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Ross

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[54] **FIXED FORMAT VIDEO DATA DISPLAY EMPLOYING CROSSED-LINE PATTERN FORMAT DELINEATION**

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[52] **U.S. Cl.**..... **340/324 AD,** 273/54, 340/323 B

[51] **Int. Cl.**..... **G06f 3/14**

[58] **Field of Search**..... 340/336, 324 A, 324 AD, 340/323 B; 273/54

[56] **References Cited**

UNITED STATES PATENTS

3,404,309	10/1968	Massell et al.	340/324 AD
3,500,115	3/1970	Auger, Jr.	340/324 AD
3,589,725	6/1971	Townsend et al.	340/336

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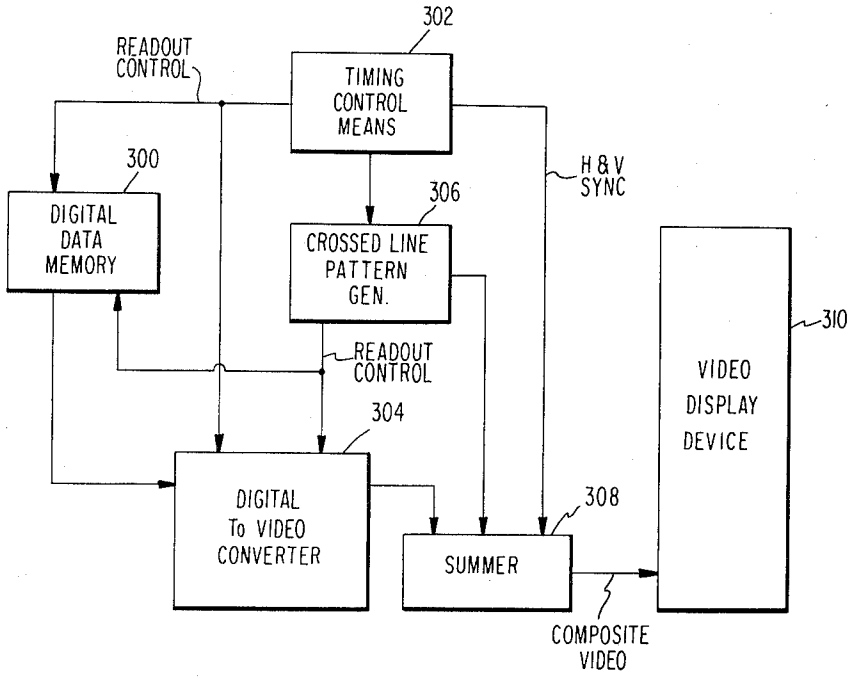
[57] **ABSTRACT**

Time-controlled means independent of displayed stored character data for generating, as part of a raster-scan display, a pattern of crossed lines having predetermined locations which delineate individual areas of a standardized fixed format as in the display of a bowling score format.

10 Claims, 4 Drawing Figures



DISPLAY SYSTEM

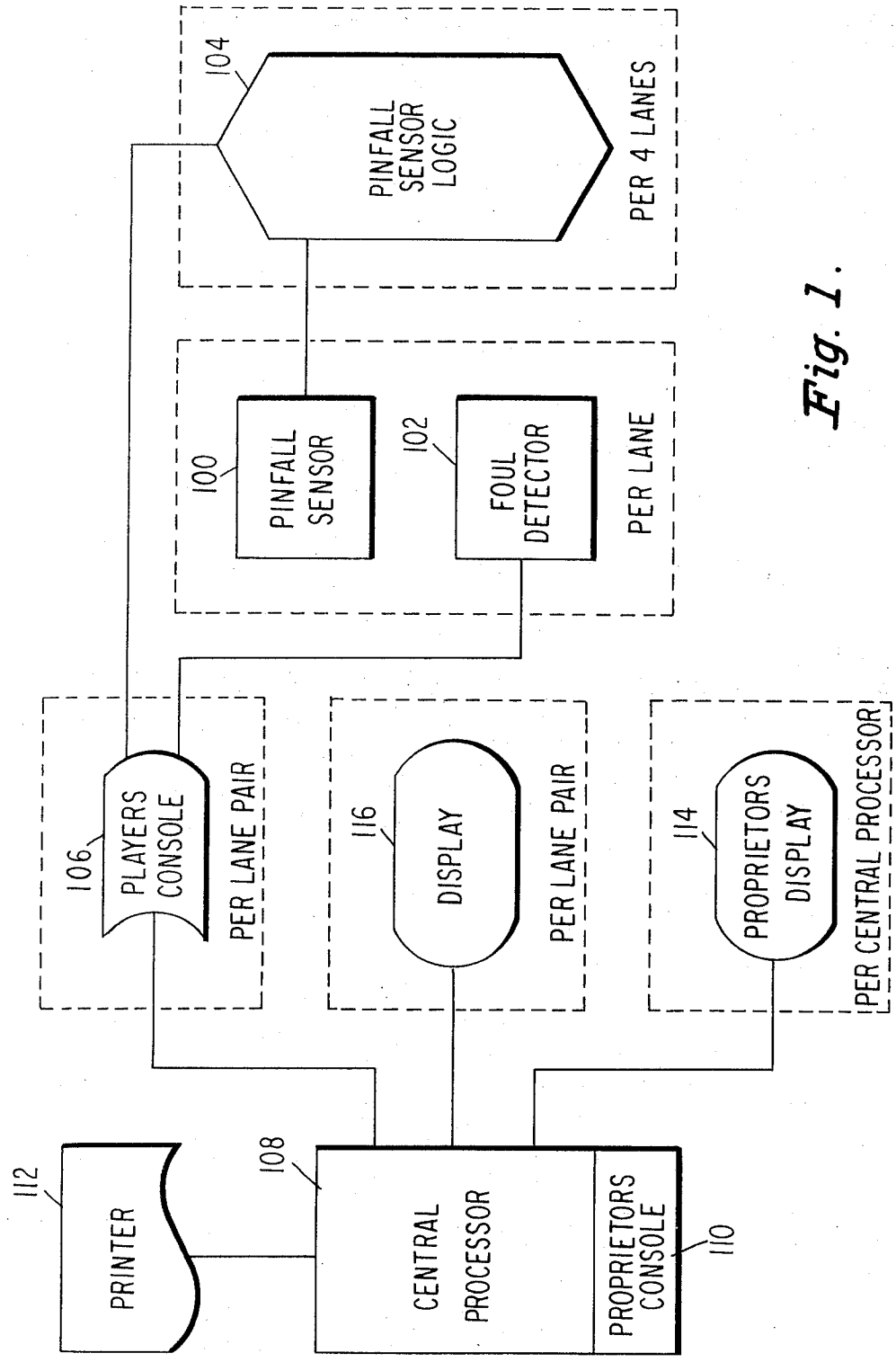


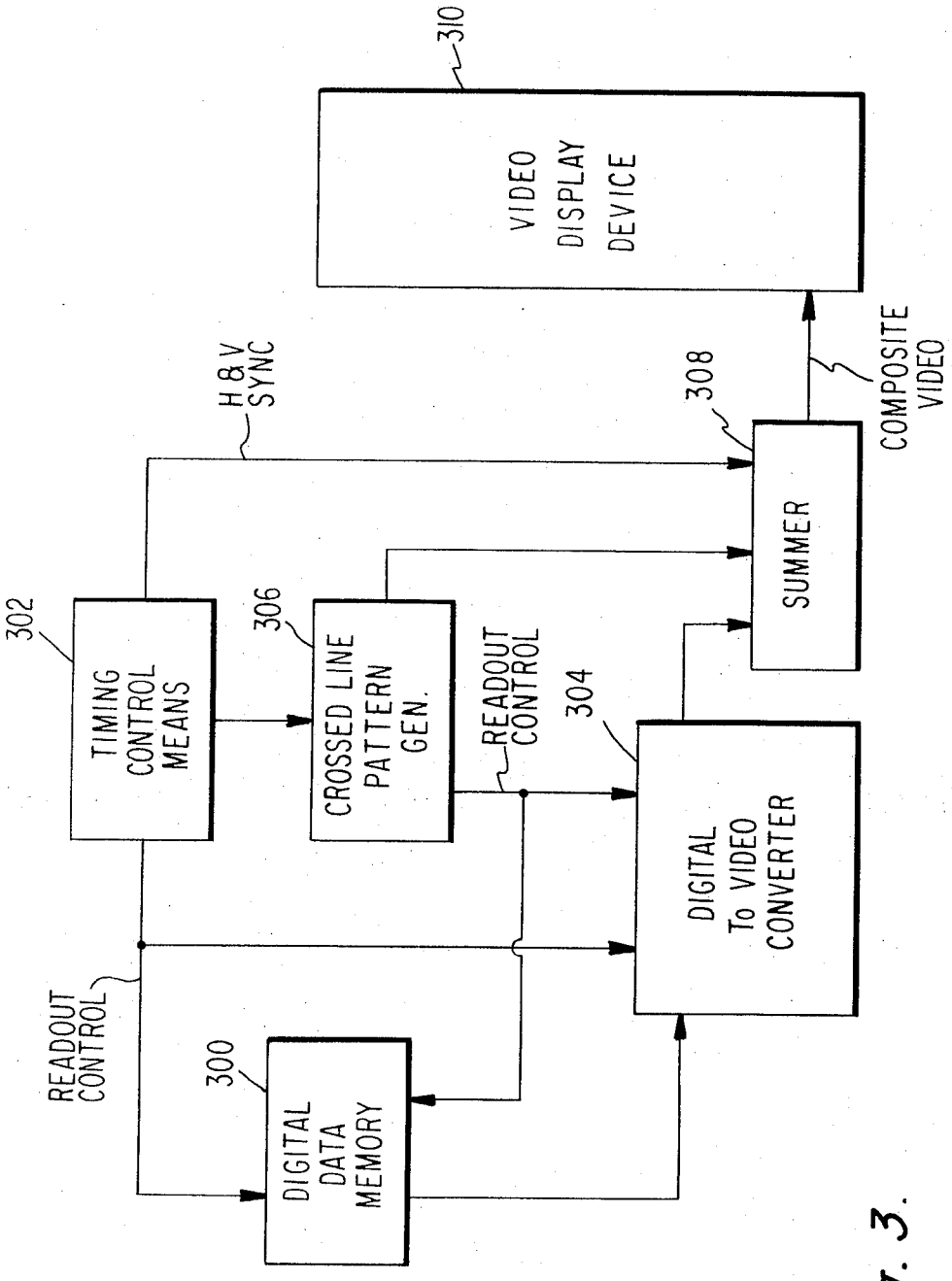
Fig. 1.

AUTOMATIC BOWLING SCORING SYSTEM

Fig. 2.

LEAGUE	1	2	3	4	5	6	7	8	9	10		15
JOE FISCHER	2 2 4	0 4 8	4 0 12	2 4 18	4 2 24	4 4 32	2 4 38	2 2 42	F 2 44	4 0 48		127
MAUREEN SCHM	X 24	X 44	E 4 / 64	X 88	X 108	4 / 122	o 4 / 134	2 2 138	X 168	X X 198	X	
+ ROY ITO	3 / 20	X 48	X 67	8 1 76	3 2 81	E 5 / 99	o 8 0 107	3 / 124	7 1 132	6 / 152	X	
WALTER ROSS	X 30	X 58	X 77	o 8 1 86	E 7 1 94	o 8 / 114	X 133	3 6 142	0 / 159	7 2 168		
ARTHUR FREED	7 2 9	6 / 29	X 49	7 / 65	6 3 74	o 8 1 83	7 X 103	X 121	7 1 129	6 / 147	8	
KENNY GASPAR										138		826

LEAGUE	1	2	3	4	5	6	7	8	9	10		16
MYRA LUKE	2 2 4	0 4 8	E 4 0 12	2 4 18	4 2 24	4 4 32	2 4 38	2 2 42	F 2 44	4 / 62	8	103
HAROLD HITE	X 24	X 44	4 / 64	X 88	X 108	4 / 122	o 4 / 134	2 2 138	X 168	X X 191	3	
AL GOODMAN	2 1 3	3 1 7	4 3 14	2 1 17	E 1 7 25	3 6 34	1 8 43	o 7 2 52	3 2 57	2 2 61		
STAN STODDAR	7 / 16	6 / 34	8 / 48	4 5 57	7 2 66	X 91	X 107	5 1 113	6 1 120	7 / 130	0	
JEFF LYON										186		
+ JIM W. HAYES	X 18	7 1 26	3 6 35	X 53	7 1 61	3 2 66	X 85	7 2 94	2 7 103	3 / 123	X	733



DISPLAY SYSTEM

Fig. 3.

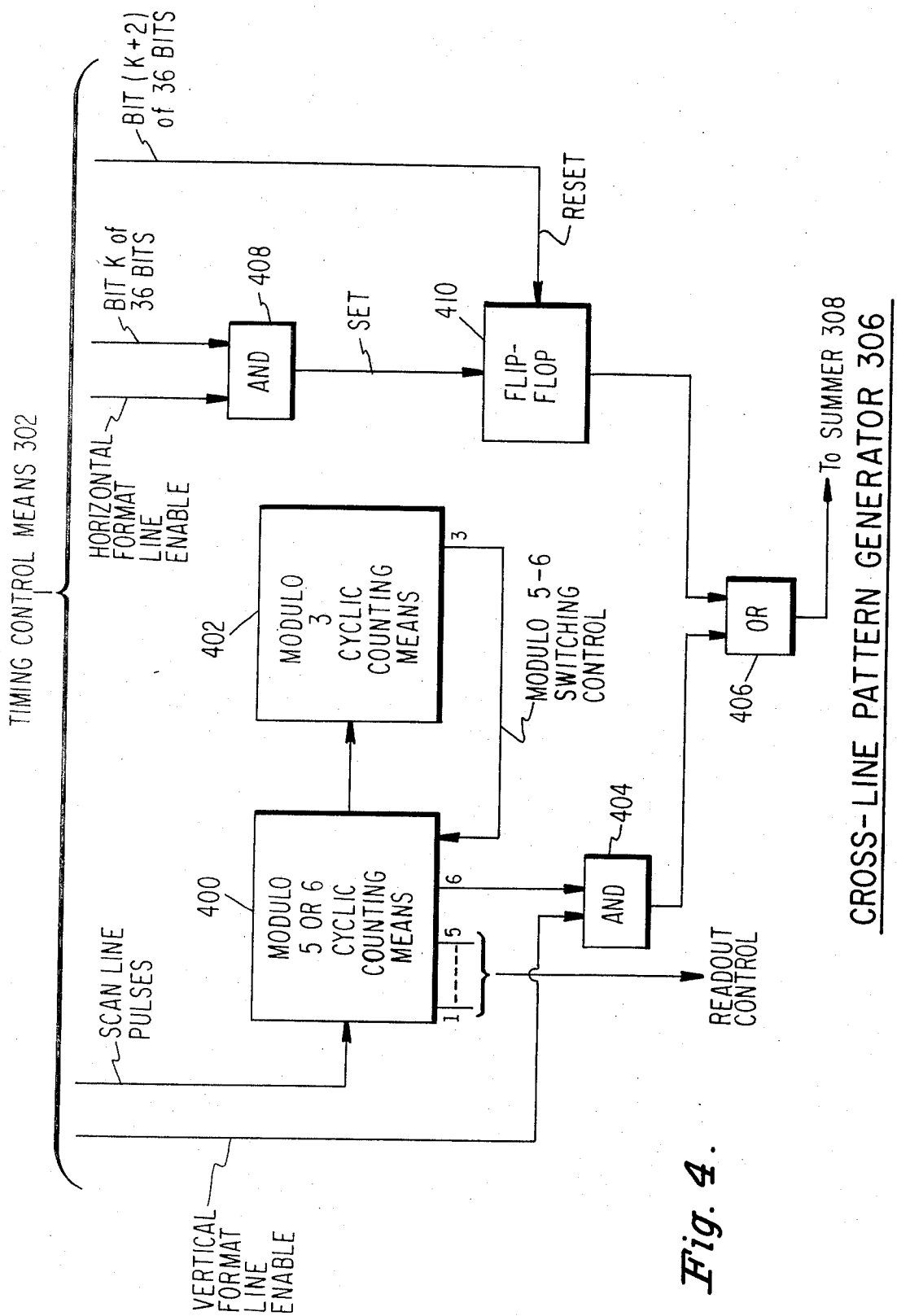


Fig. 4.

CROSS-LINE PATTERN GENERATOR 306

FIXED FORMAT VIDEO DATA DISPLAY EMPLOYING CROSSED-LINE PATTERN FORMAT DELINEATION

This invention relates to a raster-scan display system for, displaying data in a standardized fixed format and, more particularly, to such a system which is suitable for displaying game-score or other similar game information in such a standardized fixed format.

Examples of such standardized fixed formats are the arrangements of the nine boxes in tic-tac-toe, a baseball box score, and a bowling score sheet. In all these cases, the display is divided into a plurality of separate regions in accordance with the standardized fixed format and different respective ones of predetermined items of variable data are displayed within the region with which that item of data corresponds. Normally, these different regions are delineated by a given pattern of lines determined solely by the standardized fixed format. Thus, this given pattern of lines is independent of the variable data to be presented within the spatial regions delineated by the given pattern of lines.

Automatic game scoring systems have been developed in which the game score information is displayed on a video display device, such as the face of a cathode ray tube. One such system, directed to the game of bowling, is disclosed in U.S. Pat. No. 3,589,725, issued to Ralph Townsend et al. on June 29, 1971. Although, in this patent, bowling game score information is in the conventional standardized format for bowling (the score for each of a plurality of bowlers being presented in a different row of the display with the bowlers name to the left and the pinfall and score information for each of the ten frames being presented to the right of the bowlers name), only the pinfall and game score information portion of the format is presented on the face of the video display device. The names of the players are provided on labels each of which is held by an appropriately located holder. More important, no pattern of lines is employed in the video display of this prior art system to delineate each of the ten frames for each of the various bowlers.

An improved automatic bowling score system has been developed in which the entire standardized bowling format, including both the bowlers names and the frame information, is displayed on the video display device. More important, from the point of view of the present invention, a crossed-line pattern delineating the various name regions and frame regions of the standardized bowling format is also displayed on the video display device.

Although this new automatic bowling score system is employed herein to illustrate the present invention, it should be understood that the present invention may be employed with equal benefit in the display of game-score or other similar information in any type of game employing a standardized fixed format.

Briefly, the present invention is directed to a raster-scan data display system incorporating storage means, and readout means coupled to the storage means for use in electronically displaying stored game-score or other similar data of a given kind of game on a video-signal display device while the game is progressing. Readout means causes the scored data to be displayed in a standardized fixed format on the display device in which any of separate given portions of the data is compartmentalized within its own individual area of the display. In accordance with the present invention, the display system further includes time-controlled means independent of the storage means and any of the data for generating as part of the raster-scan display a pattern of crossed lines having predetermined locations with respect to each other which delineate each of the individual areas of the standardized fixed format.

The features and advantages of the present invention will become more apparent from the following detailed description taken together with the accompanying drawing, in which:

FIG. **1** is a functional block diagram of an automatic bowling scoring system which incorporates the present invention;

FIG. **2** shows the standardized fixed format of the bowling score display together with the displayed data of a typical bowling game;

FIG. **3** is a block diagram of the raster-scan display system which incorporates the present invention, and

FIG. **4** is a block diagram of an embodiment of the crossed-line pattern generator of FIG. **3.**

As shown in FIG. **1,** each lane of a bowling alley is provided with its own pinfall sensor **100** and foul detector **102.** Each group of four bowling lanes is provided with a single pinfall sensor logic means **104,** which receives sensed pinfall information from the pinfall sensor **100** of each of the four lanes with which it is associated.

Each lane pair has a players-console **106** associated therewith. Players-console **106** includes manually operated means, such as a keyboard, thumbwheels and pushbuttons, for the players to enter appropriate data and other information into the system. In addition, the foul detector **102** of each of the lanes with which a players-console **106** is associated provides console **106** with foul information and pinfall center logic **104** provides each players-console **106** with coded pinfall data of each of the two lanes with which that console **106** is associated. All the data and information available at each players-console **106** is forwarded to a single central processor **108,** which can handle as many as 32 lanes. Associated with central processor **108** is proprietor-console **110** through which the propreitor can exercise overall control of the lanes.

Central processor **108** includes time control means, a special-purpose computer, data storage means which may comprise a RAM, a digital-to-video converter which may comprise a ROM and, in accordance with the present invention a crossed-line pattern generator associated with the time control means thereof.

Output means associated with central processor **108** include a single printer-console **112,** a single proprietor-display **114** and a players-display **116** for each line pair. These displays are modified television monitors employing a raster scan. The present invention is primarily concerned with the generation of the players-display.

In operation, the players employ the manually operated means at a players-console to enter each of their respective names. This data is forwarded to central processor **108** and stored at appropriate addresses of the RAM data storage means. As the game progresses, game score data is forwarded to central processor **108** and, after appropriate arithmetical processing, is stored for display in appropriate addresses of the RAM. This game score data includes pinfall information sensed by pinfall sensor **100,** foul information detected by foul

detector **102** and, in case of error or otherwise, data which may be manually entered by the player with the manual data entry means of players-console **106.**

The proprietor, with his console **110,** may cause a permanent copy of any bowling score to be printed out on printer **112** or may display various types of data on proprietor's display **114.** However, the embodiment of the present invention is mainly directed to the means for providing the type of bowling-score display shown in FIG. **2** on the players display **116,** by employing the appropriate stored data in central processor **108.** Because the present invention is not directed to the overall automatic bowling-scoring system, but only to the display portion thereof, the overall automatic bowling-scoring system will not be discussed in any further detail.

Referring now to FIG. **3,** there is shown in block diagram a display system incorporated in the overall automatic bowling system of FIG. **1** for providing the standardized fixed format bowling-score display shown in FIG. **2.** In many ways the display system of FIG. **3** is similar to a conventional data display terminal employing a raster-scan display. However, because of the special requirements of a standardized fixed format display represented by the display of FIG. **2,** a conventional data display terminal is not capable of deriving the display format shown in FIG. **2.**

Specifically, the display format includes the predetermined pattern defined by the crossed vertical and horizontal lines in FIG. **2.** This pattern is fixed and is independent of the display character data which defines the name of each player to the left of each row and score information in each of the ten frame areas to the right of player's name in each row. As is known, the score information includes both the cumulative frame score, which is presented in the lower line of each frame area, and pinfall information about that frame, which is presented in the upper line of that frame area. Both the upper line and lower line of each frame area may include up to three adjacent horizontal characters situated in three contiguous character spaces. The horizontal dimension of each character space within the frame area is the same, regardless whether the character is an upper-line character or a lower-line character. However, as shown in FIG. **2,** the vertical dimension of a lower-line character in each frame area is larger than the vertical dimension of an upper-line character. An important feature of the preferred embodiment of the present invention is that the width of each of the crossed lines of the pattern is extrinsic from any character space. Thus, while adjacent character spaces within any frame are contiguous of each other, adjacent character spaces within two successive frames are separated from each other by the width of the intervening line of the line pattern. This makes for an irregular spacing between characters, rather than the regular spacing between characters provided by the conventional raster-scan data display terminal. The display system of FIG. **3,** employing a crossed-line pattern generator of the type shown in detail in FIG. **4,** provides the type of fixed format display shown in FIG. **2.**

More specifically, digital data memory **300,** which may be the RAM storage means referred to in the discussion of FIG. **1,** has digital (binary) words stored at appropriate addresses thereof, each of which manifests the identity of the particular character, if any, to be displayed in each character space of the fixed format. Timing control means **302** generates a first portion of readout control signals which are applied both to digital data memory **300** and digital-to-video converter **304.**

Timing control means **302** also applies timing signals to crossed-line pattern generator **306.** As will be described in more detail below, pattern generator **306** operating under the sole control of timing control means **302,** generates a second portion of readout control signals which are applied to both digital data memory **300** and digital-to-video converter **304.**

In response to both the first and second portions of readout control signals applied thereto, digital data memory **300** reads out the digital word sequentially and applies each of them as an input to digital-to-video converter **304.** Converter **304** which may include a read-only memory addressed by the digital word from digital memory **300,** as well as a video shift register coupled to the output of the read only memory, operates under the control of both portions of readout control signals supplied thereto generate as an output therefrom a video signal manifesting the characters to be displayed by a video display device employing a raster scan. Since digital data memory **300** and digital-to-video converter **304** may be similar to those employed by conventional data display terminals, they will not be discussed in further detail herein.

The output of converter **304** is applied as a first input to summer **308.** Summer **308** also has horizontal and vertical sync signals applied as an input thereto, which is conventional. However, in addition, summer **308** has the pattern output from crossed-line pattern generator **306** applied as an input thereto. As described, crossed-line pattern generator **308** operates under the sole control of timing control means **302** and is independent of digital data memory **300** and any of the data stored therein.

Video display device **310,** which is a raster scan television monitor normally employing a cathode ray tube display, as is conventional, includes a sync separator and horizontal and vertical generating circuitry responsive to the horizontal and vertical sync portion of the composite video signal applied thereto for providing horizontal and vertical scanning. Further, the display is intensity modulated by the composite video signal appearing at the output of summer **306.** For reasons which have nothing to do with the present invention, the video display device **310** employed in the automatic bowling system of FIG. **1** is modified with respect to a conventional TV monitor only to the extent that the scanning yoke is rotated 90° so that the line scan is in the vertical direction, rather than the horizontal as is conventional, and the field scan is in the horizontal direction, rather than in the vertical as is conventional. However, just as in NTSC television the display frame consists of two interlaced fields of 262.5 scan lines apiece, or a total of 525 scan lines per frame.

Referring now to FIG. **4,** there is shown a preferred embodiment of crossed-line pattern generator **308.** Timing control means **302** applies a vertical format line enable, scan line pulses, horizontal format line enable, bit k of each repetitive cycle of 36 bits, and bit $(k+2)$ of each of the 36 bit cycles.

Scan line pulses, which occur sequentially at the scan line rate, are applied as an input to modulo **5** or **6** cyclic counting means **400.** Every time that counting means **400** recycles, by being reset to count **1,** it produces an

output pulse which is applied as an input to modulo 3 cyclic counting means **402.** Whether counting means **400** operates as a modulo 5 or as a modulo 6 counting means is determined by the binary value of the signal then present on the modulo 5-switching control input thereto, which is obtained from the third stage of cyclic counting means **402.** In particular, counting means **400** will recycle in response to every fifth scan line pulse applied thereto when the count registered by counting means **402** is either one or two; i.e., binary value of the signal on modulo **5–6** switching control is ZERO. However, cyclic means **400** does not reset until the sixth successive scan line pulse is applied thereto when the count registered by counting means is three (i.e., the binary value of the signal on modulo **5–6** switching control is ONE). From the foregoing, it will be seen that the counting cycle of counting means **400** is **5, 5, 6, 5, 5, 6, 5, 5, 6 . . ..**

Thus, counting means **400** provides an output from its sixth stage only during the occurrence of a single scan line pulse, which occurs every sixteen consecutive scan line pulses, which occurs only at the end of every third cycle of counting means **400.** The output from each of the first five stages of counting means **400** constitute the second portion of the readout control, which is derived from crossed-line pattern generator **306.**

The output of the sixth stage of counting means **400** is applied as a first input to AND gate **404** and the vertical format line enable from timing control means **302** is applied as a second input to and gate **404.** The output from and gate **404** is applied as a first input to or gate **406.**

Bit *k*, a predetermined ordinal **1** of each cycle of **36** consecutive bits, from timing control means **302** is applied as a first input to and gate **408** and horizontal format line enable from timing control means **302** is applied as a second input to and gate **408.** The output from and gate **408** is applied as a set input to flip-flop **410** and $(k+2)$ of each cycle of **36** consecutive bits is applied as a reset input to flip-flop **410.** The output from flip-flop **410** is applied as a second input to or gate **406.** The output from or gate **406** is applied as an input to summer **308,** as shown in FIG. **3.**

The operation of the display system of FIG. **3,** including the crossed-line pattern generator of FIG. **4,** for producing the bowling score format of FIG. **2** will now be described.

As mentioned earlier, the raster scan display producing the bowling score format shown in FIG. **2** employs vertical scan lines. Each scan line is composed of a fixed number of bits, a bit corresponding to vertical sides of the smallest resolvable picture element. In accordance with the bowling score format, the height of each lower line character, used for the bowlers's names and the bowling score, is 14 bits. The height of each upper line character, used for the pinfall data, is 10 bits. The vertical dimension of each horizontal line of the crossed-line pattern is 2 bits. The total number of bits for each player row, including a single one of the horizontal pattern lines, is 36 bits. Thus, the vertical spacing separataing characters have an overall value of 10 bits, made up of two bits below a lower-line character, 6 bits between lower-line and upper-line characters and 2 bits above upper-line character.

The size of the smallest resolvable picture element in the horizontal direction is determined by the width of each vertical scan line. Each character space of both upper and lower lines has a horizontal dimension of 10 scan lines, the first five of which occur during a first of two interlaced fields and the other five of which occur during the second of the two interlaced fields. The horizontal dimension of each display character is composed of four vertical scan lines for each of the two interlaced fields leaving a single vertical scan line for each of the two interlaced fields corresponding to the spacing between two horizontally adjacent characters which are not separated by a vertical pattern line. Each pattern line itself is composed of a single vertical scan line for each of the two interlaced fields, which is addition and extrinsic from the vertical scan lines forming the character spaces. Thus, the horizontal positioning of the character spaces, composing the upper and lower lines of each row is not regular.

Returning to FIG. **3,** the first portion of the readout control applied directly from timing control means **302** to digital data memory **300** and digital-to-video converter **304** relates to the cyclic **36** bits within each vertical scan line which controls the vertical format of the display. Crossed-line pattern generator **306,** which is described in more detail below, derives a second portion of readout control. This second portion is applied to digital data memory **300** and digital-to-video converter **304** to control the horizontal format of the display in a manner which provides the aforementioned irregular horizontal spacing of character spaces in each row of the display. As far as the present invention is concerned, the interval operation of the digital data memory **300** and digital-to-video converter **304** for deriving, under readout control, the video signal of the stored digital data in memory **300** for raster-scan display, may be the same as that conventionally employed in raster scan data display terminals.

As described above, counting means **400** and **402** operate to provide two successive count cycles of five scan lines followed by a cycle of 6 scan lines from counting means **400,** after which the process is repeated. The second portion of the readout control, which is derived from the first 5 stages of counting means **400,** which designate the vertical scan lines of the character space occurring during one field, provide three contiguous character spaces, as required. However, the occurrence of the "6" count between the "5" count of a third-successive cycle and the "1" count of the next cycle provides for the irregular horizontal spacing of character spaces, referred to above.

During each vertical line scan, the vertical format line enable is selectively present or absent in accordance with the position in the display in the upper bowling team and the lower bowling team, respectively. In particular, the vertical format line enable is absent during the portion of each vertical scan line below the lower-displayed team, the portion between the lower and upper displayed teams, the portion above the upper-displayed team shown in FIG. **2,** and during the scan of the players-name section of the displayed field. Otherwise, it is present. During the presence of the vertical format line enable for that single one of each sixteen consecutive vertical scan lines which correspond with a binary ONE being present on the sixth stage of counting means **400,** AND gate **404** applies an output through OR gate **406** to summer **308.** This output, when applied to video display device **310,** results in the vertical pattern line being displayed in its proper format position.

The displayed width of each vertical pattern line is equal to twice the width of a vertical scan line, because the vertical pattern line is composed of two contiguous vertical scan lines which individually occur during separate ones of the two interlaced fields.

The horizontal format line enable is present except when the portion of a field to the left or the right of the location of the displayed format is being scanned. As long as horizontal line enable is present, flip-flop **410** is set in response to the occurrence of the predetermined one of each **36** consecutive bits and is then reset two bits thereafter. Thus, flip-flop **410** cyclically produces an output having a duration equal to twice that of a bit period with a length of a cycle being to **36** bit periods. The output from flip-flop **410,** after passing through gate **406** and summer **308** to video display device **310,** results in horizontal pattern lines being displayed in the format shown in FIG. **2.**

What is claimed is:

1. In a raster-scan data display system incorporating storage means, and readout means coupled to said storage means for use in electronically repetitively generating successive raster-scanned fields displaying stored game-score or other similar data of a given kind of game on a video-signal display device while the game is progressing, said readout means causing said score data to be displayed in a standardized fixed format of said display device in which any of separate given portions of said data is compartmentalized within its own individual area of said display; the improvement wherein said readout means includes time-controlled means independent of said storage means and any of said data for generating as part of said successive raster-scanned fields a pattern of crossed lines having predetermined locations with respect to each other which delineate each of said individual areas of said standardized fixed format.

2. The system defined in claim **1,** wherein each of said given portions of said data includes characters, wherein said storage means and said readout means are arranged to display the respective characters of any of said given portions within different ones of a number of separate contiguous character spaces into which the entire area of that given portion is divided, and wherein said time-controlled means is arranged to situate said predetermined locations of said pattern of crossed lines wholly outside of any of said character spaces, whereby adjacent character spaces of adjacent areas are not contiguous with each other but are separated by the display-width of a line of said pattern.

3. The system defined in claim **1,** wherein said given kind of game is bowling and said standardized fixed format is that of a bowling score sheet; and wherein said time-controlled means is arranged to provide a pattern display of crossed lines which includes a set of spaced horizontal lines defining separate horizontal regions respectively for the score of each one of a group of players and a set of spaced vertical lines defining a player-name region toward the left of the display and ten adjacent frame regions to the right of said player name region, whereby the given compartment corresponding to any single frame of any single player delineated by said crossed horizontal and vertical lines constitutes one of said individual areas.

4. The system defined in claim **3,** wherein said storage means and said readout means are arranged to display pinfall data within an upper row of each horizontal region and to display score data within a lower row of each horizontal region which is contiguous with said upper row thereof, the upper row of any given compartment being divided into a given plurality of identically-sized separate contiguous character spaces within any one of which a single character of pinfall data may be displayed, the lower row of any given compartment being divided into a given plurality of identically-sized separate contiguous character spaces within any one of which a single character of score data may be displayed, and wherein said time-controlled means is arranged to control the respective positions of said character spaces in said display and to situate said vertical and horizontal lines wholly outside of any character space, whereby adjacent character spaces of adjacent given compartments are separated by the display-width of a line of said pattern.

5. The system defined in claim **4,** wherein said given plurality of the character spaces of both said upper and lower rows is three.

6. The system defined in claim **4,** wherein the direction of a raster scan line is parallel to one of said horizontal lines or said vertical lines.

7. The system defined in claim **4,** wherein the direction of a raster scan line is parallel to said vertical lines.

8. The system defined in claim **4,** wherein a first given number of raster scan lines during each display field correspond with any character space, and wherein said time controlled means includes first cyclic counting means for counting raster scan lines and second cyclic counting means coupled to said first counting means for counting cycles of said first counting means, said first counting means having a count capacity equal to said first given number in a first mode thereof and equal to a second given number greater than said first given number in a second mode thereof, said second counting means having a count capacity equal to the number of contiguous character spaces aligned in a direction normal to a raster scan line which are situated within a given compartment, said second counting means being further coupled to said first counting means for maintaining said first counting means in its first mode when said second counting means manifests a count less than its count capacity and for maintaining said first counting means in its second mode when said second counting means manifests a count equal to its capacity, and means coupled to said first counting means for controlling the position of a character space in response to said first counting means manifesting any count up to and including said first given number and for causing a raster scan line to be displayed on said display device in response to said first counting means manifesting a count greater than said first given number, whereby displayed raster lines constitute one of said sets of crossed lines of said pattern.

9. The system defined in claim **8,** wherein said raster scan lines are vertical, and said given plurality of contiguous character spaces of both said upper and lower rows is equal to said number of contiguous character spaces aligned in a direction normal to a raster scan.

10. The system defined in claim **9,** wherein said raster scan display consists of two interlaced fields.

* * * * *