(No Model.) 3 Sheets—Sheet 1.

J. W. SNAPP.

MACHINE FOR TAKING AND RECORDING TOPOGRAPHICAL MEASUREMENTS.

No. 385,827. Patented July 10, 1888.

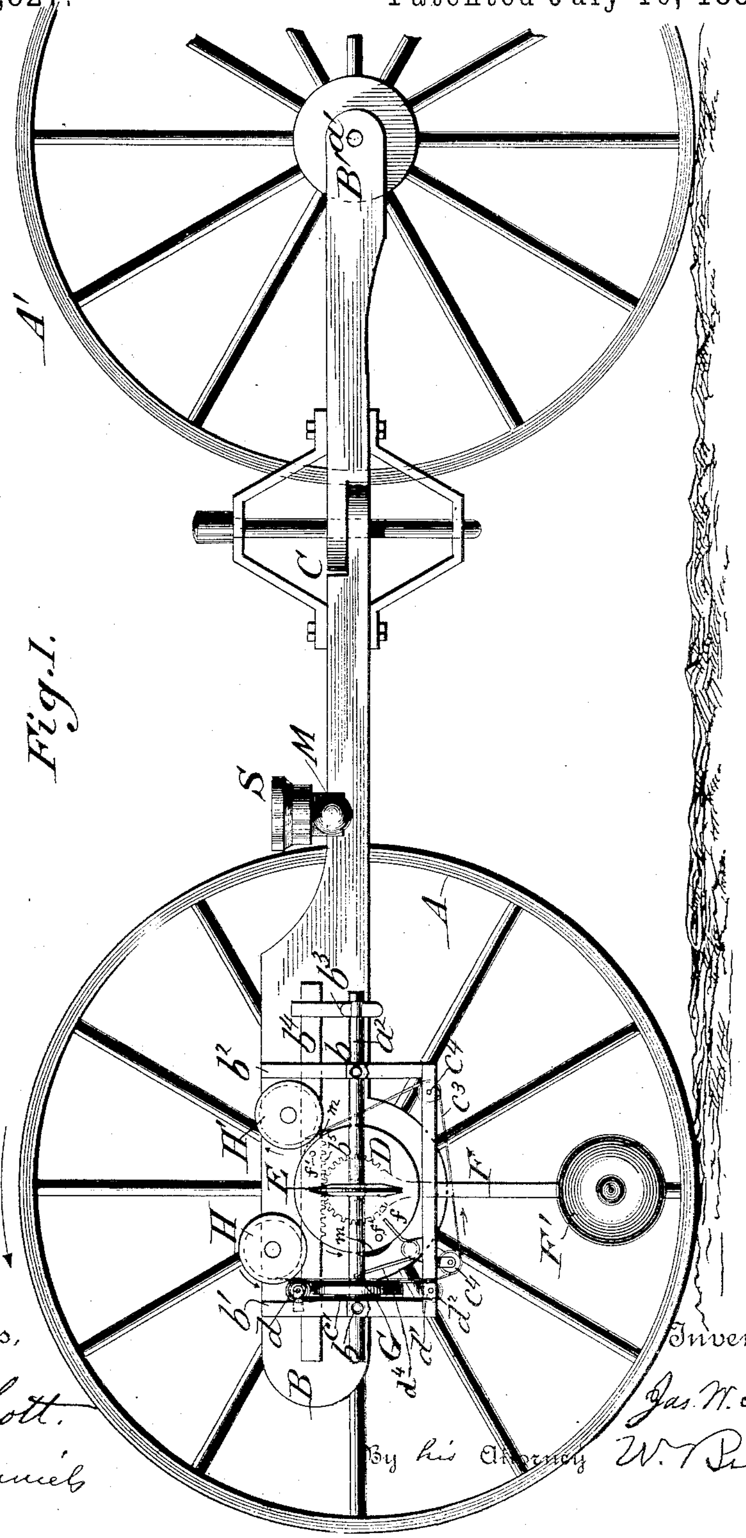

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

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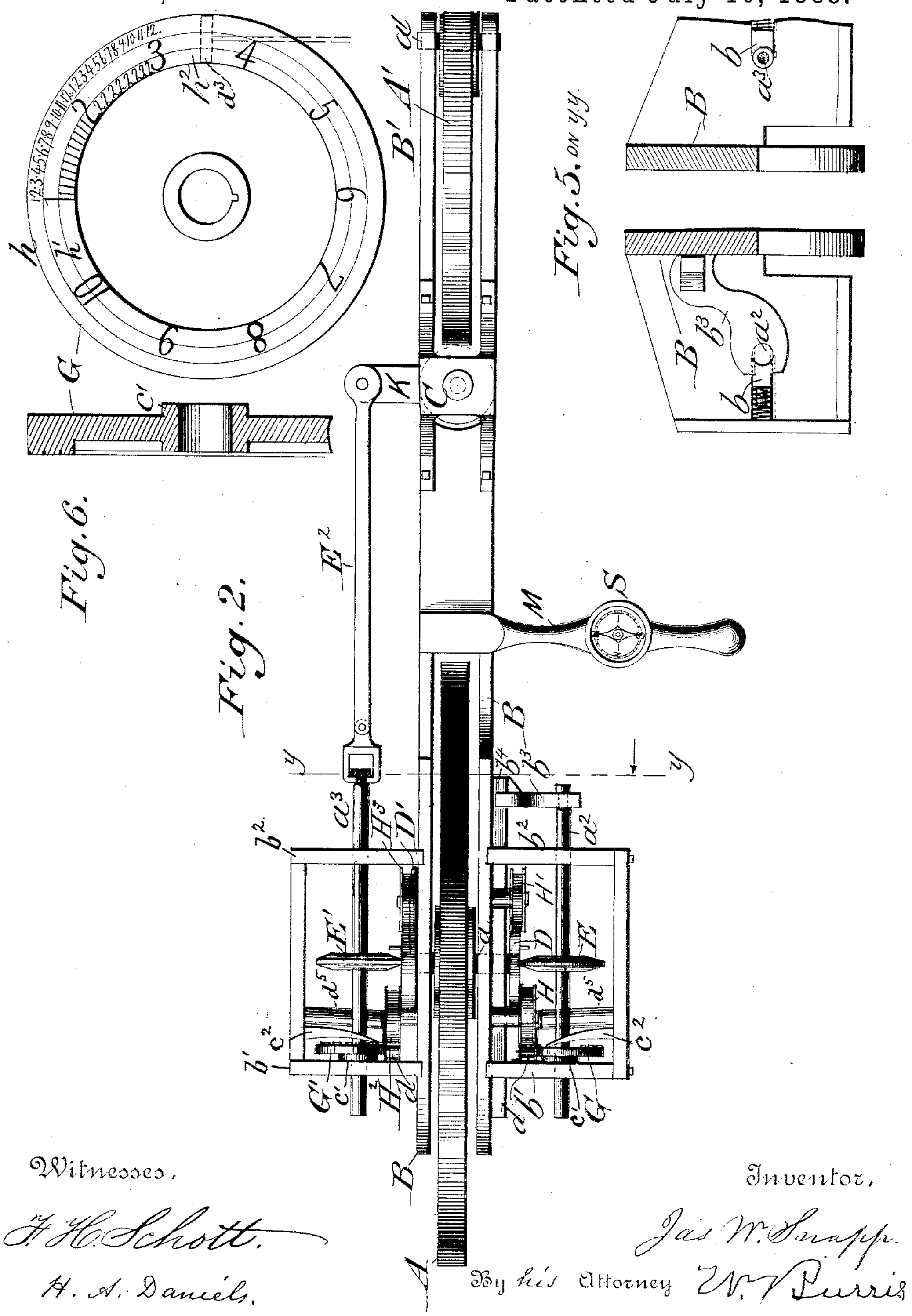

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(No Model.) 3 Sheets—Sheet 3.

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MACHINE FOR TAKING AND RECORDING TOPOGRAPHICAL MEASUREMENTS.

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Fig. 3.

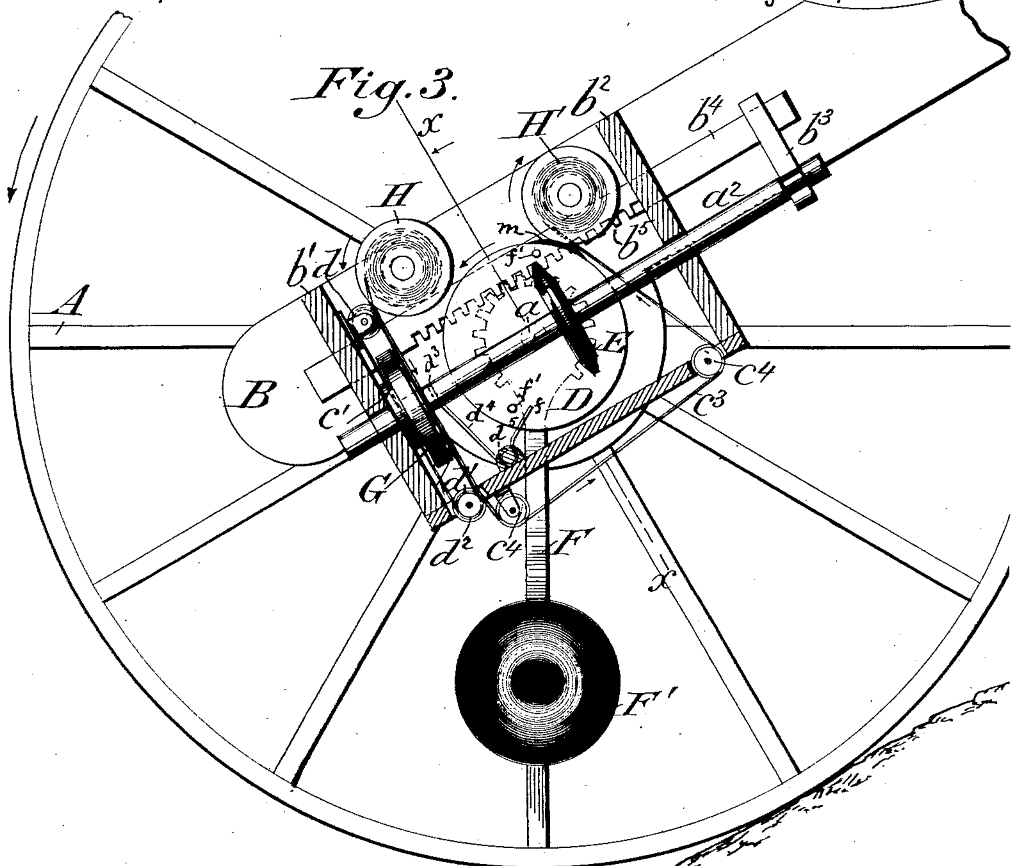
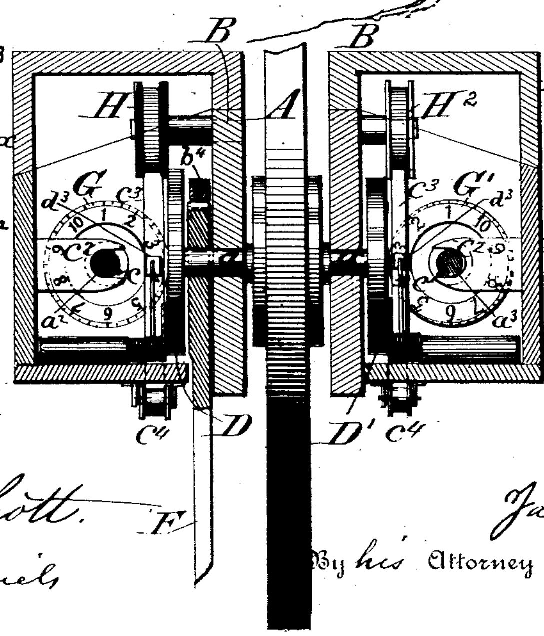


Fig. 4. on x x



Witnesses.

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UNITED STATES PATENT OFFICE.

JAMES W. SNAPP, OF JASPER, TENNESSEE, ASSIGNOR OF ONE-HALF TO A. LAWRENCE SPEARS AND WILLIAM D. SPEARS, BOTH OF SAME PLACE.

MACHINE FOR TAKING AND RECORDING TOPOGRAPHICAL MEASUREMENTS.

SPECIFICATION forming part of Letters Patent No. 385,827, dated July 10, 1888.

Application filed July 14, 1887. Serial No. 244,280. (No model.)

To all whom it may concern:

Be it known that I, JAMES WARWICK SNAPP, a citizen of the United States of America, residing at Jasper, in the county of Marion and State of Tennessee, have invented certain new and useful Improvements in Machines for Taking and Recording Topographical Measurements, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to topographical measurements, and the machine which I employ for this purpose I denominate an "auto-topographometer."

The invention consists of the devices for measuring and automatically recording longitudinal distances, elevations, depressions, and horizontal deflections from a straight line over ground-surfaces, the measurements of the elevations, depressions, and horizontal deflections being taken and recorded by means mainly of revolving disks, in combination with wheels placed transversely to and rotated by the frictional contact of their peripheral surfaces against the faces of the disks, the wheels being reciprocated over the faces of the disks and connected with devices adapted to automatically record the measurements, as hereinafter fully set forth and claimed.

In this application the devices employed are illustrated as carried by two ground-wheels, similar in size and construction, arranged to run one ahead of the other and connected by a jointed coupling.

In the accompanying drawings, Figure 1 is a side elevation of the devices and carrying-wheels. Fig. 2 is a top view of the same. Fig. 3 is an enlarged side elevation of the forward ground-wheel, showing the position of the devices when the machine is on a downgrade. Fig. 4 is a cross-section on line x x of Fig. 3, seen in the direction of the arrow. Fig. 5 is a cross-section on line y y of Fig. 2, seen in the direction of the arrow. Fig. 6 is an enlarged face view and central section of one of the registering-wheels detached, showing the arrangement of the raised figures and the registering-hammer in dotted lines.

A and A′ designate the front and rear ground-wheels, respectively, which wheels are rigidly fixed upon axles a a', revolving in bearings in the two sides of the slotted frame, which is made in two sections, B B′. The front and rear sections of this carriage-frame are pivotally coupled together, as shown at C.

D D′ designate disks mounted rigidly on the extended ends of the front wheel-axle, a.

E E′ designate plane wheels mounted, respectively, rigidly on reciprocating shafts a^2 a^3, revolving in yielding bearings b, constructed as shown or in any other suitable manner, and placed in slots in the plates b' b^2, attached to the sides of the carriage-frame. The rear end of the shaft a^2 is provided with an annular groove to receive the bifurcated end of the arm b^3, which is attached to the rear end of a bar, b^4, constructed and arranged to be reciprocated through bearings in the plates b' b^2. The lower edge of the middle portion of this bar is provided with teeth b^5.

F is a weighted lever, the upper end of which is pivoted loosely on the wheel-axle a behind the disk, and the upper end of this lever is curved and provided with teeth to engage the teeth on the rack-bar b^4 for the purpose of reciprocating the shaft a^2, and thus causing the wheel E to travel over the face of the disk, as hereinafter fully explained. The lower end of this lever is provided with a weight, F′.

G G′ are registering-wheels mounted, respectively, loosely on the shafts a^2 a^3. The inner faces of these wheels near their peripheries are provided with raised figures, which figures in the same circle are placed equidistant from each other for indicating measurements on the tapes. The number of the figures on each registering-wheel depends upon the size of the ground-wheels. For example, if the circumference of the ground-wheels is ten feet there will be ten figures, from 1 to 10, inclusive, indicating feet, and the spaces in the outer circle between the figures indicating feet will be divided into inches, indicated by smaller figures.

The wheels G G′ are provided with grooves to receive, loosely, feathers c on the shafts to enable the shafts to slide longitudinally through the wheels and to cause the wheels to revolve with the shafts. The outer faces of these wheels are provided with central hubs, c', forming small bearings against the faces of the plates b'. (See Fig. 2.) The spaces between the raised figures and the central portion of the inner face of these wheels are recessed, so that the bifurcated arms c^2, which hold wheels G G′ in place, will have as small bearing and produce as little friction as possible.

H H′ H^2 H^3 indicate spools, which carry the tapes c^3, upon which the measurements are stamped, as hereinafter fully explained.

c^4 designates rollers for guiding the tapes as they run from one spool to another. The machine is provided with the rollers d d' for carrying endless ink-ribbons d^2, one side of which runs over the face of the raised figures, and the other side of the ribbons runs between the wheels and plates b'. These ink-ribbons are moved by means of frictional contact of the rims of their rollers d with the rims of spools H H^2, so that when these spools are rotated the positions of the ink-ribbons over the raised figures will be changed.

The machine is provided with hammers d^3, as shown in Fig. 4, which hammers are arranged to automatically strike the tapes c^3 against the ink-ribbons opposite the faces of the raised figures on the registering-wheels G G′. These hammers may be operated by any suitable devices adapted to produce one stroke at every revolution of the ground-wheels. For the present I attach the hammers to the upper ends, d^4, of wires coiled around blocks d^5, rigidly fastened to the bottom plates of the inclosing-case. The other ends, f, of these coiled wires are extended in front of the faces of the disks far enough to be engaged by the trip-pins f', attached to the disks for operating the hammers, as hereinafter fully explained.

While the principle of my invention does not depend on the particular location and arrangement of the raised figures on the registering-wheels, I prefer at present to place the figures upon the wheels as shown in Fig. 6 of the drawings, in which it will be seen that in the circular space h nearest the periphery small figures are placed, representing inches, and in the double circular space h' the large figures are placed, designating feet-measurements. The space h' is subdivided, forming an inner space, h^2, in which are placed the feet-figures of smaller size in range on radial lines with the inch-figures. For example, in the space in the inner circle between the feet-indicating figures 1 and 2 is placed figure 1, and between 2 and 3 is placed figure 2, as shown, and so on.

The length of the face of the hammers is required to be equal to the entire width of the spaces occupied by the raised figures; but the width of the face of the hammers should be equal only to one space and a half occupied by a single figure representing the measurement of feet.

The devices described and shown as located on the left of the wheel A register, by means of the weighted lever and rack-bar, the measurements of the elevations and depressions, or, in other words, the deflections from a horizontal plane.

The devices located on the right of wheel A, which are employed for registering horizontal deflections, are precisely the same in construction and arrangement in relation to each other as the devices on the left of that wheel, except the weighted lever and rack-bar, which are dispensed with, and the shaft carrying wheels E′ G′ is reciprocated by means of a bar, E^2, having pivotal connection with the rear end of the shaft and the outer end of an arm, K, rigidly attached to the front end of section B′ of the carriage-frame.

M designates a transverse bar rigidly attached to the section B of the carriage-frame in the rear of wheel A, which bar is shaped to form a handle for running the machine by hand. The central portion of this bar is constructed to form a seat for a surveyor's compass, S, as shown in Fig. 2 of the drawings.

It is evident that all the actuating devices of the machine must be constructed and arranged in relation to each other very exactly and accurately in order to secure accuracy in the operation of the machine.

The wheels E E′ may be constructed with small annular grooves on their peripheries to receive small bands of rubber or other frictional substance to form the bearings against the faces of the disks. The bearing edges or surfaces of these wheels must be as narrow as possible, to avoid unnecessary friction and liability of the wheels being rotated when they are at the center of the disks. Instead of constructing these wheels with the annular grooves, as stated, each wheel may consist of two metallic plates tightly clamped and fastened together, having between them a plate of rubber, with its periphery extended slightly beyond the peripheries of the plates. This machine is comparatively very light and may readily be run by one person over any ordinary ground-surface where a person can walk, and may be readily lifted over a ditch, fence, or other obstruction; and the actuating devices are simple in construction and comparatively few in number, and when accurately constructed are not liable to readily get out of order.

The machine in use will often be run over rough ground and through tall weeds and underbrush, and to protect the actuating devices they are inclosed within boxes B^2, provided with hinged lids B^3, the front and back ends of these inclosing-boxes being the plates b' b^2 above named, as shown in the drawings.

In starting out to take topographical measurements with my machine the two sections B B′ of the carriage-frame are placed in exact line with each other and exactly on the line upon which the machine is to be started, and by means of the compass the exact bearing or direction of the starting-line must be noted; also, before the machine is started the wheel A is revolved by hand until the hammers are caused to strike and register upon the tapes. When the peripheries of wheels E E′ are at the center of motion of their disks, the wheels will not revolve. When the wheels are moved to the front of the center of motion of their disks, the wheel E will be revolved to the right and wheel E′ will be revolved to the left, rotating both of the figure-wheels in the direction of the arrangement of the raised figures 1 2 3, &c., and the registrations of measurements upon the tapes on the left of the ground-wheel A will give the elevations and the registrations on the tapes on the right of wheel A will give the horizontal deflections to the right of the line of the forward movement of the machine; and when the wheels E E′ are moved to the rear of the centers of their disks (which will take place with wheel E when the machine is on a downgrade and with wheel E′ when the machine is deflected to the left of a straight line) their rotary movements will be reversed, and the registrations of measurements on the tapes located on the left of wheel A will give the depressions and the registrations of measurements on the tapes located on the right of wheel A will give the deflections of the line of the forward movement of the machine. It will be observed that one of these wheels E E′ may be in front and the other in the rear of their respective disks at the same time, which will be the case when the machine is on an upward grade and deflected to the left, and vice versa.

The accurate registration of measurements of the deflections from a horizontal plane and straight line, as herein set forth, depends upon the exact construction and relative sizes of the wheels E and E′ and the devices directly connected with and actuating them. The diameters of the wheels E E′ must be precisely equal to the length of the longitudinal movements of these wheels across the faces of the disks, measuring between the farthest points to which the wheels are carried on both sides of the center of the disks. These extreme points are reached only when the lines of deflection are at right angles to a horizontal plane or to a straight line.

It will be readily seen that the distance traveled by the wheel E over the face of the disk D depends upon the size and construction of the toothed head of the weighted lever, its teeth, and the teeth on the rack-bar, and the distance traveled over disk D′ by the duplicate wheel E′ depends upon the length and location of the arm K. The required size of the wheels E E′ may be first determined upon, and then the lever-head, rack-bar, and arm K may be constructed to cause the wheels to travel the required distance equal to their diameters. I prefer, however, to first construct the devices which reciprocate the wheels across the faces of the disk the desired size, and then ascertain by actual measurement the length of the longitudinal movements of the reciprocating wheel-shafts, giving thus the exact diameter required for the wheels.

Of course in the manufacture of the machines, patterns and scales of the exact sizes of all the essential parts of the machine will be provided and used.

The yielding bearings of the reciprocating shafts are provided with set-screws (not shown) for the purpose of adjusting the wheels E E′ to the faces of their disks, so that these wheels will be revolved with certainty and accuracy by frictional contact with the disks; and, if desired, the surfaces of the faces of the disks may be milled, corrugated, or otherwise prepared to prevent any slipping of their faces over the bearing surfaces of the peripheries of the wheels.

The accurate operation of the machine in registering the elevations, depressions, and horizontal deflections, as described, may be explained as follows: It is evident that when the wheel E is exactly on the center of its disk the registering-wheel G will have no rotary movement. This wheel E will be in that position always when the machine stands on a horizontal plane; and this wheel will be at the extreme point of distance from the center of its disk when the line of deflection from a horizontal plane is at right angles to said plane. The disk revolving with the ground-wheels and making a complete revolution with each revolution of those wheels, and the distance of the extreme point of the wheel E from the center of its disk being then, as described, exactly equal to half the diameter of the wheel, it is evident that the circle of the contact-surface on the face of the disk with the periphery of the wheel E must be exactly equal to the periphery of this wheel, and therefore wheel E and figure-wheel G will make one complete revolution with each revolution of the ground-wheel and disk. Now, the wheel being at the extreme point and the highest numeral on the figure-wheel corresponding with the size of the peripheries of the ground-wheels, the registration upon the tape at the completion of a revolution of the ground-wheel will show an elevation or depression equal to the size of the periphery of the ground-wheel, or, in other words, that the elevation or depression is perpendicular to the horizontal plane. For example, if the circumference of the ground-wheel A is ten feet, the tape will register an elevation or depression of ten feet. Now, if the movement of the wheel E to the extreme points of distance from the center of the disk causes the registration of ten feet of deflection, the movement of the wheel one-tenth of that distance will cause the registration of one-tenth of the greatest deflection. It is thus readily seen that when the machine has ascended an elevation of one foot the wheel E will be moved by the weighted lever one-tenth the distance from the center of its disk to the extreme point, and this wheel and wheel G will be revolved one-tenth of a revolution, and one foot will be registered on the tape, and so on with all intermediate points. If the ascent is continuous and the altitude ultimately reached is greater than the highest number upon the figure-wheel, the registration upon the tape will be repeated—that is, after ten will come the figures 1 2 3, &c., to be added to ten, and so on until the highest elevation is reached.

Precisely the same principle of registration obtains in registering depressions, except that the registering-wheel is revolved backward and the depression is shown by the backward order from 10 to 1 of the figures on the tape. Hence in reading the registrations on the tape the forward arrangement of the figures from 1 upward indicates elevation invariably, while the backward arrangement from the highest number downward indicates depression.

If between stations the surface is elevated at one or more points and depressed at other points, that fact will be indicated on the tape—the elevations by the forward arrangement of the figures and the depressions by the backward arrangement of the figures. For example, suppose there is an elevation of eight feet and then a depression of three feet. The first numbers on the tape will run from 1 to 8 and then will read 7 6 5, showing that the highest point of elevation was eight feet and that three feet are to be deducted, and that the last station is five feet above the first.

The same explanations substantially apply to the operations of the devices which register the horizontal deflections by substituting the word "right" for "elevation" and "left" for "depression"—that is, deflections to the right of the line of movement will be indicated upon the tape by the arrangement of the figures from 1 upward, and deflections to the left of the line of movement will be indicated by the backward arrangement from 10 downward on the tape, and the figures on the tape will show all intermediate changes of the deflections from right to left, and vice versa.

The face of the disk may be provided with any desired number of trip-pins, so as to cause the machine to register any intermediate distances. For example, the circumference of the ground-wheels being ten feet, if the disk be provided with ten pins equidistant apart, the registering-wheel being provided with the requisite raised figures, the tape will show the deflections at every foot traveled by the machine. Such intermediate pins should be removably attached to the disks, so that the pins may be inserted and removed as desired. Where more than one pin is used, a corresponding number of the lugs *m* (shown in the drawings and hereinafter more fully explained) must be placed upon the periphery of the disks for the purpose of changing the positions of the tapes, presenting thus blank spaces on the tapes to receive each registration. These intermediate lugs should also be removably attached to the disks, so that when any of the pins are removed a corresponding number of lugs may be removed; and as a matter of convenience the intermediate lugs and pins may be constructed in one piece, to be inserted and removed together. The raised figures may be formed on or they may be removably attached to the faces of the registering-wheels, so that they may be changed, and letters may be substituted in place of the figures.

A bell (not shown) may be attached at any convenient point upon the machine, to be rung by any suitable devices, for the purpose of reporting audibly the registration of each revolution of the ground-wheels, so that the distances traveled by the machine may be noted, or these distances may be automatically shown upon a dial or by any other suitable devices to enable the operator to know when the machine has measured any required distance.

The tapes upon which the measurements are stamped are carried upon spools, as set forth. For example, the tape c^3 is wound upon a spool, H, and the end of the tape is extended downward along the face of the ink-ribbon, under guide-rollers c^4, and then carried upward, and its end is attached to spool H′. This spool is rotated by means of one or more lugs, *m*, on the periphery of the disk D, which winds up the tape on spool H′ and unwinds it from spool H, causing it to change position, so as to present always a blank space to the face of the raised figures before each stroke of the hammer. These spools being placed loosely on spindles attached to the machine-frame, so that they may be readily removed and replaced when the tape is entirely unwound from the spool H, the spool H′ holding the stamped tape is removed, the empty spool H is inserted in place of H′, and a filled tape spool inserted instead of H.

Any required number of spools, numbered regularly from 1 upward, may be provided, to be used on the machine in the order of their numbers.

After the topographical measurements have been thus taken for any required distance during a whole day, or a succession of days together, these measurements may be read and mapped out by observing to read the tapes from the spools in the order of their numbers. The measurements registered upon the tapes may be transferred upon maps by hand in the usual manner of mapping out topographical surveys and measurements. I contemplate, however, the construction of an apparatus adapted especially for speedily and accurately mapping out all of the measurements by this machine.

The weighted lever is always held by gravitation in a vertical position. Hence when the machine is changed from a horizontal plane to a descending grade the wheel E is moved to the rear of the center of the disk, as shown in Fig. 3 of the drawings, and when the machine is changed to an ascending grade the wheel E is moved to the front of the center of the disk.

What I claim as new is—

1. The combination, with a topographometer-frame, of the revolving disk D, the reciprocating revolving shaft a^4, the rotative wheel E, mounted rigidly on the said shaft in position for the periphery of the wheel to bear against the face of the disk, the reciprocating rack-bar b^4, connected with the shaft, and the

weighted pivoted lever F, provided with a spur-gear adapted to engage with the rack-bar and to cause the wheel to be automatically reciprocated by gravitation across the face of the disk, substantially as and for the purposes described.

2. In a topographometer, the revolving disk D and the wheel E, rotated by frictional contact with and reciprocated across the face of the disk, in combination with a revolving recording-wheel provided with raised figures, an endless ink-ribbon adapted to be run across the face of the raised figures, a tape arranged to run against the face of the ink-ribbon, and the automatically-operating hammer, substantially as and for the purposes set forth.

3. The combination of the section B of the carriage-frame, the axle a, having its bearings in the frame, the ground-wheel A, rigidly fixed on the axle, the disk D, mounted rigidly on an extended end of the axle and provided with one or more trip-pins, the revolving reciprocating shaft a^2, the wheel E, mounted rigidly on the said shaft in position for the peripheral surface of the wheel to bear against the face of the disk, the recording-wheel G, mounted loosely on and revolving with the shaft a^2 and provided with raised figures, the endless ink-ribbon d^2, arranged to run in front of the face of the raised figures, the tape c^3, adapted to be run against the face of the ink-ribbon, the stamping-hammer d^3, adapted to be automatically operated by the trip-pins, the reciprocating rack-bar b^4, provided with the bifurcated arm b^5, connected with the reciprocating shaft a^2, and the weighted pivoted lever F, provided with spur-gearing adapted to engage with and reciprocate the rack-bar, and thus cause the wheel to be automatically reciprocated by gravitation across the face of the disk, substantially as and for the purposes described.

4. The combination, with a topographometer-frame in two sections, B B′, pivotally connected with each other, of the revolving disk D′, mounted on an axle having its bearings attached to the section B of the frame, the reciprocating revolving shaft a^3, mounted in bearings attached to said section B and pivotally connected at one end with the section B′ of the frame, and the rotative wheel E′, mounted on the said shaft in position for the periphery of the wheel to bear against the face of the disk, said devices being all constructed and arranged to enable the rotative wheel to be reciprocated automatically across the face of the disk by the horizontal changes in the direction of the movements of the machine, substantially as and for the purposes described.

5. The combination, with a topographometer-frame in two sections, B B′, pivotally coupled together, of the revolving disk D′, provided with one or more trip-pins, the reciprocating revolving shaft a^3, pivotally connected with section B′ of the frame, the wheel E′, mounted rigidly on the said shaft in position for the periphery of the wheel to bear against the face of the disk, the recording-wheel G′, mounted loosely on the shaft a^3 and provided with raised figures, an endless ink-ribbon arranged to run in front of the face of the raised figures, a tape arranged to run along the face of the ink-ribbon, and the hammer d^3, adapted to be operated automatically by the trip-pins, substantially as and for the purposes set forth.

6. In a topographometer, a revolving disk and a wheel rotated by the frictional contact of its peripheral surface with and reciprocated across the face of the disk, in combination with recording devices consisting of a revolving wheel provided with raised characters, a measuring-tape caused to travel across the raised characters on the recording-wheel, and an automatically-striking hammer, all the devices being constructed and arranged to automatically record the distances, elevations, depressions, and horizontal deflections of ground-surfaces traveled over by the machine, substantially as and for the purposes set forth.

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

JAMES W. SNAPP.

Witnesses:

H. A. DANIELS,

FRANK M. GREEN.