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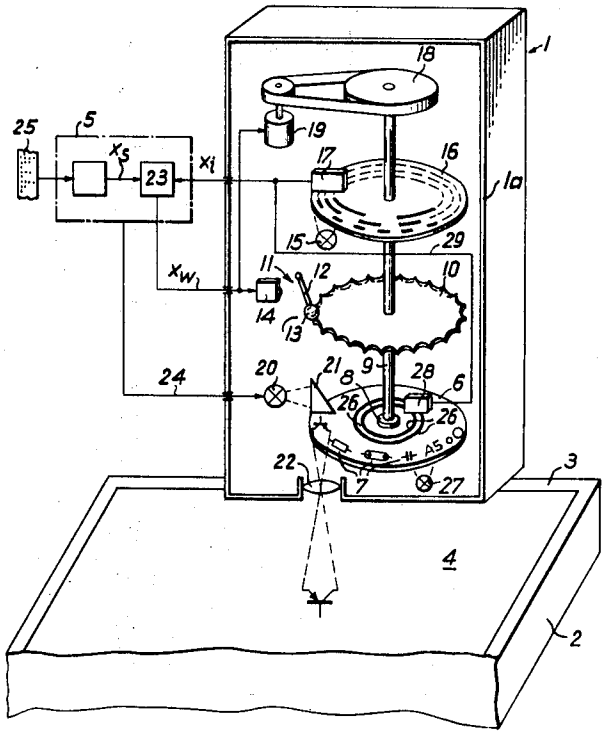
[54] **AUTOMATIC DRAWING DEVICES**
2 Claims, 1 Drawing Fig.

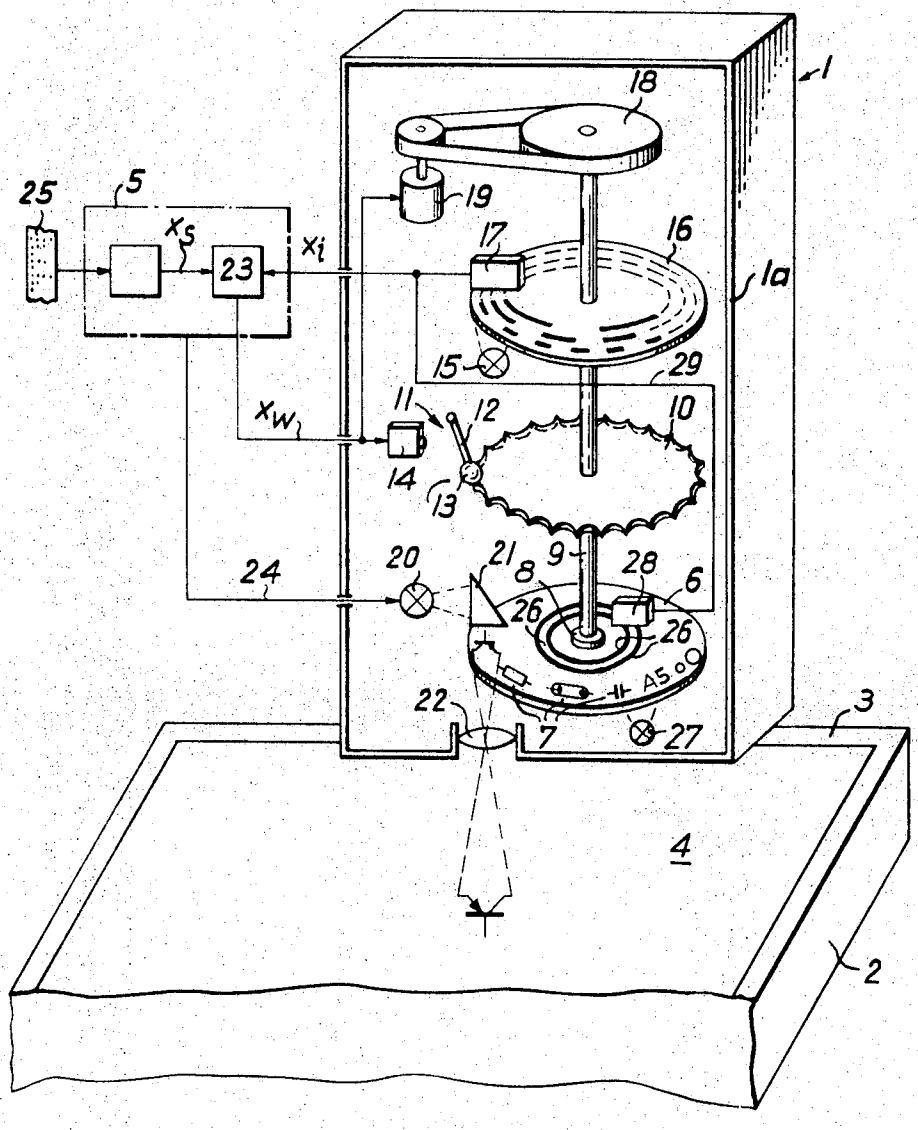
[52] **U.S. Cl.** 95/1; 346/107
[51] **Int. Cl.** **B41b 17/04**
[50] **Field of Search** 346/107, 108; 95/1, 4.5

[56] **References Cited**
UNITED STATES PATENTS
3,330,182 7/1967 Gerber et al. 95/1

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ABSTRACT: A device for automatically selecting symbols to be reproduced in the automatic production of drawings, which device includes a disc carrying various symbols to be produced and means for automatically rotating the disc so as to bring it into position to produce a desired symbol, this automatic positioning being accomplished by causing the disc to rotate in unison with a code carrying element which produces a code signal coinciding with a position instruction symbol when the disc is in such a position that the desired symbol is in position to be reproduced on a drawing surface.





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AUTOMATIC DRAWING DEVICES

BACKGROUND OF THE INVENTION

The present invention relates to an optical writing head with a symbol magazine, preferably for use in a numerically controlled coordinatograph or the like.

The article "Numerische Steuerung und Messung bei Koordinatographen" (Numerical Control and Measurement in Coordinatographs) published in AEG-Mitteilungen (AEG News), Vol. 54, No. 5/6, (1964) pages 376—381, describes the movement of the writing implement of a coordinatograph in two mutually perpendicular directions, across a drawing surface by means of a numerical control device. The drawing surface is of a suitable paper and the writing implement is a pen supplied with india ink, the application of the pen to, and its removal from, the drawing surface being effected by the numerical control device.

The cited article further discloses that numerically controlled coordinatographs can be used in cartography, photogrammetry and, generally, in the construction field. A numerically controlled coordinatograph can also be used to advantages for the preparation of the master drawings for printed circuits and for extensive electrical circuit diagrams and the like.

Previously, the preparation of an etching pattern for printed circuits was accomplished in the following manner: A photographic transparency is required for the production of the printed circuit by an etching process, the transparency carrying a pattern conforming to the required conductive paths in positive or negative. To produce the master for this transparency, use is made of suitable drawing paper, which is provided with a grid pattern if required, onto which the required conductive paths, soldering dots, and the like are drawn with india ink. The drawing is then photographed to produce the transparency, which is to a smaller scale than the drawing.

It is also known to prepare the pattern to be photographed by placing narrow strips and round patches of black adhesive material on the drawing paper rather than drawing the conductive paths and soldering dots with india ink.

Both methods for preparing the pattern are rather cumbersome and time-consuming, particularly when used for preparing patterns for printed circuits which have a large number of conductive paths of soldering dots.

Moreover, certain problems arise in the preparation of the pattern using india ink due to the fact that, in order to produce a fault-free drawing of the conductive paths, a rotating writing implement, *e.g.*, an ink-filled tubular pen, is used. As a result, the rate of advance of this writing implement, *i.e.*, the rate at which a line is drawn, can not be too great or else the conductive paths will not be properly drawn and they will have the form of cycloids.

The preparation of extensive drawings in various fields, in which a plurality of symbols are produced by means of a numerically controlled coordinatograph, has the drawback that the programming of these symbols and the drawing of them by means of the writing implement of the coordinatograph requires a great deal of time.

An optical exposure head is also known which operates in conjunction with light-sensitive paper, one of these being the optical exposure head manufactured by Gerber Scientific Instrument Company. The exposure head has a magazine which serves to hold a number of symbols whose image can be projected onto the light-sensitive paper. The exposure head is intended to be used particularly in connection with the preparation of printed circuits. The drawback of this exposure head is that its magazine must be reloaded repeatedly with different sets of symbols depending on the task to be accomplished. Erroneous loading of the magazine with the wrong symbols or with symbols in the wrong order is possible. Moreover, the repeated loading of the magazine requires a considerable amount of time.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to overcome these drawbacks and difficulties.

Another object of the invention is to substantially simplify the automatic production of drawings.

A more specific object of the invention is to accelerate and simplify the selection of various symbols to be reproduced.

Still another object of the invention is to provide a device which can be readily adapted to the production of different sets of symbols.

These and other objects according to the invention are achieved by the provision of certain improvements in a writing head having a symbol magazine for reproducing symbols on a drawing surface under the control of a symbol selecting numerical control device. According to the improvements of the invention, the magazine is constituted by a disc carrying a plurality of symbols to be reproduced, the disc being rotatably mounted in such a manner as to be interchangeable with other discs and so that the position of each symbol is permanently associated with a respective instruction produceable by the control device.

BRIEF DESCRIPTION OF THE DRAWINGS

The single drawing FIG. is a partly perspective, partly schematic view of a preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The FIG. who shows only the writing implement **1** and the coordinate table **2** with its clamping frame **3** for a drawing surface **4** of the coordinatograph. A more detailed illustration of the coordinate table and the guide mechanism for moving the writing implement across the drawing surface can be found in FIG. 4 of the above-cited article. While an optical writing device is shown here, the invention is not limited thereto.

The writing implement **1**, whose housing **1***a* can be moved across the drawing surface **4** and stopped at any location indexed by the schematically illustrated numerical control device in a manner not illustrated, consists of a symbol magazine **6** which is advantageously constructed as a transparent disc provided near its periphery with a plurality of symbols **7**. In the present case the selected symbols are dots and short lines of different thicknesses, letters, numerals and circuit symbols used in the electronic art.

The symbol magazine **6** is mounted, in a manner not shown in detail, against a flange **8** of a shaft **9** so as to have an accurately determined axial position with respect to the shaft. One symbol magazine **6** can be interchanged with other magazines containing other sets of symbols. Not shown in detail is the provision of the writing implement housing **1***a* with an opening for insertion and removal of symbol magazines.

The shaft **9** carries a star wheel **10** which has at its periphery a number of notches corresponding to the number of symbols **7**. The star wheel **10** cooperates with a detent mechanism **11** consisting of a lever **12** pivotally mounted at one end and carrying a detent ball **13** at its other end. The lever **12** is permanently biased, for example by a spring (not shown) into the detent position shown and is associated with an electromagnet **14** which is energizable to pull the lever into a refracted position.

The shaft **9** further carries a code disc **16** which is illuminated by a light source **15** and whose digital code, in the form of transparent areas, is scanned by a photoelectric reading device **17**. From the output of the reading device **17**, magazine indexing, or position, answer-back signals are fed to a digital comparison member **23** of the numerical control device **5**. The code disc **16** could be eliminated if instead the star wheel **10** or the symbol disc **6** is provided with the digital code. Instead of photoelectric scanning of the answer-back code, the code could be in the form of areas of conductive material and a contact brush scanning method could be used.

The shaft 9 is connected with the shaft of a servomotor 19 via a belt pulley, the servomotor being controlled by the comparison member 23 of the numerical control device associated with the coordinatograph.

The symbol magazine 6 has an associated light source 20 which is controlled by the numerical control device 5 and whose light, for example, is directed onto the symbol region of magazine 6 by a prism 21. The illuminated symbol, here a transistor symbol, is focused by an optical system 22 onto the light-sensitive drawing surface 4. The symbol to be photographically recorded is determined by the positioning of the symbol magazine 6.

It is desired to keep the writing implement 1 as small as possible. Thus the symbol magazine 6 should not have a diameter larger than about 5 cm. This would permit approximately 64 symbols to be disposed in a circle near the periphery of the symbol magazine 6. Accordingly the symbol magazine must be able to be set at any one of 64 angular positions and the star wheel 10 should have 64 detent notches.

Rotation of the symbol magazine into a selected one of the 64 positions is effected by the positioning system consisting of servomotor 19, star wheel 10, detent mechanism 11 and code disc 16 associated with scanner 17. For each positioning of magazine 6, the numerical control device 5 derives a digital nominal position value X_s from an information storage medium such as punched tape 25 and delivers this value to the digital comparison member 23 for positioning the symbol magazine 6. The comparison member 23 compares the nominal position value X_s with the actual position values X_i constituting answer-back signals detected by scanner 17. The error, or nonidentity, signal X_w appearing at the output of the comparison member 23 causes the servomotor 19 to receive a driving voltage and the electromagnet 14 to be energized. Thus, the lever 12 of the detent mechanism 11 is attracted to the magnet 14 so that the star wheel 10 is free to rotate and the wheel, the symbol magazine 6 and the code disc 16 are driven in one direction by motor 19 until the answer-back signal X_i sensed by scanner 17, coincides with the nominal position value X_s. This coincidence reduces X_w to zero so that the servomotor 19 is stopped and the electromagnet is deenergized. The lever 12 is thus released so that it can pivot to permit its ball 13 to engage in the notch of the star wheel 10 which is then adjacent detent 11.

The symbol magazine 6 is thus rotated under the influence of control mechanism 5 until it reaches a certain angular position and its exact placement in the predetermined position is accomplished by the detent mechanism 11 and the star wheel 10. The numerical control device 5 emits control signals via line 24 to the light source 20 associated with the symbol magazine 6 to effect an on–off control of the light source 20.

To prepare the desired drawing on the surface 4 the numerical program of the control mechanism 5 is fed in, for example, by means of the punched tape 25.

Drive and positioning means for the magazine can also be constructed in such a manner that the drive is accomplished by a stepping motor and that a reference mark is provided on the symbol disc itself or on the motor shaft, which is coupled to the symbol disc for relating the symbol positions with the answer-back signal. This reference mark is the starting point from which the number of stepping pulses is selected for each positioning action depending on the selected symbol.

The form of construction according to the present invention can be applied to achieve a simple solution to a diversity of problems. Thus it is possible, for example, without any modifications of the writing implement 1, to change over from a device for preparing a conductive path drawing for an etching pattern to a device for preparing drawings for electrical circuit diagrams, current paths, and the like.

Conductive paths are produced with the writing implement 1 by selecting a dot of a certain diameter in the symbol magazine 6. In the writing implement according to the drawing, the symbol magazine 6 is displaced by its positioning device and by the numerical control mechanism until, for example, this first dot symbol, rather than the transistor symbol, appears under the prism 21. Light source 20 is then turned on by a signal on line 24 and the writing implement 1 is then moved continuously, by signals delivered by the numerical control device 5 to suitable carriages (not shown), as required, over the light sensitive surface 4, so as to cause the image of the light dot of the writing implement 1 to be projected on the surface 4 and to appear thereon as a drawn line. The table 2 is provided with drive means (not shown in detail) for so displacing the writing implement 1.

The construction of the symbol magazine 6 as a transparent disc and the positioning device as a star wheel, detent mechanism and coded disc permits a simple, but very exact, positioning.

The previously required drawing of symbols, such as for transistors, resistors, etc., by moving the writing implement is thus completely eliminated.

The preparation of, for example, an extensive electrical circuit diagram is accomplished as follows:

The location of circuit symbols on the surface 4 are programmed, as are the connections, by drawn line of the symbols representing various circuit elements. Advisably, all of the symbols are first applied to the surface 4 and then the lines to connect these symbols are drawn. As already mentioned above, the symbol magazine 6 is set for this purpose for a "-dot" symbol of a certain diameter and the light dot appearing on the surface 4 is moved, as required, by movement of the writing implement.

The numerical control device 5 acts to move the writing implement to produce drawn lines if required, and controls which symbol the writing implement is to employ.

The insertion of a wrong symbol disc 6 in the housing 1*a* is prevented according to the invention by a suitable code incorporated into the position answer-back signal. The symbol disc 6 is provided with a plurality of digital code tracks 26 illuminated by a light source 27 and scanned by a photoelectric reading devise 28. The disc 6 carries, for example, three code tracks 26 representing the binary number LOL (5) for this disc. The scanner 28 adds a disc number signal (LOL) via line 29 to the output of the scanner 17. Each other disc, not shown, carries a different code 26. Thus, the actual position values X_i are performed by combination of the digital position answer-back signal of scanner 17 with the disc number signal of scanner 28.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations.

I claim:

1. An optical writing head comprising, in combination: a symbol magazine for reproducing symbols on a drawing surface, said magazine including:

a. a disc carrying symbols to be reproduced and a disc identification code unique to that disc;

b. support means on which said disc is mounted for rotation and in such a manner as to be interchangeable with other discs;

c. first signal producing means associated with said disc for producing a signal representing the disc identification code;

d. position code means rotatable in sychronism with said disc and carrying a code representing the position of each symbol on said disc;

e. second signal producing means associated with said position code means for producing a signal representing that symbol which is in a position to be reproduced; and

f. drive means connected for rotating said disc; a symbol selecting numerical control device for producing an instruction identifying the disc to be employed and the position of the symbol to be reproduced; and comparison means connected to said control device and to said first and second signal producing means and operatively associated with said drive means for terminating the rotation produced thereby when the signals produced by said

first and second signal producing means coincide with the instruction produced by said control device.

2. An arrangement as defined in claim 1 further comprising

a second disc mounted for rotation with said symbol carrying disc and carrying said position code means.