May 7, 1963 K. SCHWIDEFSKY ETAL 3,088,209

APPARATUS FOR DRAWING PROFILES

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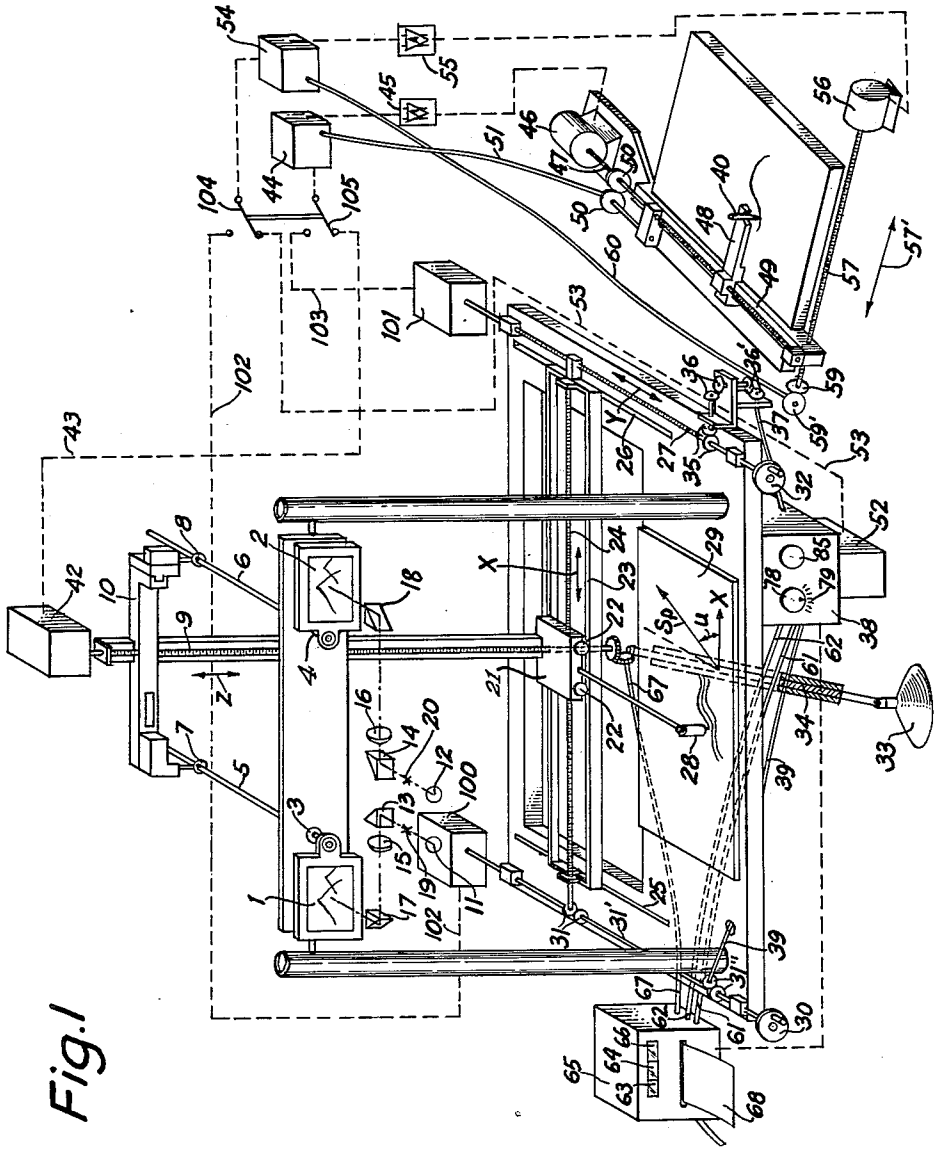


Fig. 1

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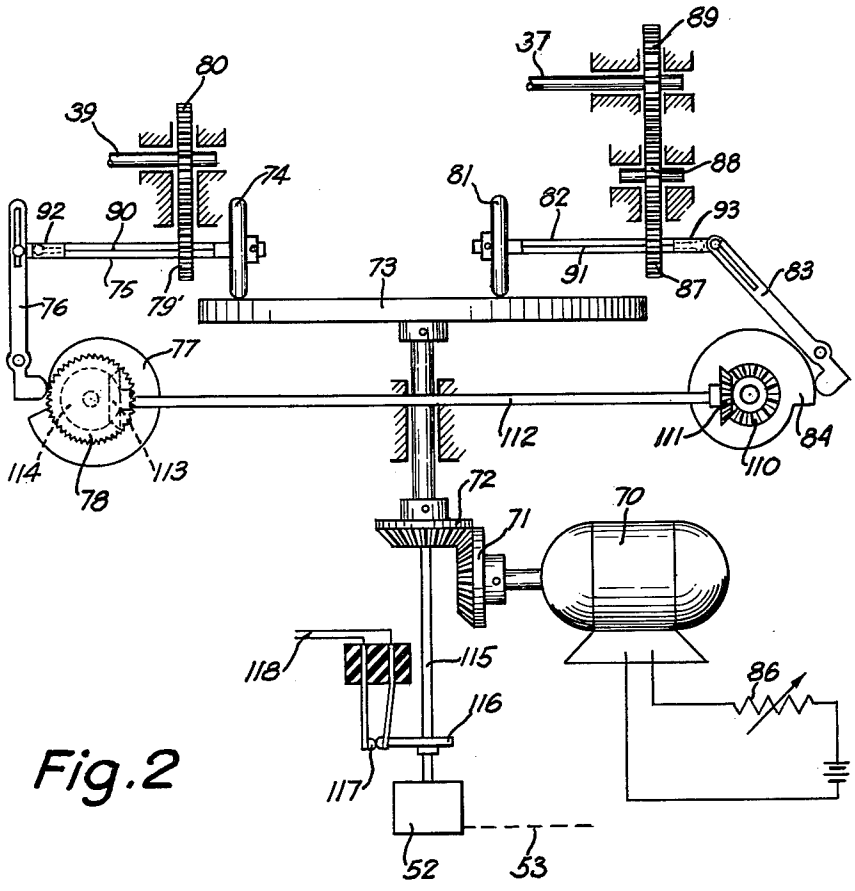


Fig. 2

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APPARATUS FOR DRAWING PROFILES

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3 Claims. (Cl. 33—20)

The present invention relates to an apparatus for interpreting and drawing profiles of aerial or terrestrial photographs. More in particular, the present invention relates to an apparatus of the type referred to, which is capable of producing a stereoscopic image of the reference mark and transmitting three-dimensional movements of the latter to the drawing pencil.

It is known in the art to provide an apparatus for drawing profiles for stereoscopic devices for interpreting aerial or terrestrial photographs, wherein the stereoscopic image of a reference mark can be displaced in the direction of a profile track and which is also adapted for height adjustment relative to the terrestrial view and wherein the respective position of the reference mark can be read from a recording device. The movement of the reference mark is transmitted to a drawing pencil recording this movement on a piece of paper. The drawing pencil is connected with a cross-slide supporting the reference mark or the aerial photographs, so as to record the movements of the latter. For the drawing of a profile a first guide is positioned on the piece of paper in the direction of the profile track. A second guide supports the drawing pencil, is disposed vertically relative to the piece of paper and can be displaced in the first guide. By moving the cross-slide supporting the reference mark or the aerial photograph in the directions of one coordinate, the reference mark is displaced parallel relative to the first guide. If the height of the reference mark is so adjusted as to scan, the representation of the landscape in the direction of the profile track its scanning movement is transformed into a corresponding motion of the drawing pencil in the second guide.

The details of this known apparatus are described, for example, in Schwidefsky, Grundriss der Photogrammetrie, Stuttgart 1954, page 86 (pages 103–105 of the English translation of this book—An Outline of Photogrammetry, London, 1959).

This known apparatus has a plurality of substantial disadvantages. The accuracy of measurement is limited. The lever transmission means between the cross-slide and the drawing pencil is a source of considerable error. Furthermore, the rigid connection between the drawing pencil and cross-slide makes it impossible to place the drawing table at any desirable position relative to the apparatus which would be frequently advantageous as it would enable a better observation of the movement of the drawing pencil. The fixed coupling between the drawing pencil and the cross-slide also necessitates a constant scale of reproduction, and it is not possible to vary the scale.

The known apparatus is also rather complicated as it requires additional means for separating the cross-slide from one of the spindles in order to prevent the driving means of the reference mark from being blocked by the other spindle.

With the foregoing in mind it is an object of the present invention to provide an apparatus for drawing profiles for the stereoscopic interpretation of terrestrial views, which is comparatively simple in structure.

It is another object of the present invention to provide an apparatus for drawing profiles for the stereoscopic interpretation of terrestrial views, which operates with far greater accuracy than the known devices.

It is a further object of the present invention to provide an apparatus for drawing profiles for the stereoscopic interpretation of terrestrial views, which makes it possible to place the drawing table at any desirable location with respect to the apparatus.

It is still another object of the present invention to provide an apparatus for drawing profiles for the stereoscopic interpretation of terrestrial views, which makes it possible to vary the scale of reproduction of the drawing.

These objects and advantages are achieved by the apparatus of the present invention comprising driving means impelling, via friction disk means, the spindles which in turn drive the reference mark, thereby displacing them in the plane of measurement along the profile track in proportion to the sine and in proportion to the cosine of the profile track, and wherein the driving means simultaneously actuate recording means wherefrom the respective positions of the reference mark can be read. In this apparatus, the reference mark is moved along the profile track entirely independently from the drawing means. This apparatus greatly simplifies the scanning operation of the landscape model since the reference mark has to be adjusted only as to its height and it is no longer necessary to adjust the same in different coordinate directions. The driving means may comprise a variable speed motor or can be hand-impelled.

According to another embodiment of the present invention, the spindles are connected with electric follow-up control means transmitting the movement of the spindles to a drawing pencil. There is further provided a switch adapted for connecting, at will, the follow-up means driving the drawing pencil either with those spindles effecting a displacement in two coordinate directions or with all spindles effecting a displacement in three coordinate directions. In the first case the apparatus is used like a conventional map-plotting device, whereas in the last-mentioned instance it is used for drawing a profile.

According to a further embodiment of the invention the spindles can be connected with recording means actuated by a contact control disk impelled by the driving means. The contact control disk actuates the recording means to effect recordings in predetermined intervals. The recording means can be provided with a printing device known per se, printing the recorded values of the three-dimensional coordinates.

The invention will be better understood upon the following description of the accompanying drawings illustrating the invention, by way of example, with respect to an apparatus for drawing profiles for the stereoscopic interpretation of horizontal terrestrial views, wherein FIGURE 1 is a perspective view of the apparatus of the invention; FIGURE 2 is a perspective view of the driving means in the apparatus of the invention.

Referring now to the drawings more in detail and turning to FIGURE 1 showing in its left-hand portion stereoscopic viewing means for stereoscopically viewing measuring marks and a terrestrial photograph, the reference numerals 1 and 2 identify two terrestrial photographs, which are mounted on levers 5 and 6 respectively. The levers 5 and 6 are hingedly positioned in the fixed joints 3 and 4. With their respective opposite ends the levers 5 and 6 are hingedly connected with the support 10 by means of ball joints 7 and 8.

The stereoscopic viewing means comprise two eye pieces 11 and 12, the mirror prisms 13 and 14, the objective lenses 15 and 16 and two further mirror prisms 17 and 18. Two reference marks 19 and 20 are disposed in the image plane of the eye pieces.

The terrestrial photographs 1 and 2 can be stereoscopi-

cally observed through the eye pieces 11 and 12, the mirror prisms 13 and 14, the objectives 15 and 16 and the two further mirror prisms 17 and 18. At the same time, the two reference marks 19 and 20 appear as a single reference mark in the stereoscopic terrestrial view. Carrier or support 10 constitutes a displacement element movable in three perpendicular coordinate directions by means of an apparatus comprising three-dimensional displacement means for relatively moving the reference mark in the directions x, y, and z within the stereoscopically viewed pictures. For effecting this, the support 10 is mounted on a spindle 9, and both the support and the spindle are mounted on a carriage 21. The carriage 21 can be moved in the directions x, as indicated by the double-headed arrow, by means of the spindle 24, and on rolls 22 travelling along the guide rail 24. This displacement is done by turning a hand wheel 30 actuating the spindle 24 via bevel gears 24.

This guide rail 23 can be moved in the directions y (as indicated by the double-headed arrow) by means of a spindle 27, travelling along guide rails 25 and 26 extending perpendicularly relative to the guide rail 23. The movement is effected by means of the hand-wheel 32, turning the spindle 27 and thereby displacing the guide rail 23 along the guide rails 25 and 26.

The displacement of the carrier 10 in the directions z (as indicated by the double-headed arrow) is effected by means of a foot-operated pedal 33 actuating the spindle 9 via the Cardan shaft 34.

The position of the reference mark relative to the aerial or terrestrial view is changed by the afore-described three-dimensional displacing means. The reference mark can thus be moved in the directions x, y, and z by displacing the carriage 21, the guide rail 23, and the support 10, respectively. The reference mark can thus be positioned at any location of the landscape represented by the terrestrial view. If, for example, the reference mark is adjusted to a particular height by the support 10 and if the reference mark is displaced horizontally along the landscape represented by the terrestrial view, then a drawing pencil 28 connected with the carriage 21 draws on a sheet of paper 29 the contour lines corresponding to the adjusted height z.

The apparatus of the invention is further equipped with means for drawing a profile section, such as, for example, a profile section having a track Sp in the x—y plane, and forming with the x coordinate the angle u, as shown on the paper 29, and comprising a plurality of driving means, transmission means and control means which will next be described.

The spindle 27 is connected with the driving means 38, consisting e.g. of an electric motor, via the bevel gears 35, 36, 36′ and the flexible shaft 37.

The spindle 24 is also connected with the driving means 38, via the bevel gears 31, the driving shaft 31′, the bevel gears 31″ and the flexible shaft 39.

As described in detail further below, the driving means turn the shafts 37 and 39 in such a manner, that the carriage 21 moves in the directions x in proportion to the cosine of angle u, and that the guide rail 23 moves in the directions y in proportion to the sine of angle u. Consequently, the reference mark moves along the profile track Sp.

For the drawing of the profile the foot pedal 33 is in communication with follow-up control means which, in turn, actuate a drawing pencil 40. The follow-up control means comprise electric control element 42, a receiver 44, an amplifier 45, a servo motor 46, the driving spindle 47, slide carriages 48 and 49, gears 50 and shaft 51. The electric control element 42 is connected with spindle 9 and produces a voltage in proportion to the revolutions of spindle 9. As an electric control element it is possible to use, for example a rotary field instrument.

The control voltages produced by the electric control element 42 are fed into the receiver 44 via wiring connection 43 (indicated by the dashed lines). The receiver controls the motor 46 via amplifier 45, the motor 46 driving spindle 47. The latter displaces the slide carriage 48 mounted on slide carriage 49, which latter bears the drawing pencil 40. The spindle 47 actuates receiver 44 via gears 50 and shaft 51 in such a manner that the receiver supplies zero voltage as soon as the follow-up operation has been completed.

The drawing of the profile by the aforedescribed means is initiated by pressing foot pedal 33 and adjusting the reference mark so as to remain in constant contact with the landscape represented by the terrestrial view. The movement of spindle 9 as actuated by foot pedal 33 via shaft 34 is then transmitted to the drawing pencil 40 by the follow-up control means.

The second component of displacement of drawing pencil 40, in the directions as indicated by double-headed arrow 57′, is obtained directly from the driving means 38, through a second follow-up control means comprising the electric control element 52, receiver 54, amplifier 55, servo motor 56, shaft 57 and carriage 49, bevel gears 59 and 59′ and the flexible shaft 60. The electric control element 52 is connected with the driving means, and, via the wire connection 53 (indicated by the dashed line), with the receiver 54. The latter controls the follow-up motor 56 via amplifier 55, and motor 56 turns shaft 57, which, in turn, displaces the carriage 49. The shaft 57 actuates the receiver 54 via gears 59, 59′ and flexible shaft 60 in such a manner, that the receiver supplies zero voltage as soon as the follow-up operation has been completed.

The apparatus of the invention further has recording means, comprising a counter 65 and rollers 63, 64, 66. The counter 65 is connected with the spindles 24, 27, and 9 via the shaft 61, 62 and 67, respectively, and records the respective movements in the directions x, y, z, on the rollers 63, 64 and 66. As described further below, the driving means 38 actuates a printing device in the counter 65 in predetermined intervals, thereby recording the values of the counter on a paper strip 68.

The driving means 38 is shown in greater detail in FIGURE 2. The motor 70 can be adjusted for operation at various speeds and drives a friction disk 73 via the bevel gears 71, 72, thereby impelling the rollers 74 and 81 running on the upper surface of friction disk 73.

The first roller 74 is connected with a curved disk 77 via the levers 75, 76, whereby it is possible to adjust the distance of roller 74 from the center of friction disk 73. The curved disk 77 is connected with a rotary control button 78. By turning this button 78, the desired angular value u with which the profile is to be drawn up can be adjusted on a scale 79 (see FIGURE 1), whereupon the roller 74 obtains a value proportional to the cosine of u from the friction disk 73. The roller 74 than drives the gears 79′, 80, which, in turn, impel shaft 39.

The second roller 81 can also be adjusted with respect to its distance from the center of friction disk 73. For that purpose the roller is connected with the rotary control button 78 via the bevel gears 110, 111, shaft 112 and bevel gears 113, 114. If, as mentioned above, the control button 78 is adjusted to the angle value u on scale 79, the roller 81 is removed from the center of friction disk 73 so as to rotate in proportion to the sine of angle u. The rotary movement of roller 81 is transmitted to the gears 87, 88, 89, the latter gear driving the flexible shaft 37.

The gears 79′ and 87 are positioned in guides 90 and 91 of the levers 75 and 82, respectively; thus they rotate together with the levers 75 and 82 but at the same time allow for the axial displacement of rollers 74 and 81. The ends of the levers 75 and 82 opposite to the rollers 74 and 81 are rotatably positioned in bushings 92 and 93.

The recording means can be equipped with a printing

device associated with the counter 65 (not shown). Such a printing device can be controlled as follows:

A control element 52 is connected with bevel gear 72 via the shaft 115. The shaft 115 bears a contact disk 116 actuating a switch 117. The printing device is connected by this switch 117 via wire 118.

The apparatus of the present invention is further provided with means for adapting it to two-dimensional operation, in which case only the x and y movements of the reference mark are transmitted to the drawing pencil. The apparatus then operates like a conventional map-plotting device.

In order to effect this adjustment, there are provided two further control elements 100 and 101. The control element 100 is connected with the spindle 24 via the bevel gears 31 for the x-displacement, whereas the control element 101 is connected with spindle 27, for the y-displacement. The control voltages produced by the control elements 100, 101, can be supplied to the receivers 54 and 44 via wires 102, 103 and switches 104, 105.

If the switches 104, 105 are in their respective closed positions, the apparatus of the invention operates like a conventional map-plotting device, as only the x and y-movements of the reference mark are transmitted to the drawing pencil 40, whereas the z directions are not transmitted. If the height is held constant, the drawing pencil will draw the contour lines.

Thus, the apparatus of the invention can be used either as a two-dimensional map-plotting device, or as a device recording the three-dimensional displacement of the reference mark so as to draw profile sections in any desired direction, depending on the position of switches 104 and 105. Consequently, it is also possible to dispense with the drawing means 28 and 29.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

What we claim is:

1. An apparatus for drawing profiles for the stereoscopic interpretation of terrestrial views comprising, in combination, two terrestrial photographs; two stereoscopic viewing means, each of said viewing means having an eye piece, a plurality of mirror-prisms and an objective lens, and two reference marks, respectively arranged in the ray path formed in said stereoscopic viewing means for said photographs, said terrestrial photographs and said reference marks forming a steroscopic terrestrial image with a visual reference mark floating therein; a displacement element movable in three perpendicular coordinate directions including two horizontal and one vertical direction; means for recording the position of said displacement element; means for transferring the three directional movement of said displacement element as individual, two directional displacements of said terrestrial photographs relative to said reference marks; first driving means for moving said element in a settable straight line in a horizontal plane, thereby guiding said visual reference mark on a correspondingly straight line through said terrestrial image; a second driving means for moving said displacement element in a vertical direction; a drawing means having a slide carriage; two spindles provided for said slide carriage at right angles to one another for displacement of said slide carriage in two directions which are perpendicular to each other; a first electrical receiver; a first control element responsive to the movement of said first driving means and connected to said first receiver; first follow up control means including a first servo motor electrically connected to and energized by said first receiver, said first servo motor driving one of said spindles of said slide carriage; a second receiver; a second control element connected to said second receiver and being responsive to said second driving means and to said vertical movement of said displacement element; and a second follow up control means including a second servo motor connected to and energized by said second receiver, said second servo motor driving the other one of said spindles of said slide carriage.

2. An apparatus for drawing profiles for the stereoscopic interpretation of terrestrial views comprising, in combination, two terrestrial photographs; two stereoscopic viewing means, each of said viewing means having an eye piece, a plurality of mirror-prisms and an objective lens, and two reference marks, respectively arranged in the ray path formed in said stereoscopic viewing means for said photographs, said terrestrial photographs and said reference marks forming a stereoscopic terrestrial image with a visual reference mark floating therein; a displacement element movable in three perpendicular coordinate directions including two horizontal and one vertical direction; means for transferring the three directional movement of said displacement element as individual, two directional displacements of said terrestrial photographs relative to said reference marks; a first driving means including a variable speed motor for moving said displacement element in said two horizontal directions; a second driving means for moving said displacement element in a vertical direction; a drawing means having a slide carriage; two spindles provided for said slide carriage at right angles to one another for displacement of said slide carriage in two directions which are perpendicular to each other; a first electrical receiver; a first control element responsive to the movement of said first driving means; and connected to said first receiver; first follow up control means including a first servo motor connected to and energized by said first receiver, said first servo motor driving one of said spindles of said slide carriage; a second receiver; a second control element connected to said second receiver and being responsive to said second driving means and to said vertical movement of said displacement element; a second follow up control means including a second servo motor connected to and energized by said second receiver, said second servo motor driving the other one of said spindles of said slide carriage; two electric elements individually responsive to the movements of said element in said two horizontal directions; and selective switching means for respectively connecting said two electric elements to said two receivers and disconnecting said two receivers from said first and second control elements.

3. An apparatus as described in claim 2, further comprising recording means for individually recording the three directional movement of said displacement element, and a contactor driven by said first driving means for periodically actuating said recording means.

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