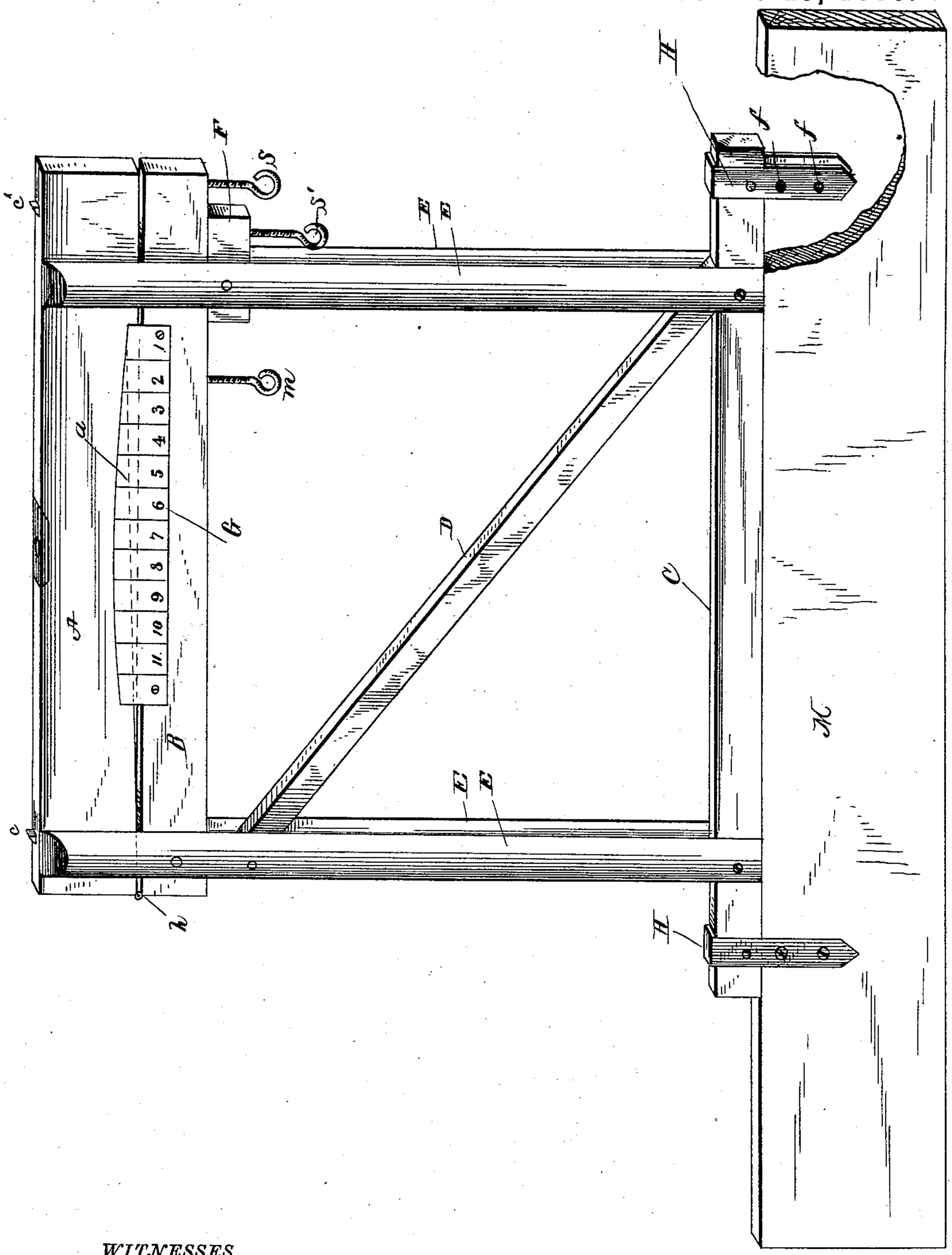
(No Model.)

R. GRAY.

CLINOMETER.

No. 343,634. Patented June 15, 1886.



WITNESSES
F. L. Ourand.
John T. Suiter.

INVENTOR
Richard Gray
Frank A. Fouts.
Attorney

UNITED STATES PATENT OFFICE.

RICHARD GRAY, OF BLOOMINGTON, ILLINOIS.

CLINOMETER.

SPECIFICATION forming part of Letters Patent No. 343,634, dated June 15, 1886.

Application filed April 21, 1885. Serial No. 162,959. (No model.)

To all whom it may concern:

Be it known that I, RICHARD GRAY, a citizen of the United States, residing at Bloomington, in the county of McLean and State of Illinois, have invented certain new and useful Improvements in Clinometers, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to that class of instruments used to measure the inclination or declination of a line or plane, and is particularly designed for use in locating and determining the grade of ditches and drains upon agricultural lands.

It is well known that the capacity and durability of a tile-drain or ditch depends largely upon the proper adjustment of its grade, and hence it frequently becomes necessary to employ a skilled engineer and the use of his expensive mathematical instruments. Now, with the ordinary farmer this is attended with inconvenience and an expense which he can ill afford; besides, in many instances, the records and marks left by the engineer are not understood by the workman, because he does not possess the necessary mathematical attainments, and the farmer cannot afford to retain the engineer and his instruments while the work of constructing the ditch is progressing.

To avoid the foregoing difficulties and expense, a large majority of the farmers either locate and construct their ditches and tile-drains by guess or improvise rude contrivances of their own, which are inconvenient and give unreliable results, and, by reason of the foregoing, immense loss has heretofore been sustained.

The object of my invention is the production of a cheap and durable instrument so constructed and arranged as to enable any person of the simplest arithmetical attainments to locate and determine the grade or fall of a ditch or drain with a sufficient degree of exactness for practical purposes, and which can be retained and used by the workman during construction.

The invention consists in the several parts arranged as a whole and with respect to each other, as pointed out in the following specification.

The accompanying drawing represents a side elevation of my improved instrument, in which—

A represents an ordinary carpenter's level, provided with sights *c c*, and hinged to B at *h*.

B is a bar, pivoted at *h* near one end, and provided with an elevating-screw, *s*, near the other end, and a clamp-screw, *m*, engaging a nut attached to the bottom side of A.

G is a scale consisting of a thin plate uniformly graduated or marked in inches, and is firmly attached to the bar B.

F is a bar provided with an elevation-screw, *s'*.

E E are standard-supports.

C is a bar provided with downward projections H, having holes *f*.

D is a brace attached to the standards E, as shown. The bar F is firmly fixed between the standards. The level A and the bar B loosely fit between the standards, and are raised and lowered at one end, either together or separately, by the screws *s* and *s'*—that is to say, the screw *s* operates upon the level A alone, and *s'* operates upon A and B together as one. A fine straight line, *a*, starting from the upper right-hand corner of the scale G, and taking a direction toward the pivotal point of the hinge *h*, is made upon the side. The level A and bar B, when not elevated by the screws, are parallel to the bar C and to each other, and therefore when in this position, if A is level, B and C will also be level, and if the end of A alone is elevated, B and C remaining level, the inclination of A to B will be equal to the inclination of A to C.

The manner of using my improved instrument is as follows: A stake is placed at the lower end of the proposed ditch-line and marked plainly at a point of a height above ground equal to the height of the instrument. The instrument is then placed at the upper end of the proposed ditch-line in line with the stake. The downward projections H are pressed into the ground, so that the instrument will stand upright. The lower bar, C, should be placed so that the end toward the stake is somewhat higher than the other. With the screw *s'* the bars A and B are now brought to a level position. Then with screw *s*, B remaining stationary, the end of A is elevated until the tops of the sights *c* are brought in line with mark upon the stake. It is plain

that the angle formed by A and B is the angle of inclination required. In the operation the intersection of the line *a* and the upper edge of the scale G will have traversed a distance equal to amount of fall in a rod of ditch-line, and the reading is —— inches fall to the rod. By means of the clamp-screw *m* the bars A and B are now firmly secured and retained in this relative position. The object of clamping these two bars together is to lessen the liability to mistakes. The reading alone may be relied upon. By means of the screw *s'* the two bars A and B are lowered until B rests upon F, as before. Now, if the instrument be reversed and inclined so that A is level, it is plain that the inclination of C will represent the grade.

Having thus ascertained the grade, the further use of the instrument in obtaining this grade at the bottom line of the ditch is as follows: By means of the downward projections H the instrument is fastened to the edge of a straight bar or board, M, of equal width at each end, as represented in the drawing, and the board with the instrument attached is drawn lengthwise along the bottom of the ditch at intervals as the work progresses, taking care that the bar A is level, while the boards fit the bottom of the ditch. This board should be of considerable length, to render the process more easy and certain. It will be observed that no mathematical calculations are required when the ditch-line is straight. In case the line is broken or curved it is only necessary to determine the ratio of the increase of length, and decrease the rate of fall in the same ratio, or, in other words, to decrease the rate of fall in proportion to the increase of the length of ditch-line.

I will describe the following simple process of obtaining the form and location of the scale G. The line *a* is made upon the face of the level A, as described. Then a piece of transparent paper of suitable size is divided into inch spaces by parallel lines drawn perpendicular to the base, as shown in the drawing. The paper is now fastened to the side of B, so as to cover the line *a*. The instrument is firmly secured in an upright position, and a fine string or thread is drawn over the sight *c*, above the sight *c'*, and extended a horizontal distance of one rod from *h*, where it is fastened to a suitable support. With screw *s'*, A and B are elevated until the sight *c'* touches the thread. The paper is punctured at the point of intersection of the line *a* and the zero-point of the scale. The outer end of the thread is then elevated one inch, and with screw *s*, A is inclined so that the sight *c'* again touches the thread, when the paper is punctured at the point of intersection of the line *a* and the first division-line of the scale, and so on for all the divisions of the scale. These punctures will indicate the line of contour for the upper edge. Subdivisions can be traced in the same manner, and any units of measure employed for the radius and sine. The inch and rod are selected for the reason that they are familiar. The upper edge of the scale G may be straight, in which case the line *a* will be curved, and can be traced in a similar manner, without the use of the transparent paper, by simply marking the points of intersection upon the face of the bar A. It is also obvious that the scale G may be fastened to A instead of B, in which case the line *a* would be traced upon the face of B.

It is not expected that an instrument constructed in this cheap and simple manner will give sufficiently accurate results upon which to base extended mathematical calculations, or that it is adapted to the purposes of the civil engineer; but it is found to give sufficiently near approximations to answer the purpose for which it is designed.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In combination with the bar A, having a line, *a*, formed on it, as described, the bar B, the graduated plate G, secured to it, the said plate having a curved upper edge, and the adjusting-screws, all arranged substantially as and for the purposes specified.

2. In a clinometer, the pivoted level-bar A, having the line *a* in its stock and provided with an adjustment-screw, in combination with the bar B, provided with a graduated scale, G, whereby the angle of inclination is compared to the distance traveled by the point of shearing contact of the line *a* with the edge of the graduated scale G, substantially as described, and for the purpose specified.

3. In a clinometer, the combination, substantially as set forth, of a rigid supporting-frame, a level hinged or pivoted in the upper part of said frame, a scale for indicating the inclination of the level, adjusting devices, substantially as described, for raising and lowering the level, and a straight-edge secured to the lower side of the frame, whereby the device is adapted both to determine the relative levels of two separate points and to serve as a guide in securing a uniform and definite inclination from one point to the other.

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

RICHARD GRAY.

Witnesses:
H. R. BENSON,
GEO. O. LLOYD.