

SCANNER

TECHNICAL FIELD

5 The present invention relates to a scanner, and particularly to an apparatus which increases a speed of scanning by a laser beam in a laser marker for marking at a higher speed.

BACKGROUND ART

10 There has been the demand for marking at a higher speed by a laser marker in recent years. A technique for attaining a higher speed of this kind is disclosed, for example, in Japanese Patent Application Laid-Open No. 2-268988. According to the technique, the display
15 plane of a liquid crystal mask is divided into upper and lower halves in a laser marker. When the scanning of an upper half is complete and also when a lower half begins to be scanned, it begins to replace a pattern of marking for the upper half.

20 The aforesaid technique surely improves the speed of pattern replacement, but does not contribute anything to the attainment of a higher speed in terms of time required for scanning because scanning itself is executed over an entire image plane.

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SUMMARY OF THE INVENTION

In view of the foregoing, it is an object of the

present invention to provide an apparatus being capable of increasing a scanning speed itself.

According to a first aspect of the present invention, there is provided a scanner which main scans
5 a predetermined image plane in the direction X and executes sub scanning in the direction Y perpendicular to the direction X, the scanner including storage means for storing positions in the direction Y to be main scanned out of all positions in the direction Y in the
10 image plane in advance, position detecting means for detecting a position in the direction Y which is currently main scanned, and sub scanning control means which, based on the result of detection by the position detecting means, reads the next position in the
15 direction Y to be main scanned from the stored information in the storage means and which starts main scanning at the position in the direction Y thus read as soon as the current main scanning is complete.

According to a second aspect of the present
20 invention, there is provided a similar scanner wherein the order of sub scanning is obtained in advance based on positions in the direction Y to be main scanned out of all positions in the direction Y in the image plane, and main scanning is executed at each position in the
25 direction Y in the order of sub scanning thus obtained.

In the construction according to the first aspect of the present invention, the positions in the

direction Y where no main scanning is executed are removed in the image plane, and only the positions in the direction Y to be main scanned are stored in advance. On the other hand, the position in the direction Y which is currently main scanned is detected. Then, based on this result, the next position in the direction Y to be main scanned is read from the stored information, and the main scanning of the next position in the direction Y thus read is started as soon as the current main scanning is complete, thus making it possible to execute the scanning at a higher speed.

Also, in the construction according to the second aspect of the present invention, positions in the direction Y are thinned out based on the positions to be main scanned in the direction Y in the image plane by removing the positions in the direction Y which are not to be main scanned, thereby obtaining the order of sub scanning in advance. Main scanning is executed at each position in the direction Y in the order of sub scanning thus obtained, thus making it possible to execute the scanning at a higher speed.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view which illustrates a scanner of a laser marker according to the present invention;

Fig. 2 is a view which illustrates how a laser

beam scans the display plane of a liquid crystal mask of Fig. 1;

Fig. 3 is a view which illustrates a pattern of marking;

5 Fig. 4 is a flow chart which illustrates the processing of a first embodiment to be executed by a controller of Fig. 1; and

Fig. 5 is a flow chart which illustrates the processing of a second embodiment to be executed by the
10 controller of Fig. 1.

BEST MODE FOR CARRYING OUT THE INVENTION

A scanner according to embodiments of the present invention will now be described with reference to the
15 drawings.

Fig. 1 is a view which illustrates the embodiments of the present invention and which assumes an apparatus of scanning a liquid crystal mask in a laser marker by a laser beam.

20 A laser oscillator 1 produces a scanning laser beam, for example, a YAG laser beam. The produced laser beam impinges on a reflecting surface 2a of a deflector 2, which is a galvanometer scanner. The laser beam reflected at the reflecting surface 2a
25 impinges on a reflecting surface 3a of a deflector 3, which is a polygon mirror, through a lens 4. The laser beam reflected at the reflecting surface 3a impinges on

a liquid crystal display plane 6a of a liquid crystal mask 6 through a lens 5. The reflecting surface 2a of the deflector 2 is pivoted in the direction A of an arrow by a motor 8, and the reflecting surface 3a of the deflector 3 is rotated in the direction B of an arrow by a motor 9. Hence, as the reflecting surface 3a rotates in the direction B of the arrow by driving and controlling the motor 9, the laser beam main scans the liquid crystal display plane 6a of the liquid crystal mask in the direction X of an arrow, and also as the reflecting surface 2a pivots in the direction A of the arrow by driving and controlling the motor 8, the laser beam sub scans the liquid crystal display plane 6a of the liquid crystal mask 6 in the direction Y of an arrow.

A controller 7 drives and controls the motors 8,9 and controls laser oscillations of the laser oscillator 1, and moreover outputs a signal to drive predetermined pixels on the liquid crystal display plane 6a of the liquid crystal mask 6.

In detail, based on information about a pattern of marking which has been input by predetermined input means, the controller 7 outputs a signal to drive corresponding pixels on the display plane 6a of the liquid crystal mask 6. In response to this signal, the corresponding pixels are driven on the display plane 6a of the liquid crystal mask 6. Then, the motors 8, 9

are driven and controlled, and the laser oscillator 1 is driven and controlled, thereby executing scanning by the laser beam. The laser beam penetrates through the portion of the driven pixels and marks the work surface with a character, symbol or the like corresponding to the shape of the portion of the driven pixels, i.e. the shape of the pattern of marking through a predetermined optical system (not shown).

Fig. 2 illustrates how the laser beam scans the display plane 6a of the liquid crystal mask 6, pixels in a predetermined row being scanned in order from the left by main scanning in the direction X. Then, sub scanning in the direction Y causes scanning to proceed to the row next to the row where X scanning has completed. As a result, it becomes possible for X scanning to scan the next row in order from the left. A photosensor 10 is disposed at each row of the display plane 6a to detect whether the row is currently irradiated with the laser beam, for example, according to a photo reception level, and the result of detection by the photosensor 10 is sent to the controller 7. Based on an input signal from the photosensor 10, the controller 7 detects the row which is currently scanned by the laser beam.

The processing of a first embodiment which is executed by the controller 7 will now be described with further reference to a flow chart in Fig. 4. The

controller 7 executes control so as to scan only those rows where driven pixels exist.

First, the controller 7 creates the marking presence/absence data based on the aforesaid information about a pattern of marking. The marking presence/absence data indicates "presence of marking" for a predetermined row on the display plane 6a if there is even one pixel to be marked for the row and indicates "absence of marking" for a predetermined row if there is no pixel to be marked for the row. In detail, as illustrated in Fig. 3, when only hatched pixels on the display plane 6a are to be driven for marking a work with a character or the like corresponding to the driven pixels, the marking presence/absence data for each row is of logic "1" or "0" level corresponding to "presence of marking" or "absence of marking", respectively. The data of logic "1" or "0" level is stored in a memory, which is the predetermined storage means of the controller 7 (step 101).

Next, a signal is sent to the liquid crystal mask 6 to drive corresponding pixels on the image plane 6a of the liquid crystal mask 6 based on a pattern of marking, thus driving the pixels. For example, for a pattern in Fig. 3, only hatched pixels are driven (step 102).

Then, the motor 8 is driven such that scanning

starts from the starting row of Y scanning based on the marking presence/absence data created at step 101. For a pattern of marking in Fig. 3, the contents of the marking presence/absence data are "0" for the first and second rows, and hence the third row where the marking presence/absence data first becomes "1" is taken as the starting row; accordingly, the motor 8 is driven such that scanning starts from this starting row. Also, the motor 9 is driven such that scanning starts from the leftmost pixel on the third row (step 103).

Then, the motor 9 is driven to execute scanning in the direction X at the third row where driven pixels exist. As a result, the laser beam penetrates only through hatched pixels on the third row for marking (step 104). Then, the position in the direction Y (row) which is currently main scanned in the direction X is detected by the position detecting means based on an output from the photosensor 10 (step 105).

Then, it is judged whether the data for the row next to the detected row is "1", i.e. whether the next row is to be main scanned (step 106). Here, suppose that the third row is detected as a currently scanned row, and since the data for the next fourth row is "1" (refer to Fig. 3), the result of judgment is YES, and accordingly the procedure proceeds to step 107; hence, the motor 8 is driven so as to go to the next fourth row. Then, the aforesaid steps 104-107 are repeatedly

executed for executing main scanning as long as driven pixels exist (refer to the fourth and fifth rows in Fig. 3).

When the data for the next row to be main scanned is judged to be "0", i.e. NO at step 106, it is judged whether the row is the last row on the display plane 6a (step 108). Whether the next row is the last row is judged from whether or not the marking presence/absence data itself exists. In the case of the sixth row in Fig. 3, the data is "0", but the marking presence/absence data for the next seventh row exists; hence, it is judged that the sixth row is not the last row, and accordingly the result of judgement becomes NO, and the procedure proceeds to step 109.

At step 109, the processing is executed to go to the next row of the marking presence/absence data "1". In the case of the pattern of Fig. 3, since the data for the sixth row is "0" and since the main scanning of this row has nothing to do with marking, the search for the next row of the data "1" is made. Here, since the data for the seventh row is "1", the motor 8 is driven so as to go to the seventh row. Back at step 104, the motor 9 is driven to execute main scanning at the seventh row in the direction X. Steps for looping back from step 106 to step 104 are executed by the sub scanning control means.

At step 106, since the data for the eighth row is

"0", i.e. NO, the procedure proceeds to step 108.

Since the eighth row is the last row, the result of judgment is YES at step 108, thus putting an end to the processing on the assumption that marking is complete
5 for one image plane.

According to the first embodiment, the photosensor 10 to detect the laser beam is provided on the side of the liquid crystal mask 6, and the position in the direction Y which is currently main scanned is detected
10 based on an output from the photosensor 10; however, the present invention is not to be limited to this form, but the position in the direction Y may be detected by detecting the rotational position of the motor 8. Also, the position in the direction Y may be
15 detected based on the contents of a drive instruction to the motor 8.

According to the first embodiment, whether the next row is to be scanned is judged during executing scanning, but it is also possible to execute scanning
20 in previously determined order.

In this connection, a second embodiment of the present invention will now be described with reference to the flow chart of Fig. 5. First, the marking presence/absence data is created as in the aforesaid
25 step 101 (step 201). Then, the order of sub scanning is obtained based on the created data. For example, for a pattern of marking shown in Fig. 3, the order of

sub scanning is the third, fourth, fifth and seventh rows the contents of the data for which are "1". A drive instruction to the motor 8 is created such that main scanning is executed in this order of sub scanning (step 202).

Then, as in the aforesaid step 102, a pattern of marking is displayed on the liquid crystal mask 6 (step 203), the drive instruction created at the aforesaid step 202 is sent to the motor 8, and a drive instruction is sent to the motor 9 to execute main scanning at each row. As a result, main scanning is executed in order only at the rows the contents of the data for which are "1", i.e. only at the rows where driven pixels exist, thus reducing the processing time (step 204). Since the second embodiment does not require the photosensors 10, it has an advantage that the cost of the scanner reduces accordingly.

The first and second embodiments of the present invention have been described on the assumption that an object of application is a laser marker; however, the present invention is not to be limited to this form, but may be applicable to any other forms if they allow main scanning at predetermined rows to be omitted. Also, the first and second embodiments assume that main scanning is executed in the lateral direction (direction X) of the display plane, but main scanning may be executed in the longitudinal direction. In this

case, the marking presence/absence data may be created in columns, not in rows.

INDUSTRIAL APPLICABILITY

5 The present invention serves effectively in a laser marker as a scanner which increases the speed of scanning by a laser beam and greatly improves the work efficiency by marking at a higher speed.



WHAT IS CLAIMED IS:

1. A scanner which main scans a predetermined image plane in the direction X and executes sub scanning in the direction Y perpendicular to the direction X, said scanner including:

storage means for storing positions in the direction Y to be main scanned out of all positions in the direction Y in said image plane in advance;

position detecting means for detecting a position in the direction Y which is currently main scanned; and

sub scanning control means which, based on the result of detection by the position detecting means, reads the next position in the direction Y to be main scanned from the stored information in said storage means and which starts main scanning at said position in the direction Y thus read as soon as the current main scanning is complete.

2. A scanner according to Claim 1, said scanner being applied to a case where a liquid crystal mask in a laser marker is scanned by a laser beam, said scanner characterized in that said storage means stores, as positions to be main scanned by the laser beam, positions in the direction Y after removing the positions in the direction Y on a liquid crystal mask where no marking is executed, which positions to be removed are obtained based on a pattern of marking on



the liquid crystal mask.

3. A scanner which main scans a predetermined
image plane in the direction X and executes sub
5 scanning in the direction Y perpendicular to the
direction X,

wherein the order of sub scanning is obtained in
advance based on positions in the direction Y to be
main scanned out of all positions in the direction Y in
10 said image plane, and main scanning is executed at each
position in the direction Y in the order of sub
scanning thus obtained.

4. A scanner according to Claim 3, said scanner
15 being applied to a case where a liquid crystal mask is
scanned by a laser beam in a laser marker, said scanner
characterized in that said positions in the direction Y
to be main scanned are those after removing the
positions in the direction Y on a liquid crystal mask
20 where no marking is executed, which positions to be
removed are obtained based on a pattern of marking on
the liquid crystal mask.