(No Model.) 3 Sheets—Sheet 1.

O. F. SONNE.

GRADE DELINEATOR.

No. 573,717. Patented Dec. 22, 1896.

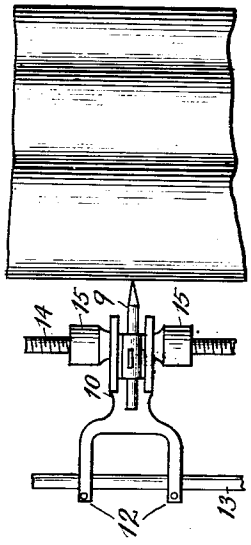

Fig. 6.

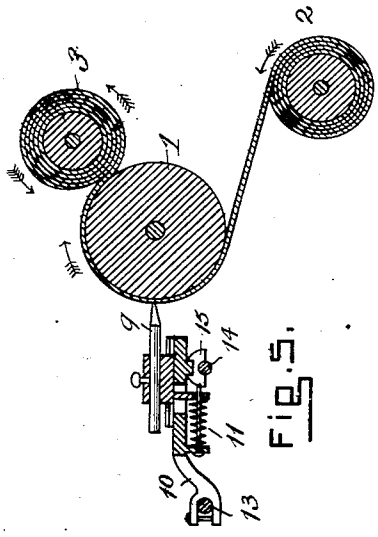

Fig. 5.

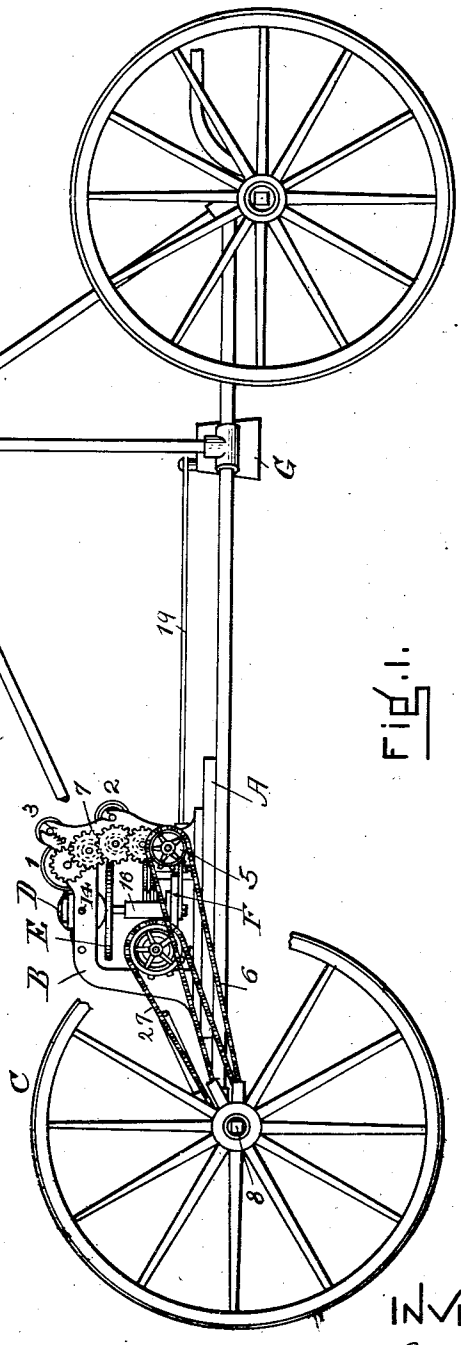

Fig. 1.

WITNESSES

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Ellen B. Tomlinson.

INVENTOR

Otto F. Sonne

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attorney.

(No Model.) 3 Sheets—Sheet 2.

O. F. SONNE.

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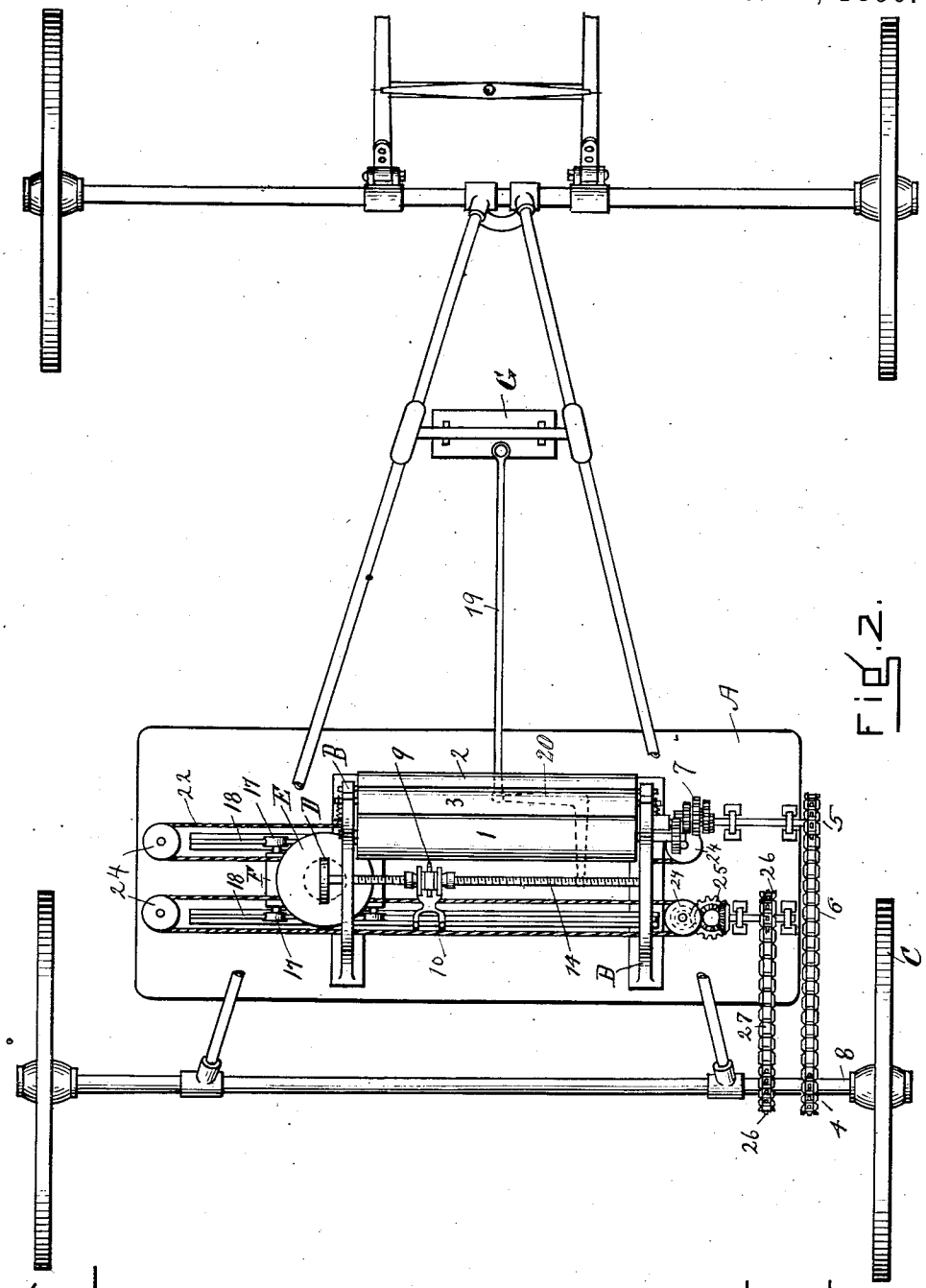

Fig. 2.

WITNESSES

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(No Model.)

3 Sheets—Sheet 3.

O. F. SONNE.

GRADE DELINEATOR.

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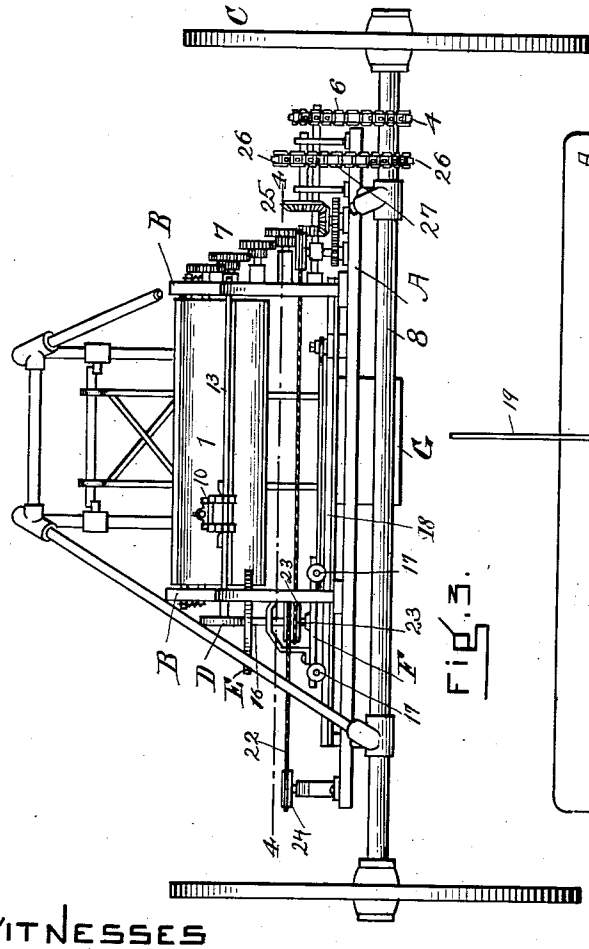

Fig. 3.

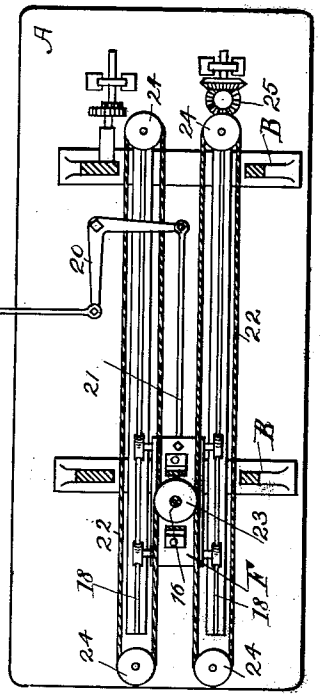

Fig. 4.

WITNESSES

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INVENTOR.

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UNITED STATES PATENT OFFICE.

OTTO F. SONNE, OF BOSTON, MASSACHUSETTS.

GRADE-DELINEATOR.

SPECIFICATION forming part of Letters Patent No. 573,717, dated December 22, 1896.

Application filed June 14, 1894. Serial No. 514,593. (No model.)

To all whom it may concern:

Be it known that I, OTTO F. SONNE, a citizen of Denmark, and a resident of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Grade-Delineators, of which the following is a specification.

My invention relates to devices for surveying purposes which give automatically a graphic record of the grades and length of the course passed over, and its object is to provide a practical and efficient device of this character embodying certain features of improvement which I will now proceed to describe and claim.

In the drawings accompanying this specification, Figure 1 is a side elevation of my machine with a part of the framework broken away. Fig. 2 is a top plan view of the same. Fig. 3 is a rear end view of the same. Fig. 4 is a horizontal section of the recording mechanism, taken on the lines 4 4 of Fig. 3. Figs. 5 and 6 are detail views, being, respectively, a central section and a plan view of the marking-pencil and the frame which carries it, hereinafter more fully described.

The device is supported upon a carriage-like framework, the general construction of which is not material, except as hereinafter described.

A represents a platform borne by the carriage, and B B are uprights secured to the platform, in which uprights are journaled three rollers 1, 2, and 3. The roller 1 is made to rotate with a velocity proportional to that of the carriage by means of suitable connections between it and the wheel C of the carriage, which may consist, as shown, of the sprocket-wheels 4 and 5, the sprocket-chain 6, and the train of gearing 7, journaled in one of the uprights B. The wheel 4 is rigidly secured to the axle 8, which turns with the wheel C.

A roll of paper, preferably what is known as "profile-paper," is wound on roller 2, carried over part of roller 1 and around the third roller 3. During the forward motion of the carriage the friction between the paper and the surface of the roller 1 will make the paper move with the same surface velocity as the roller 1, wind off the roller 2, and on roller 3, this latter being pressed against roller 1 by one or more springs, thus attaining the same surface velocity as the roller 1, while at the same time its bearings are so arranged as to allow play for its axle, which will retreat from the roller 1 as the paper winds up on it and increases its diameter. In this manner a very simple and effective construction is provided for carrying and feeding the paper, the rollers 2 and 3 being easily removable whenever it is desirable to renew the supply of paper.

Opposite the paper where it passes around the roller 1 is located a pencil or other marker 9, which is carried by a frame 10, and is pressed against the paper by means of a spring 11. The two rearward-extending arms 12 of the frame 10 are bifurcated to embrace the guiding-rod 13, along which said frame is moved in either direction by means of the screw-threaded rod 14, which engages with half-nuts 15 15, formed on the frame 10. Half-nuts are employed in order that the pencil may be readily lifted away from the paper and shifted along the rod. This is very desirable in practice in order that the pencil may be set at any desired starting-point, and also in order that it may be kept from passing off the paper by reason of a prolonged grade.

The rod 14 is journaled in the uprights B B and carries on one end a disk D, which is adapted to be rotated by frictional contact with a second disk E. Said disk E is secured to the upper end of a vertical spindle 16, journaled in a car F, which runs on wheels 17, guided by means of tracks 18, secured to the platform A.

G is a pendulum of considerable weight suspended from a convenient part of the carriage, so that it is free to swing, and it is connected to the car F, preferably by means of rod 19, bell-crank lever 20, journaled in platform A, and rod 21. This arrangement will cause the car F to take a certain position on its track, dependent on the position which the pendulum occupies in relation to the carriage, and in such a way that according to whether the carriage is inclined upward or downward the car F will occupy positions on the track on opposite sides of its central position, *i. e.*, the position it occupies when the carriage is on a level, and, further, its dis-

tance from this central position will be proportional to the deviation of the pendulum from its central position, that is, to the inclination of the carriage or the slope of the ground over which the carriage is being moved. The connections are so proportioned that the extreme range of movement of the disk E will not exceed the length of its diameter, and also so that when the carriage is on level ground and the car and the pendulum are in their central position the center of the disk E will be directly under disk D. The rod 19 is preferably made detachable from the pendulum G, in order that the disk E may be rendered inoperative, if desired. This may be conveniently done by means of an eye formed on the end of said rod, through which eye a bolt passes loosely and is screwed into the pendulum G.

In view of the lateral motion of the car F and the disk E it is necessary to provide some means for rotating said disk, which not only shall be equally operative for all positions of the disk on the track, but also shall have no tendency to move the disk laterally in either direction. To this end I have devised means consisting, preferably, of an endless belt 22, which passes around the two-grooved pulley 23 on the spindle 16, as shown, and also around the pulleys 24, secured to the platform A. One of the pulleys 24 is connected by gear-wheels 25, sprocket-wheels 26, and sprocket-chain 27 to the axle of the carriage, which, as previously mentioned, rotates with the wheel C. By this construction rotary motion will be transmitted to the axle of the disk equally well for any position of the car F, and the pulling parts of the belt will act in opposite directions and counterbalance each other, and thus will not tend to move the car F from its position.

As thus constructed it will be seen that as long as the carriage is in motion both roller 1 and disk E will be continuously rotated with velocities proportional to the velocity of the carriage. If the carriage is on level ground, the disk D will touch disk E at the center thereof, as described above, and consequently will not be rotated thereby. The pencil 9 will therefore remain stationary and will trace a straight line on the paper, passing over roll 1 as it rotates, the length of the line traced being proportional to the length of the course traversed. If, however, the surface of the ground be inclined or sloping, the pendulum G, in maintaining a vertical position, will cause disk E to move under disk D, and the resulting relative position of the two disks will cause disk D to be rotated by frictional contact with disk E, the direction of rotation of disk D being determined by the slope of the ground upward or downward, since said direction of rotation changes whenever disk D passes the center of disk E, that is, whenever the vehicle passes from rising to falling ground, or vice versa. The speed of rotation of disk D is determined by its distance from the center of the disk E, a greater distance causing a greater speed, and said distance corresponds exactly with the pitch or grade of the ground being passed over, as has been described. Consequently by the rotation of the disk D and the screw-threaded rod 14 with it the marker 9 is caused to move lengthwise of the roll 1, and since this motion corresponds at all times in direction and velocity, as explained above, with the slope of the ground the pencil or marker will be moved in the appropriate direction a certain distance for each foot the ground rises or falls, thus recording the elevations of the ground, as well as the distance, so that the line traced by the pencil, being the resultant of its own motion and of that of the roll 1, will represent the profile of the course passed over.

The scales on which the distance and elevations are recorded may be made alike or different, as desired, and by making part of the gearing changeable the scales may be varied on the same machine.

The device may be modified in a number of particulars within the limits of my invention. Thus the number and arrangement of the pulleys 24 need not be exactly as shown; also, if the pulley 23 be made with a single groove and the belt be passed entirely around it and around two pulleys 24 on opposite sides thereof and in line therewith the mechanism will still be operative.

Theoretically my device will give a strictly accurate record only when moving on level ground, since the movement of the paper is at all times proportioned to the distance traveled by the carriage, whereas on a grade said movement should strictly be proportional to the projection of said distance on a horizontal line. For all ordinary grades, however, the error thus arising will be very slight and usually not so great, as I find in practice, as the error arising from inaccuracies in the ruling of the paper, so that by omitting necessarily complicated devices for the correction of this error I obtain a great advantage in the simplicity of my machine.

What I claim is—

1. In a grade-delineator, the combination of a carriage, a roller over which passes a sheet of paper, gearing connected with the axle of the carriage for driving said roller, a frame, a pencil secured therein, a screw-threaded rod for moving said pencil parallel to the axis of said roller, a disk D on the end of said rod, a laterally-movable car, a disk E on said car engaging with and driving disk D, a pendulum, connections between the pendulum and the car for moving the latter, and means for rotating disk E.

2. In a grade-delineator, a car, means for moving said car laterally, a disk journaled in the car, mechanism coöperating with the said disk for recording grades, and means for rotating said disk, consisting of pulleys fixed to the framework of the machine, an endless belt passing around the disk-spindle and also

around the said fixed pulleys, and mechanism for driving one of the fixed pulleys, as set forth.

3. In a grade-delineator, in combination, a pendulum, a car movable thereby, a disk journaled in said car, an endless belt passing around the disk-spindle and around fixed pulleys, means for driving said belt, a screw-threaded rod provided with a disk arranged to be driven by frictional contact with the first-mentioned disk, a frame movable laterally by engagement with said screw-threaded rod, a pencil carried by said frame, a recording-surface, and mechanism for moving said surface past the pencil in a direction at right angles to the direction of motion of the pencil, substantially as described.

4. In a grade-delineator, a car, mechanism for laterally moving the car, a disk journaled in said car, mechanism coöperating with said disk for recording grades, and means for rotating said disk consisting of a double-grooved pulley on the disk-spindle, pulleys secured to the framework of the machine, and an endless belt passing around the latter pulleys and twice around the disk-spindle pulley, in such manner that the pulling parts of the belt will act on the latter pulley in opposite directions, in combination with mechanism for driving the endless belt, for the purpose set forth.

In testimony whereof I have hereunto subscribed my name this 11th day of June, A. D. 1894.

OTTO F. SONNE.

Witnesses:
MOSES S. CASE,
E. D. CHADWICK.