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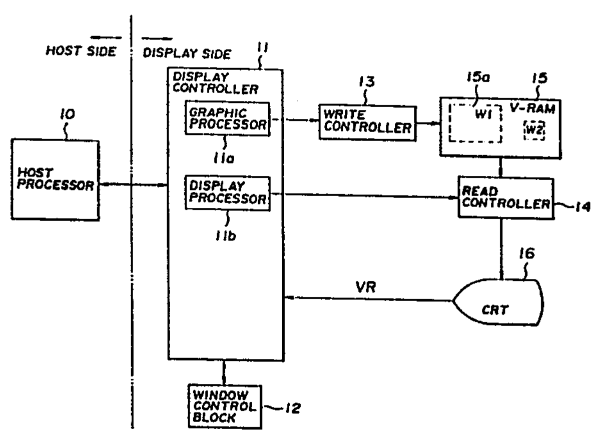
(54) **METHOD OF CONTROLLING DISPLAY.**

(57) At least one window image (W2) in a multiwindow image displayed on the screen of a CRT (16) is displayed by being moved relative to another window image (W1). The coordinate of position on the display screen of window image (W2) being moved is renewed while the beam is flying back vertically. The moving window image (W2) is read from a memory (15) and is displayed on the display screen when the beam is present in a region designated by the coordinate of position.



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DESCRIPTION

DISPLAY CONTROL METHOD

Technical Field

This invention relates to a display control method in which one window image among multiple window images displayed on a display screen is moved with respect to the other window images.

Background Art

In a multi-window image display in which one image W2 is displayed superimposed on another image W1 displayed in a first display region of a display screen, as shown in Fig. 4, a video RAM (V-RAM) 1 is provided, as shown in Fig. 5, the window images W1, W2 are stored in respective prescribed storage regions 1a, 1b of the V-RAM 1, and data indicating where the window images are to be displayed on the display screen and the precedence assigned in overlapping is inputted, in response to which a display controller displays the multi-window image on the display screen using the data.

More specifically, the window images W1, W2 are stored in the V-RAM 1, and the display positions and display precedence (e.g. W2>W1) of the window images W1, W2 on the display screen are inputted. In response, the display controller, which is not shown, reads the window images W1, W2 out of the V-RAM 1 in synchronization with the raster scanning of a CRT beam, and inputs the images to the CRT to display the multiple window images. It should be noted that the multi-window image display is performed by reading image W1 out of the storage area 1a of V-RAM 1 while the beam is present on the solid line arrows of Fig. 4, reading the image W2 out of the storage area 1b of V-RAM 1 while the beam is present on the dashed line arrows, and outputting the images to the CRT.

In a multi-window image display of this kind, there are cases where at least one window image W2 among the multiple window images is moved with respect to the other window image W1.

For example, in order to check an NC part program automatically created by an automatic programming section in an automatic programming system, a simulation is performed using the NC part program. In such a simulation, it is necessary to display on the display screen the manner in which the tool is moved relative to the workpiece to perform machining. To this end, the window image W1 in Fig. 4 is adopted as a workpiece, the window image W2 is adopted as a tool, and the window image W2 (the tool) is moved relative to the window image W1, which is the workpiece, in conformance with actual tool movement, i.e. from the solid-line pattern to the dashed-line pattern and thence to the one-dot line pattern, and so on, as shown in Fig. 6.

In order to move the window image W2, solely the position of this window image on the display screen is updated based on tool movement.

In the prior art, the coordinates of the position of the window image are updated at an arbitrary timing, and the updating is almost always carried out while the display screen (CRT screen) is in the course of being scanned by the beam. Therefore, cases arise in which, when the window image W2 is situated at the solid-line position in Fig. 6 and an i-th scanning line H_i is being scanned by the beam, the coordinates of the position of the image window W2 are updated to the coordinates of the dashed-line position in response to an input of tool movement data. When such is the case, a window image portion W2' before updating of the coordinates and a window image W2" after updating of the coordinates are displayed on the display screen in combined form, as shown in Fig. 7.

In other words, with the prior-art method, the moved window image is distorted and flickers.

Accordingly, an object of the present invention is to provide a display control method in which a window image will not become distorted and will not flicker in a multi-window image display wherein a window image is moved relative to fixed window image.

Another object of the present invention is to provide a display control method in which the motion of a moving object can be displayed in a manner faithful to actual motion.

Disclosure of the Invention

In a case where at least one window image among multiple window images displayed on a display screen is moved relative to another window image, position coordinates of the moved window image on the display screen are updated during vertical retrace of a beam, and the moved window image is read out of a memory and displayed on the display screen when the beam is present in a region designated by the position coordinates.

Brief Description of the Drawings

Fig. 1 is a block diagram of a display control system in which first and second display control methods according to the present invention can be applied;

Figs. 2(a), (b) are views for describing the contents stored in a window control block;

Fig. 3 is a time chart for describing a second control method according to the present invention;

Figs. 4 and 5 are views for describing a multi-window image display;

Figs. 6 and 7 are views for describing the drawbacks of the prior art, in which one window image is moved relative to another window image; and

Fig. 8 is a time chart for describing an inconvenience encountered in a first control method according to the present invention.

Best Mode for Carrying Out the Invention

Fig. 1 is a block diagram of a display control system. Numeral 10 denotes a host processor, such as the processor of an automatic programming apparatus for automatically creating an NC part program.

Numeral 11 denotes a display controller having a graphic processor 11a, a display processor 11b, and the like. Numeral 12 designates a window control block, 13 a write controller, 14 a read controller, 15 a V-RAM, 16 a CRT, and VR a vertical synchronizing signal.

The graphic processor 11a uses image data received from the host processor 10 to generate a fixed window image (a workpiece or stationary portion of a machine) W1 and a moving window image (a tool) W2, ..., writes these window images in prescribed storage areas 15a, 15b, ... of the V-RAM 15, and stores the display position of each window image and the display precedence data, which are transferred thereto from the host processor, in the window control block 12. The window control block 12 stores display position data and precedence data P_i shown in Fig. 2(b), where it is assumed that the display positions of the window images W1, W2 on the display screen are as follows:

$P_{1S}(x_{1s}, y_{1s}), P_{1E}(x_{1e}, y_{1e});$

$P_{2S}(x_{2s}, y_{2s}), P_{2E}(x_{2e}, y_{2e})$

(the display positions are specified by the coordinates of the diagonal points P_{1S}, P_{1E}; $P2_S$, P_{2E} of the window images), as shown in Fig. 2(a).

When movement data for moving a window image on the multi-window image display is transferred from the host processor 10, the image processor 11a executes processing for updating the display position of this window image stored in the window control block 12.

The display processor 11b provides a read controller 17 with an input of window image precedence and window image display position stored in the window control block 12. The read controller 14 reads each window image out of the V-RAM 15 based on these data and the beam position, and inputs the window images to the CRT 16.

A first display control method in accordance with the present invention will now be described. It will assumed that the fixed window image W1 and moved window image W2 have already been stored in the V-RAM 15, and that predetermined data has been stored in the window control block 12.

The display processor 11b of display controller 11 provides the read controller 14 with an input of the display position coordinates and precedence of the window images W1, W2 stored in the window control block 12. In response, the read controller 14 reads the window images W1, W2 out of the V-RAM 15 in dependence upon the display position coordinates and beam position, and inputs these window images to the CRT 16 to display a multi-window image.

When data (e.g. incremental quantities along respective axes in a predetermined period of time) for moving the window image W2 is received from the host processor 10 under these conditions, the graphic processor 11a computes the next display position coordinates using the present display position coordinates and movement data stored in the window control block 12. If beam scanning is in progress at this time, the position coordinates of the window image W2 stored in the window control block 12 are not updated immediately. Instead, the generation of the vertical synchronizing signal VR from the CRT 16 is awaited and updating is performed after it is confirmed that the beam is in the course of vertical retrace.

When the display position coordinates are updated during the course of vertical retrace, the display processor 11b inputs the new display position coordinates of the window images W1, W2, which have been stored in the window control block 12, to the read controller 14. The latter reads the window images W1, W2 out of the V-RAM 15 in dependence upon the display position coordinates and beam position, and inputs these window images to the CRT 16 to display a multi-window image, just as described above. At this time the display position of the window image W1 does not change, but the position at which the window image W2 is displayed changes by an amount conforming to the movement data.

Since the arrangement is such that the display position coordinates of the moved window image are updated during vertical retrace in the manner described above, the window image will not be distorted and it will not flicker.

It should be noted that merely updating the display position of the moved window image during vertical retrace can cause a series of movements to development jerkiness owing to a lengthening and shortening of the time needed for movement a fixed distance across the display screen.

Fig. 8 is a view (time chart) for a describing a case where the moved window image (tool) is moved in accordance with the first display control method of the invention. If the tool (moved window image) is moved linearly at a uniform speed from point P_S (X_S,Y_S) to point P_E (X_E,Y_E), as shown in Fig. 8(a), the automatic programming section applies a position command [e.g. position coordinates P_i (X_i,Y_i) every ΔT] to the display side every ΔT [see Fig. 8(b)].

Upon receiving the position command, the display side updates the position of the moved window image by the first vertical synchronizing pulse that follows the command input, namely by vertical synchronizing pulses VR1, VR3, VR4, VR6, VR8, VR9 [see Fig. 8(c)]. As a result, the position updating time interval [see Fig. 8(d)] lengthens and shortens repeatedly, thereby causing jerking motion.

Fig. 3 is a view (time chart) for describing a second control method of the present invention, in which motion is smoothly displayed by substantially equalizing the position updating time intervals. The arrangement shown in Fig. 1 can be directly applied to this second display control method.

Display control in accordance with the second display method will now be described. It will assumed that the fixed window image W1 and moved window image W2 have already been stored in the V-RAM 15 (Fig. 1), and that predetermined data has been stored in the window control block 12.

The display processor 11b of display controller 11 provides the read controller 14 with an input of the display position coordinates and precedence of the window images W1, W2 stored in the window control block 12. In response, the read controller 14 reads the window images W1, W2 out of the V-RAM 15 in dependence upon the display position coordinates and beam position, and inputs these window images to the CRT 16 to display a multi-window image.

Under these conditions, the following data for moving the moved window image (tool) W2 along a straight line is inputted from the host processor 10:

$t, N, X_1, Y_1; X_2, Y_2; \ldots. X_i, Y_i; \ldots. X_N, Y_N$

It should be noted that t is equal to T_V/n (n=3 in the example of Fig. 3), where the period of the vertical synchronizing signal VR is T_V, as shown in Fig. 3. N represents the number of partitions, inclusive of both ends of the straight line, and X_i, Y_i are the position coordinates of the tool at an i-th time t_i in the t interval.

Upon receiving the abovementioned position data, the graphic processor 11a stores the data in its internal memory and thereafter counts the number of times i the time t elapses and waits for the generation of the vertical synchronizing signal VR.

When a j-th vertical synchronizing signal VRj (j = 1, 2, ...) is generated, the aforementioned number i just prior to the generation of the vertical synchronizing signal VR_j (or just after the generation of this signal, or just before or just after generation, whichever is closest in time) is obtained.

Then, by using the position coordinates X_i, Y_i at time t_i in the i-th t interval, the position coordinates of the tool (moving window image) W2 stored in the window control block 12 are updated during vertical retrace.

When the display position coordinates are updated during vertical retrace, the display processor 11b inputs the new display position coordinates of the window images W1, W2, which have been stored in the window control block 12, to the read controller 14. The latter reads the window images W1, W2 out of the V-RAM 15 in dependence upon the display position coordinates and beam position, and inputs these window images to the CRT 16 to display a multi-window image, just as described above. At this time the display position of the window image W1 does not change, but the position at which the window image W2 is displayed does change.

Thereafter, updating of the position coordinates stored in the window control block 12 is performed in similar fashion whenever the vertical synchronizing signal is generated, thereby moving the moved window image relative to the fixed window image. Fig. 3(c) shows the position updating timing, the time interval being substantially the same as the period T_V of the vertical synchronizing signal.

Though the case described above is for linear motion at a uniform speed, the invention is also applicable to circular motion at a uniform speed and to motion where the speed is not uniform.

In accordance with the invention as described above, the arrangement is such that the display position coordinates of the moved window image are updated during vertical retrace in the manner described above. As a result, the window image will not be distorted and it will not flicker.

Further, in accordance with the invention, when the period of the synchronizing signal is assumed to be T_V, the host collectively inputs all position data indicative of the moving window image every T_V/n to the display side, and the display side updates the position coordinates of the moving window image during vertical retrace using position data of the interval T_V/n

immediately before generation of the vertical synchronizing signal, immediately after generation of this signal or immediately before or after, whichever is closest in time. As a result, the window image will not become distorted and will not flicker, and motion of a moving body can be displayed in a manner faithful to the actual motion of the body.

CLAIMS:

1. A display control method in which at least one window image among multiple window images displayed on a display screen is moved relative to another window image, characterized by:

updating position coordinates of the moved window image on the display screen during vertical retrace of a beam, and

reading the moved window image out of a memory and displaying it on the display screen when the beam is present in a region designated by said position coordinates.

2. A display control method according to claim 1, characterized in that the position coordinates of said moved window image are updated based on data inputted from a host side.

3. A display control method according to claim 2, characterized in that the host side outputs position data indicative of the moved window image every predetermined time.

4. A display control method in which, among multiple window images displayed on a display screen, position coordinates of a moved window image on the display screen are updated based on data inputted from a host side, and the moved window image is read out of a memory and displayed on the display screen when a beam is present in a region designated by said position coordinates at scanning of the display screen,

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characterized in that:

said host collectively inputs N items of position data indicative of the moved window image every T_V/n to a display side, where T_V represents the period of a vertical synchronizing signal, and

the display side updates the position coordinates of the moved window image during vertical retrace of the beam using position data of an interval T_V/n immediately before generation of the vertical synchronizing signal, immediately after generation or immediately before or after generation, whichever is closest in time.

FIG. 1

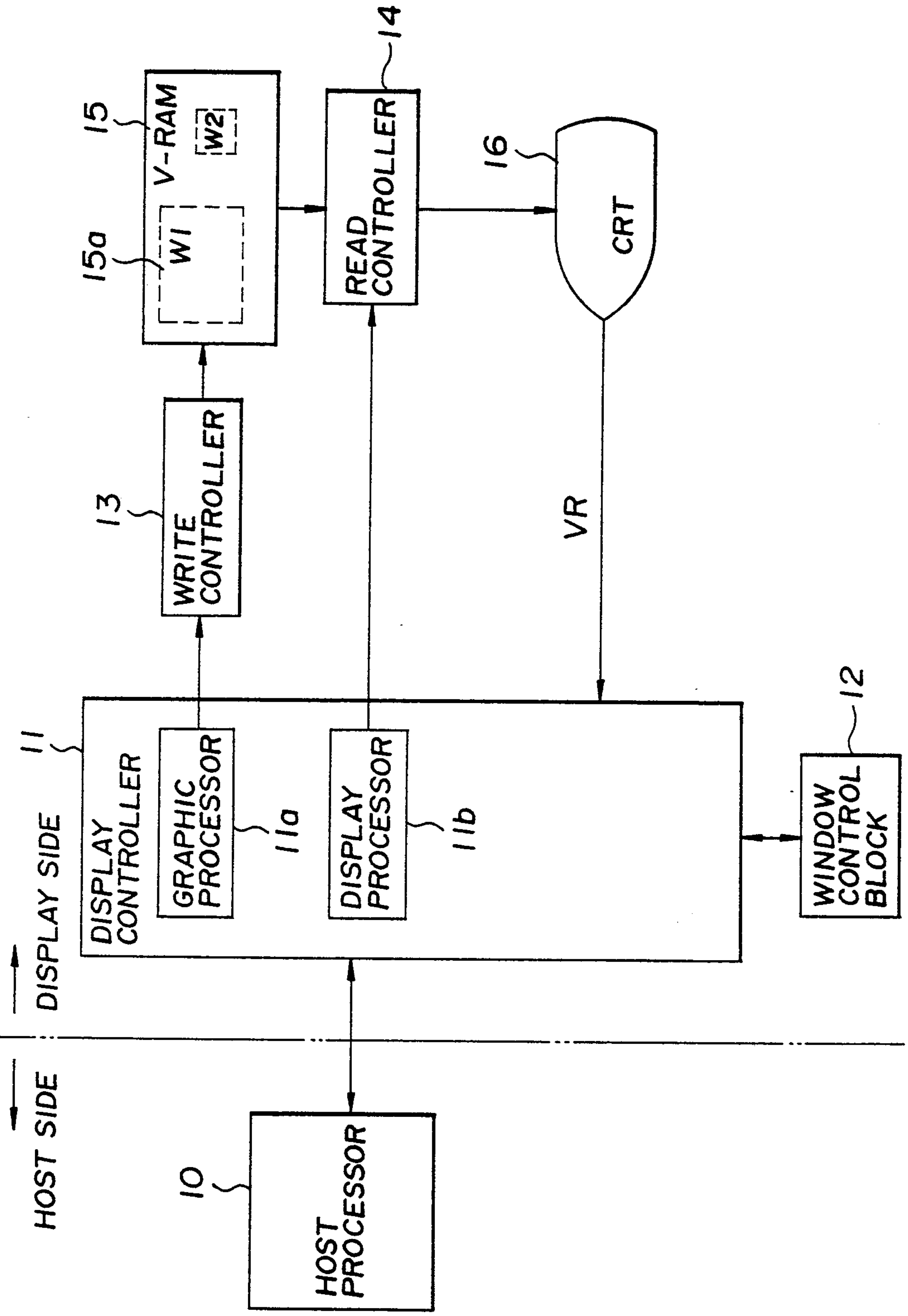
HOST SIDE
DISPLAY SIDE
10
HOST PROCESSOR
11
DISPLAY CONTROLLER
GRAPHIC PROCESSOR
11a
DISPLAY PROCESSOR
11b
12
WINDOW CONTROL BLOCK
13
WRITE CONTROLLER
14
READ CONTROLLER
15
15a
V-RAM
W1
W2
16
CRT
VR

FIG. 2 (a)

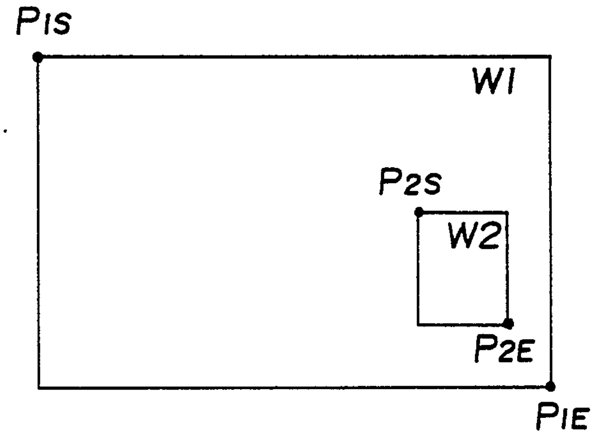

FIG. 2 (b)

W1	$x_{1S}, y_{1S}; \ x_{1e}, y_{1e}; \ P_1$
W2	$x_{2S}, y_{2S}; \ x_{2e}, y_{2e}; \ P_2$
⋮	— — — — — — — — — — — — — —

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FIG. 3

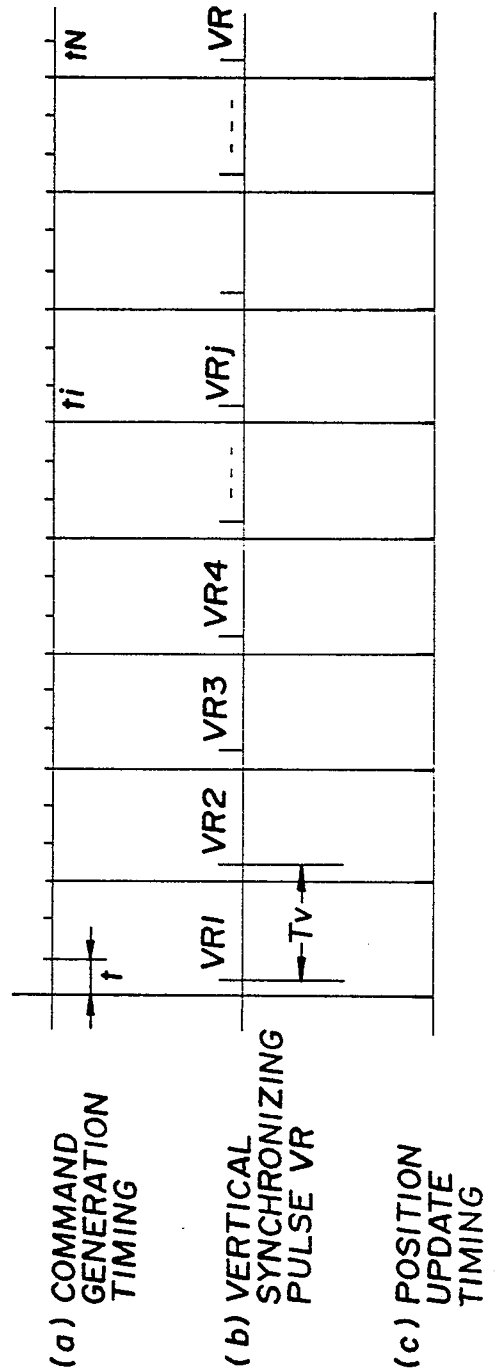


FIG. 4

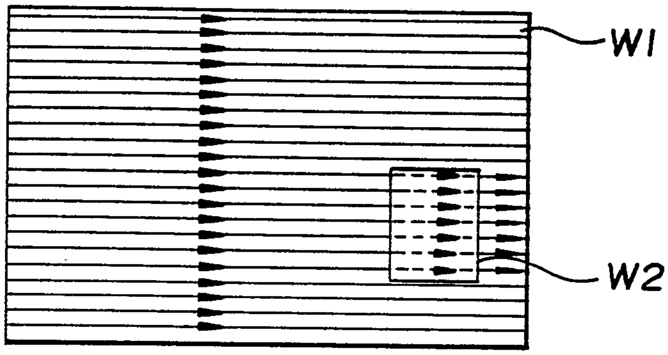


FIG. 5

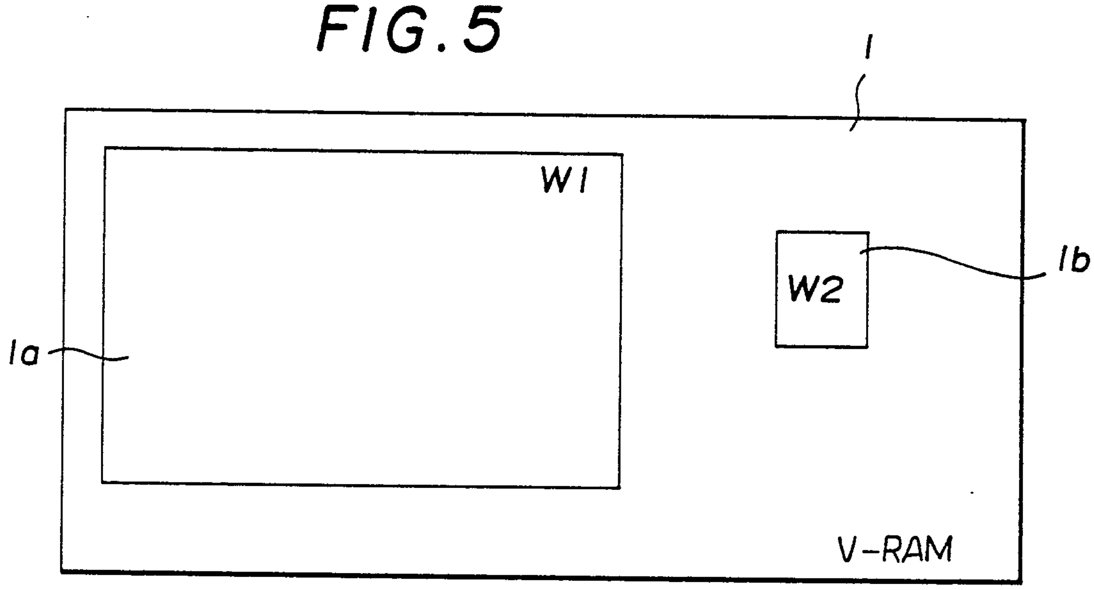


FIG. 6

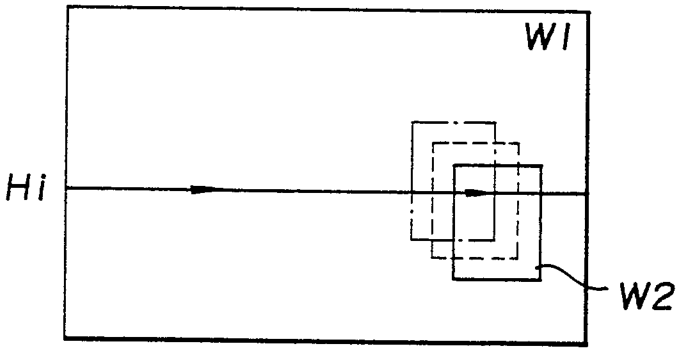


FIG. 7

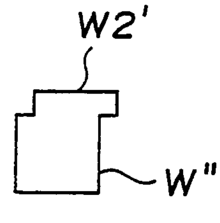
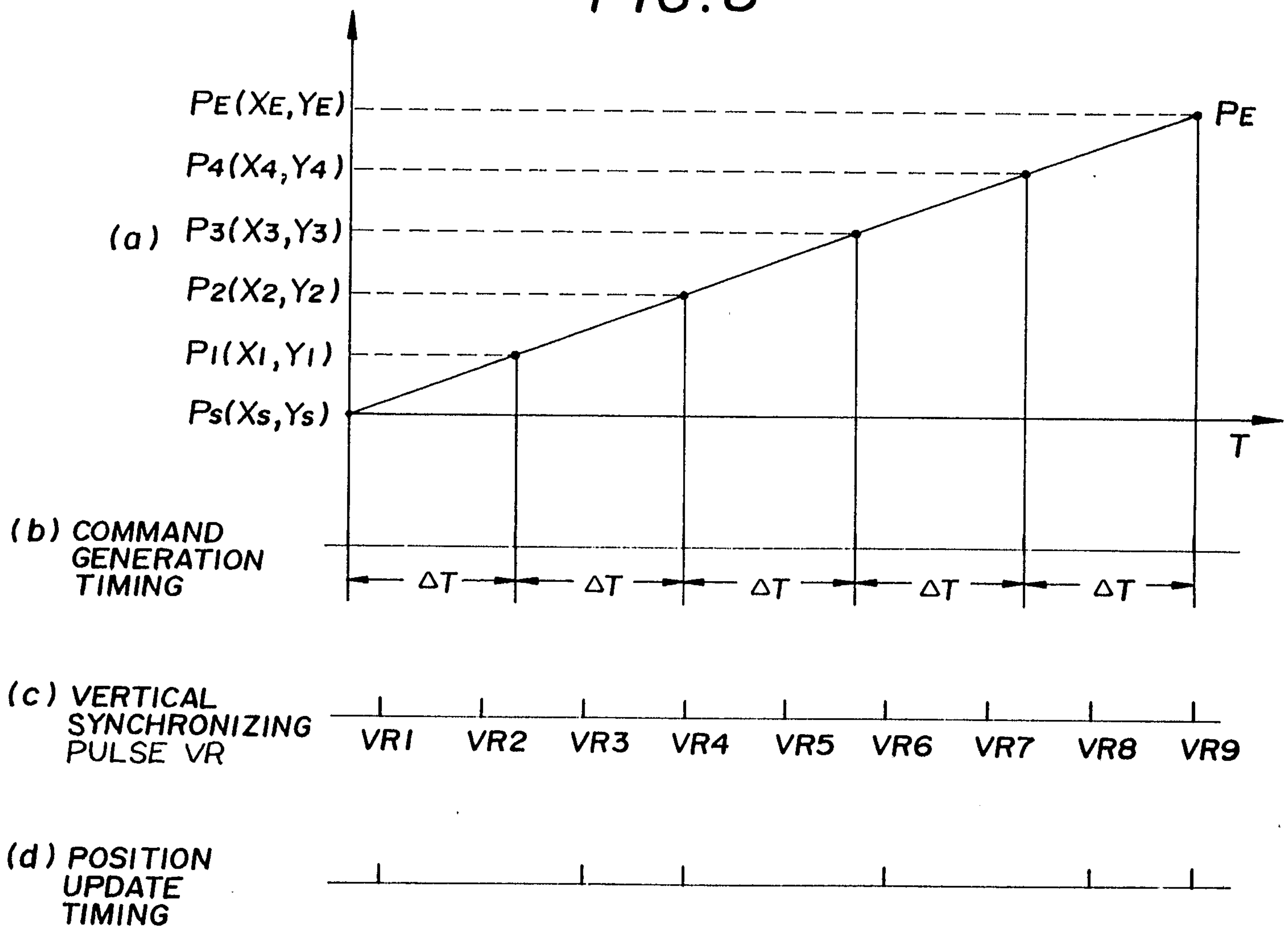


FIG.8


(a)
PE(XE,YE)
P4(X4,Y4)
P3(X3,Y3)
P2(X2,Y2)
P1(X1,Y1)
Ps(Xs,Ys)
PE
T
(b) COMMAND GENERATION TIMING
ΔT
ΔT
ΔT
ΔT
ΔT
(c) VERTICAL SYNCHRONIZING PULSE VR
VR1
VR2
VR3
VR4
VR5
VR6
VR7
VR8
VR9
(d) POSITION UPDATE TIMING

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INTERNATIONAL SEARCH REPORT

International Application No PCT/JP87/00777

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl[4] G06F3/14, 3/153, 15/60, G09G1/00

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC	G06F3/14, 3/153, 15/60, G09G1/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

Jitsuyo Shinan Koho 1972 - 1986
Kokai Jitsuyo Shinan Koho 1972 - 1985

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	JP, A, 61-132988 (Fujitsu Ltd.) 20 June 1986 (20. 06. 86) (Family: none)	1-4
Y	Denshi Tsushin Gakkai Gijutsu Kenkyu Hokoku Vol. 84, No. 308, 28 February 1985 (28. 02. 85) (Tokyo) IE84-100 "Multi-window System no Hardware Kosei" P.25-30	1-4

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
November 6, 1987 (06.11.87)	November 24, 1987 (24.11.87)
International Searching Authority [1]	**Signature of Authorized Officer** [20]
Japanese Patent Office	