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Brown et al.

[11] **3,786,479**

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[54] **VIDEO DISPLAY SYSTEM**

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Related U.S. Application Data

[63] Continuation of Ser. No. 782,154, Dec. 9, 1968, abandoned.

[52] **U.S. Cl.. 340/324 AD,** 178/6.6 A, 178/DIG. 37

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

[58] **Field of Search** .... 178/6.6 A, DIG. 33, 178/DIG. 37; 340/324 AD

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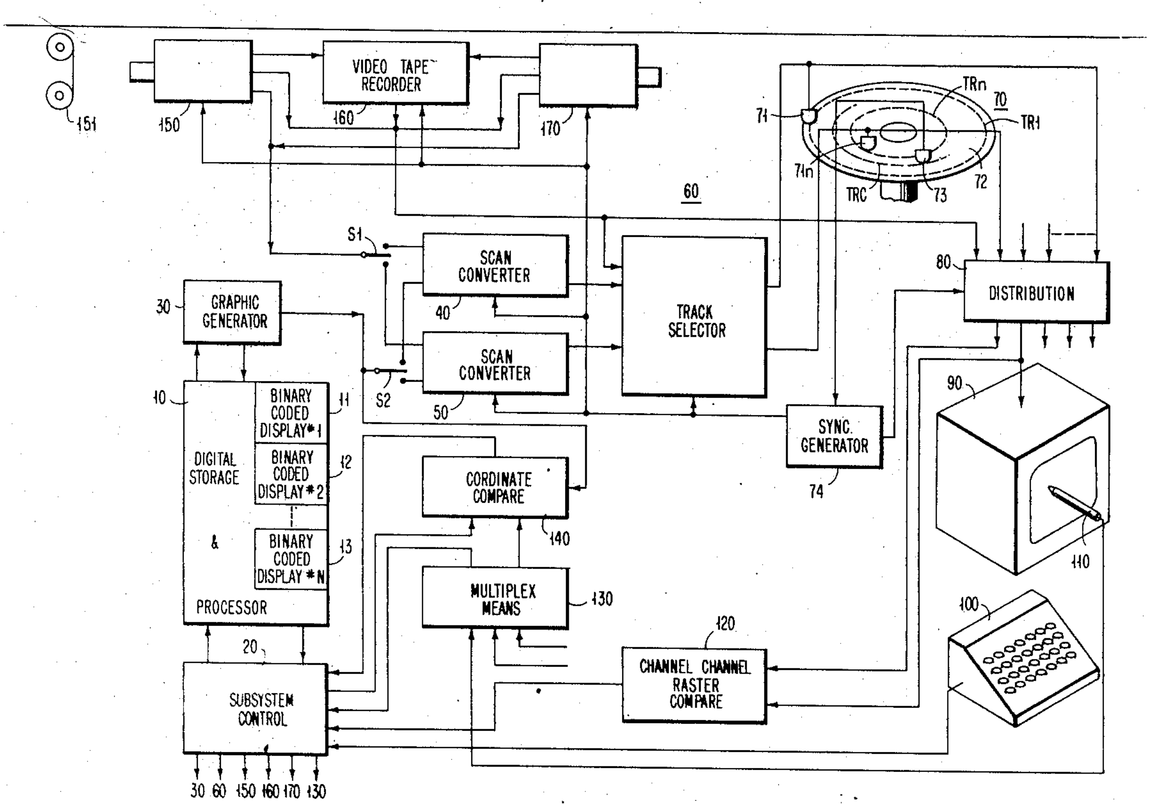
[57] **ABSTRACT**

A display system that uses a digital storage and processor having stored therein a plurality of sources of binary coded information representative of a plurality of display messages and patterns. A graphic generator converts coded information into analog stroke or painted display information. This stroke information and/or asynchronous display information from other sources is converted into television raster information which is then cyclically stored on a magnetic disk, together with displays from other synchronous noncoded and coded sources as well as live television. A plurality of remote stations can select any display information which is converted as necessary to raster video information. These frames may be recorded on one or more tracks of the magnetic disk. This information is then applied to the television monitor at the station. The operator at the station can then control the processing of the binary coded information and request other display material while viewing the monitor and in addition, can correlate portions of images on the CRT display with the originating digitally controlled stroke information. Furthermore, raster information of several selected tracks as well as synchronized video from other sources can be compared and/or mixed.

5 Claims, 4 Drawing Figures



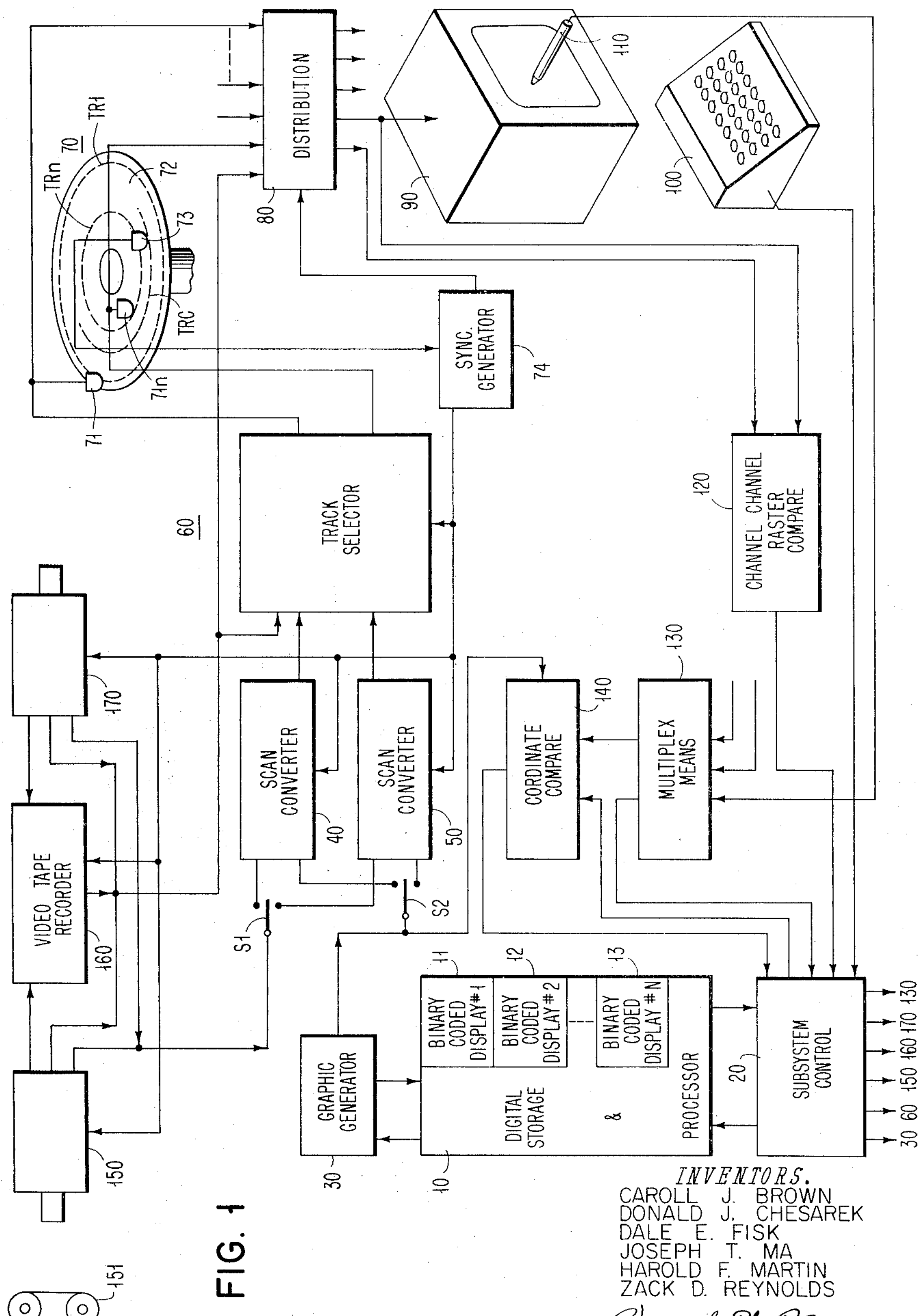


FIG. 1

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PATENTED JAN 15 1974

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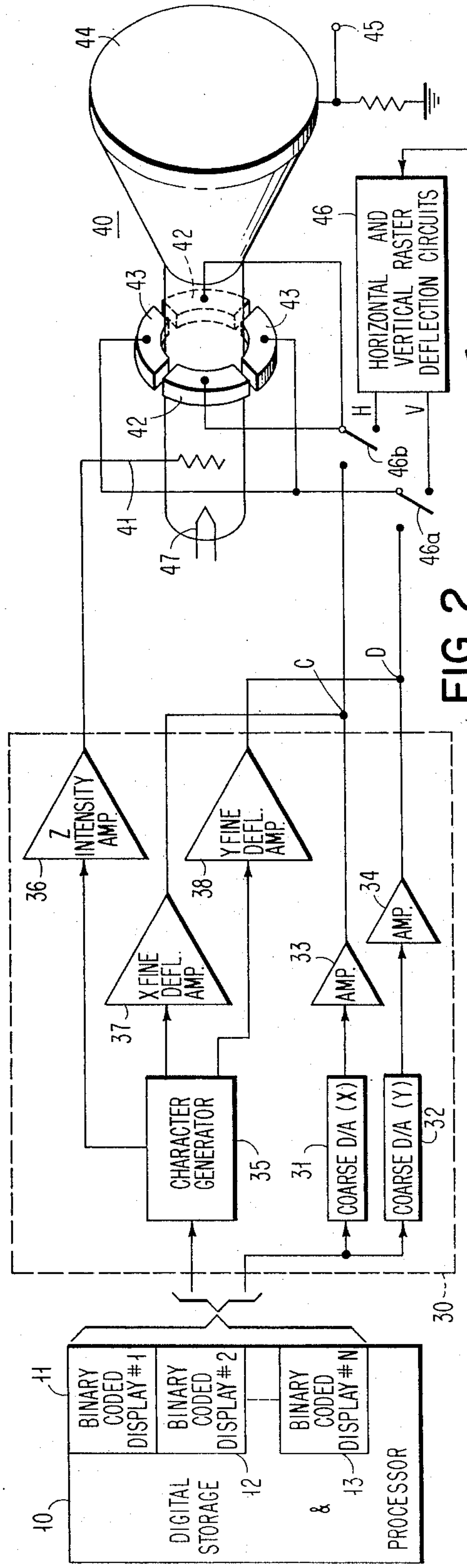

FIG. 2

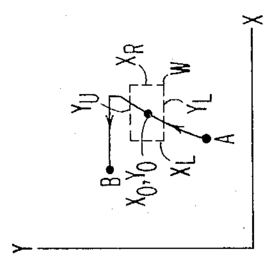

FIG. 3

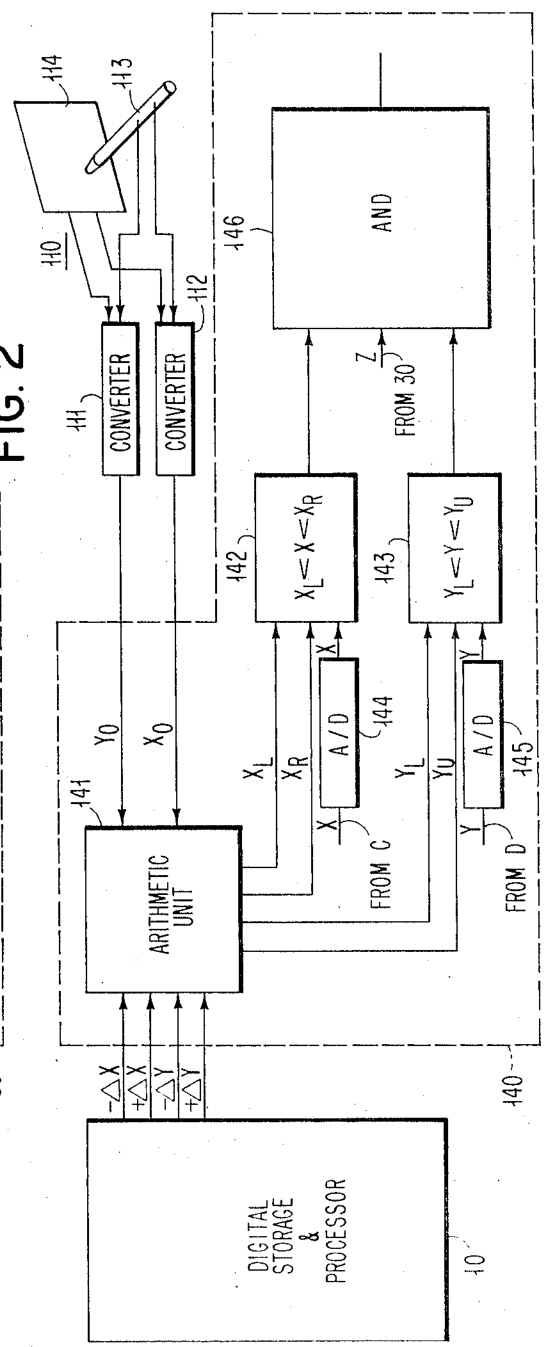

FIG. 4

VIDEO DISPLAY SYSTEM

PRIORITY

The present invention is a continuation of my copending application Ser. No. 782,154 now abandoned, filed Dec. 9, 1968, and assigned to the same assignee as this application.

BACKGROUND OF THE INVENTION

1. FIELD OF INVENTION

A display system wherein the displays originate from a digital processor storage unit and other sources.

2. DESCRIPTION OF THE PRIOR ART

In computer display systems, binary-coded information is stored which represents a particular message or pattern to be displayed on a cathode ray tube. This binary information is decoded into a form suitable to be applied to the display device such as an analog signal to deflect an electron beam in a stroke type movement of an electron beam. In order to regenerate the display, the predetermined information is cyclically accessed and repeatedly applied to the display. A plurality of displays are frequently employed which have access by some remote means to the processor.

The prior art display signals normally only emanate from one source, that is, a computer or photographic slides or a tape recorder, etc., since normally it is not feasible to accommodate other sources.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a new and improved display system having a central processing unit which can originate and modify displayed information.

A further object of the invention is the provision of a new display system for selectively applying image forming signals to a display device wherein the digital display information in the computer or files can be processed and changed without affecting the visual image.

A still further object of the invention is to provide a new and improved display system that has a high degree of flexibility, and can accommodate various sources of displayable information.

Still another object of this invention is the provision of a new and improved display system that can utilize various sources of visual displays with a minimum of complexity at the display station(s).

Still a further object of the invention is to provide a display system that can identify a point or area on the display with a minimum of interruption and/or computer processing time.

The above objects of the present invention are realized in one form thereof by employing a computer based system which contains a plurality of storage locations having binary information representative of a plurality of displayable frames of messages or patterns. This coded data is selectively converted to television raster information which is then buffered and regenerated in this noncoded form. This noncoded information is cyclically regenerated to thereby provide a visually continuous display on a monitor. By cyclically regenerating the noncoded information, the binary coded information in the computer representing this display can be processed, modified, compared, etc., without affecting the visual display at the remote station.

As a further feature of the invention, a means is provided at the remote station to generate XY information of a particular point on the display. This information is compared with signals corresponding to spatial coordinates which are provided at the output of a graphic generator prior to scan conversion into raster video form. In so doing, process time of the computer processor is saved, and display signal regeneration is not interrupted.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 contains a schematic diagram partially in block form of a display system embodying the invention,

FIG. 2 illustrates a graphic generator together witha scan converter suitable for use in the embodiment in FIG. 1,

FIG. 3 illustrates an electron beam deflection path, and

FIG. 4 illustrates a block diagram of a system suitable as a coordinate compare.

GENERAL DESCRIPTION

The above objects of the present invention are accomplished by a system connected to a digital storage and processor **10** that has a plurality of storage locations containing binary coded information, representing a plurality of separate images. Control means **20** can be actuated by keyboard **100** or other suitable means to effect movement of the data for an image to a graphic generator **30** which transduces the binary coded information into X, Y and Z signals which are capable of deflecting an electron beam to thereby provide a stroke type display or pattern. This X, Y, Z information is selectively applied to an electron beam type scan converter **40** or **50** which converts the X, Y, Z display information into television type full frame formatted raster video information which can be a time sequence of analog or digital signals. The output of the scan converter is applied to a track selector **60** which then switches this video information to a magnetic disk storage **70** having a plurality of endless tracks thereon. Tracks of the magnetic storage unit **70** are read out through a distribution network **80** to provide raster displays by a plurality of remote television monitors such as **90.** Also, at the remote station and positioned adjacent to the television monitor **90** is a coordinate identification means **110** which identifies XY locations of selected portions of the displayed image provided by monitor **90.** Other sources of images such as from films or real scenes come from a scanner or television camera **150,** a video file or tape recorder **160,** or a television camera **170.**

When the signals are provided in noncoded video form (such as analog) from the storage disk **70,** they are regenerated and produce a continuous visual display on the monitor such as **90.** The computer-derived display source is also simultaneously present in coded form in the digital storage and processor **10.** Thus, while the image is being regenerated and viewed in noncoded form, the image in coded form can be scanned and utilized or processed in the digital processor **10.** The coded image can be analyzed, compared, modified, etc., while the displayed noncoded image is being viewed without interruption. In addition, without interrupting this viewing, the image in noncoded video form can also be compared and/or coordinated with other images on the disk.

The magnetic disk storage **70** includes a clock track having clock pulses thereon which develop horizontal and vertical raster sync. Since the binary coded information is not being regenerated to provide a regenerative display and since the readout of the scan converter is synchronized with the sync signals from the storage disk, the scan converters **40** and **50** can then be used, without interrupting the display, to convert exterior asynchronous display information to synchronous display information. Synchronous exterior video sources can also be applied to the monitors or records on the disk in response to the synchronizing pulses developed from the clock pulses on the disk. The clock track can have conventional vertical and horizontal television sync pulses applied thereto for two video fields so that when using a conventional monitor synchronization for 525 lines is provided. The read out of the scan converters **40** and **50** is synchronized with the clock pulses or sync pulses on the clock track.

DETAILED DESCRIPTION

The digital storage and processor **10** includes a plurality of frame storage locations **11, 12** and **13,** each of which contains binary coded information representing a message and/or patterns for an individual image shown as number **1,** number **2** and number N, respectively. As illustrated, the binary coded information is a series of binary words with each word representing a letter or numeral by way of an alphanumeric code. In these codes, such as used with the IBM 2250 display, normally the words consist of six to eight binary bits. When this information is applied to a conventional graphic generator **30,** the output thereof will be analog X and Y signals (horizontal and vertical electron beam deflection signals) as well as a Z signal (analog or digital beam gating signal).

In addition, the storage locations **11, 12** and **13** could contain images other than alphanumeric. In such a case, binary coded words may represent end points of lines. These end points would then be converted to X and Y (horizontal and vertical) analog deflection signals that would deflect the electron beams from one end point to another as well as Z or beam gating signals to enable proper intensification of the beam. Other suitable generators that convert binary coded information (of images) to displays are shown in U.S. Pat. Nos. 3,334,304 and 3,205,488. Also see January 1961 Proceedings of IRE, pp. 185–195.

The operator at station S can effect, by way of keyboard **100,** commands from the subsystem control **20** to selectively transmit the binary information for one image from location **11, 12,** etc. to a graphic generator **30.**

The graphic generator **30** converts the binary-coded information to analog X and Y deflection and Z gating or intensification information that is suitable to deflect an electron beam in a stroke type form such as is common in graphic displays and, as illustrated in FIG. **3,** (which provides an electron beam path of the number seven by moving the beam from A to B). This stroke type deflection is converted to television raster type information by applying it to either a scan converter **40** or a scan converter **50.**

FIG. **2,** for purposes of clarity, sets forth in more detail a conventional type graphic generator such as is employed to convert binary coded display information into alphanumeric stroke information. THe graphic generator **30,** so illustrated, continuously has digital X position information which is applied to a coarse D to A converter **31** and Y position information which applies to a coarse D to A converter **32.** The output of converter **31** is applied to an amplifier or yoke driver **33** and the output of converter **32** is applied to an amplifier or yoke driver **34.** Conventionally, the coarse X information provides a signal representing the distance from the sides of the display at which a character starts to be written and the Y information indicates how far from the bottom or the top of the display (which line) the start of the character writing begins. Fine information is provided to a character generator **35** which converts this binary coded information into fine X and Y information analog and Z information which could be digital or analog. Thus, if the binary fine information from the processor indicates an A to be written, the character generator provides the analog deflection signal for the X and Y deflection yokes, necessary to write an A at or from the point determined by the X and Y coarse information. The X fine analog signal is amplified by amplifier **37** and combined with the coarse analog signal at point C. The Y fine analog deflection signal is combined with the coarse analog deflection signal at point D. Character generator **35** furthermore generates an intensity signal which passes through the intensity amplifier **36** to vary the current of the electron beam by varying the bias on a grid **41.** If the display is to be digital this signal will merely turn the electron beam on and off as is known conventionally.

The typical scan converters **40** and **50** which are illustrated herein may be a type of electron beam storage tube such as a television camera or vidicon tube described in more detail in co-pending application, Ser. No. 775,861, filed Nov. 14, 1968 in the name of John W. Brookman, Johm B. Murphy, Zack D. Reynolds and entitled "Photo Erasable Scan Converter" and assigned to the same assignee as the present invention. This co-pending application describes a television camera tube in which an electron beam is applied to the target in a stroke fashion and then the target is read out in raster form by the electron beam. Any suitable scan converter, such as a storage tube, could be employed for the function defined herein. For the purposes of illustration, the storage tube **40** includes a cathode **47,** a grid **41** which could gate on or off the electron beam or vary the intensity of the beam by the output of the Z intensity amplifier **36.** The coarse and fine X deflection signal combined at point C is applied to the X deflection yoke **42.** The fine and coarse Y deflection signal combined at point D is applied to the Y deflection yoke **43.** During write, switches **46*a*** and **46*b*** are up.

Thus, the binary coded information defining one image is converted by generator **30** to electron beam analog stroke information to provide an image on target **44.** During readout, switches **46*a*** and **46*b*** are down and the yokes **42** and **43** are deflected in the conventional raster mode by deflection circuits **46** so that the target **44** develops at the output **45** a typical raster or television type signal. The output of the scan converter **40** or **50** is selectively applied to a cyclic storage means such as a magnetic disk **70** by way of a channel selector **60.**

The track selector **60** selectively applies the raster information from either scan converter **40** or **50** to one of the plurality of magnetic tracks TR1 through TRN by way of magnetic heads **71** through **71**N. The magnetic disk **72** is rotated at 1,800 rpm so that each rotation of the disk takes the time normally used or elapsed for the recording or playing back of one video frame (two interlaced video fields). The disk can be rotated at 3,600 rpm so that the time for one rotation of the disk is equal to the time required for one video field. In such a case, two tracks would have to be utilized to provide one video frame by alternately switching between these tracks.

A separate track TRC is employed on the disk **72** with this track containing vertical and horizontal synchronizing pulses required for one video frame. In a conventional television system, this would require 525 horizontal sync pulses and two vertical sync pulses. The signal on the track TRC is either the required number of the sync pulses, horizontal and vertical (for one frame) or conventionally a multiple of pulses are recorded with the frequency divided down by a sync generator **74** to provide the required number of vertical and horizontal sync pulses.

When the actual horizontal and vertical sync pulses are recorded, the sync generator **74** is not needed but rather the output of head **73** is connected directly to the circuits **46** of scan converters **40** and **50** so as to provide proper synchronization of the horizontal and vertical raster circuits **46** shown in FIG. **2.** In addition, the head **73** would also be directly connected to the distribution network **80** where the sync signals will be added to the video information from any of the tracks TR1 through TRN. Alternatively, two tracks may be employed for the synchronization function of TRC, one with horizontal sync pulses and one with vertical sync pulses. Sync pulses are made available for other sources **150, 160** and **170** to provide a synchronous input directly into the track selector **60.** Alternatively, the clock track TRC could contain a multiple number of clock pulses which, when divided down, will produce **525** horizontal sync pulses and two vertical sync pulses. This division occurs in the sync generator **74** and operates in the same fashion as is done for developing sync pulses for a conventional television camera. An example would be that the clock track contained 6,300 pulses with this output being divided by 12 to produce 525 horizontal pulses and divided by 3,150 to produce two vertical sync pulses. The magnetic head **73** is employed to record these pulses and thereafter reads these pulses out (when appropriate) to a sync generator **74** which divides the frequency of the pulses down to provide both the horizontal and vertical synchronization pulses.

Recording a different number of pulses on TRC and dividing by different numbers in the sync generator **74** will allow television displays having other than 525 lines to be generated. This could be down to generate displays compatible with 873 line closed-circuit television monitors, for example.

It will be understood that the video information applied to the tracks TR1 through TRN could be applied on a carrier such as an FM carrier and then recorded on disk **72.** Such a suitable selector **60** and FM recording is illustrated in co-pending application Ser. No. 682,432 filed Nov. 13, 1967 in the name of J. L. Adkisson and A. B. Manildi. On readout, an FM demodulator is used to drive the video signal.

The heads 71 through 71N are always connected to a distribution network. In so doing, the video information is applied through the network **80** to a monitor such as **90,** even during writing or recording so as to provide a non-interrupted display drive. A display selection can be accomplished by way of the keyboard terminal **100** which is connected to the subsystem control **20** to thereby command the readout of one of the storage locations **11** through **13** to the graphic generator **30,** or to select an alternative input such as **150, 160** or **170.**

Since the magnetic disk storage **70** regenerates to produce a continuous display on the monitors such as **90,** other auxiliary displays can more easily be provided in the system such as photographic file **151** which can be picked up by a scanner or TV camera **150.** Furthermore, a TV camera **170** can provide live information for displays. Both **150** and **170** can be connected to a video file or tape recorder **160** or alternately to one of the scan converters **40** or **50** in asynchronous mode; in a synchronous mode, they may be connected directly to channel selector **60,** thence to disk storage **70,** and directly to distribution **80** for displaying continuously scanned information. When transducers **150, 160** and **170** are connected to the scan converters **40** or **50** in asynchronous mode the horizontal and vertical sync pulses from generator **74** are employed to provide synchronous readout therefrom.

Thus, it is seen that in a conventional type display, the binary coded information in the computer is normally directly converted into either stroke or video raster information and applied to a monitor. As such, the only video displays possible from any storage or regenerating means must come from the computer. In the present invention, however, it is seen that the binary coded information is converted first into a stroke image and then by using the scan converter, it is converted into raster information. As stated above, these scan converters are read out in synchronism with the sync pulses on the cyclic storage means such as disk **72.** Thus, it is seen that by utilizing this double transformation of the image, it is possible and easily adaptable to include in the system virtually any asynchronous display source by applying it to the input of the scan converter. Furthermore, synchronous raster information can be applied directly to the channel selectors and this image information can come also from virtually any source of raster information. It will be understood, of course, that this noncoded raster information can be analog in form similar to a conventional television signal and also can be digital display information where only on and off information on the electron beam provides the display. Furthermore, it will be understood that this noncoded information could be applied to a carrier such as by frequency modulating the carrier in a conventional manner. In such a case, demodulators would be present in the distribution system **80.**

It will be noted that a single record and read head is employed for each track so that during recording the information will continue to be supplied to the monitor connected to that particular channel.

As stated above, vertical and horizontal sync pulses are applied either to a single track or two tracks on the disk **72.** Normally, coded signals for a single binary coded display message or pattern are applied to the graphic generator and the resulting XYZ signals are applied to a scan converter, so that a single frame will be read out from the scan converter through the channel selector **60** onto the disk **72** when actuated by the vertical and horizontal sync pulses from track TRC. Asynchronous sources are normally applied to a scan converter for conversion to a synchronous output and to accommodate differing resolutions, field sizes and types of scan. They may then be applied through track selector **60** for direct recording on the disk. In this case, either the vertical sync pulses or a single home pulse on disk **72** can be applied to gate these inputs so that signals corresponding to only a single frame will be recorded on the tracks **71** through **71N**.

An additional feature is that by regenerating the raster information on disk **72** in the form described above, relatively inexpensive television monitors can be employed, resulting in a relatively large cost saving when a number of output channels or stations are in the system.

The XY locator **110** provides two digital output signals which represent the XY position of a pointer **113** on a tablet **114**. Various conventional means can be employed to produce the desired XY signals. Such an example is illustrated in U.S. Pat. No. 3,399,401 in which a tablet is employed which does not overlay the display but rather is below or to one side of the display. In such a case, coordinates on the tablet **114** correspond to coordinates on the display. The details of such a system will not be shown, but for purposes of illustration, a converter **111** is shown to develop digital Y_O coordinate signals from the pointer **113** and converter **112** is shown to illustrate developing digital X_O coordinate signals from the signals from the pointer **113** and the tablet **114**. Any suitable system which would so produce binary or digital X or Y coordinate signals in response to positioning of pointer **113** can be employed.

In the system shown in U.S. Pat. No. 3,399,401, the tablet is not transparent and thence cannot overlay the display. If it is desired to have a system wherein the identifying area overlays the display, such systems as illustrated in U.S. Pat. No. 2,338,949; 3,527,835 and 2,241,544 can be employed. These systems in general utilize two pairs of plates in the X and Y direction across which an AC signal is employed. A pointer is employed on the display, and the resulting AC output signals from the system which varies as the pointer is moved, can be rectified and converted to an analog signal which subsequently can be converted to digital signals to provide XY digital coordinate signals. This XY digital information from locator **110** is selectively applied to a coordinate compare **140**. The other input to the compare **140** selectively is the XY generator **30**. Thus, the operator can regenerate the information in the graphic generator **30**, and compare it with the point selected by pointer **113** in the coordinate compare **140**. When coincidences of the X and Y signals occur simultaneously, an output is provided which, by way of proper timing or clocking, identifies this point within the subsystem control **20**.

More specifically, when the difference or distance, between the XY position signals from graphic generator **30** and the corresponding $X_O Y_O$ signals from pointer **113** are within a selected range, coincidence is recognized. A means is provided either in the unit **10** or unit **20** to indicate the range of coincidence. This comparison can either be done in an analog form or digital form. As a particular example, if the comparison, in fact, is done digitally in the compare unit **140**, the X_O Y_0 signals from pointer **113** (if not in digital form originally) would be passed through analog to digital converters, the output being the contents of one register containing the X_O position and one register containing the Y_O position. Likewise, the X and Y information from generator **30** would be passed through analog to digital converters to provide at the output thereof an X position and a Y position. THe contents of these converters, of course, would be dynamic and change as the output of generator **30** changes. When the magnitude of the difference between X and X_O and between Y and Y_O is less than a value established by coded limits from the digital storage and processor **10**, a coincidence true condition is established. When coincidence is detected, either the position registers from graphic generator **30** could be stopped or the binary coded display information to the graphic generator could be interpreted so as to locate the position of the particular code or step within the stream of data and orders which initiated the X, Y position placement. Additionally, the X, Y coordinate position at coincidence could be obtained from XY registers of **30**.

The multiplex means **130** is employed to selectively apply the signals from pencils such as **110** at a plurality of display stations, to the coordinate compare circuit **140**.

FIGS. **3** and **4** illustrate a method of comparing the coordinates identified by the pointer **113** and the output of the graphic generator **30**. In FIGS. **3** and **4**, the computer is adjusted so as to determine if a stroke from a graphic generator goes through the window W shown in dotted lines in FIG. **3**. To this end the signals from the pointer **113** and tablet **114** are passed through converters **111** and **112** to provide binary signals representing X_O and Y_O, the position of pointer **113**. Alternatively, pens, pointers, or teaching devices with direct digital output may be used. The digital processor provides a selected window by providing arithmetic unit **141** with, as shown, $-\Delta X+\Delta X$, $-\Delta Y$ and $+\Delta Y$. The $-\Delta X$ is added to the X_O to provide an X_L coordinate output as shown in FIG. **3**. The $+\Delta X$ is added to the X_O to provide a binary X_R output. The $-\Delta Y$ is added to the Y_O to provide a Y_L binary coordinate output. The $+\Delta Y$ is added to the Y_O to provide a Y_U output. These coordinates are representative of the boundaries of the window W as shown in FIG. **3**, as illustrated therein in dotted lines. The X deflection applied to deflection coils **42**, during compare, is applied to an A to D converter **144** which provides a binary indication of the horizontal coordinate of the electron beam in converter **40**. X_L, X_R and the output of A to D converter **144** are applied to an arithmetic unit **142**. This unit has a one output when X is larger than X_L and smaller than X_R. The output of this unit is then applied to AND gate **146**.

Point D is connected to A to D converter **145** so that Y deflection current applied to coils **43** of converter **40** provides a binary indication of the vertical deflection of the electron beam in converter **40**. The Y_L, Y_U outputs of unit **141** are applied to an arithmetic unit **143**. Likewise, the output of A to D converter **145** shown as Y is applied to unit **143**. When Y is larger than Y_L but smaller than Y_U, there will be one output from **143**.

A variation of the preferred method is to convert X_L, X_R, Y_L, and Y_U to analog voltages by using digital to analog converters after the arithmetic function **141**, while eliminating analog to digital converters **144** and **145**. In this case, the compare functions **142** and **143** are accomplished with analog threshold circuits. As used in a binary mode so that the beam is either off or on, the output of Z amplifier 36 is also applied to AND gate **146.** Thus, if units **142** and **143** have a one output, the deflection currents have directed the beam within the window W. When the beam is on so that the Z input to **146** is also a one, the intensified beam is passing through the window W. It will be understood that this window W can be altered in many ways to provide various functions. If shown as a square, it allows a predetermined tolerance to identify a position of the beam. It could, for example, however, by a horizontal line, by making Δ+Y and +ΔY both zero. Thus, the pointer **113** and the beam could be moved up and down to effect a bountary indicator or a height comparator.

When used as a window to provide tolerance in selecting a beam trace, the output of the AND gate **146,** as stated above, will be a one when the beam passes through the window W. This output could, for example, stop the reading out of the display information from one of the locations **11** through **13** to thereby identify within the computer exactly the program step which corresponds to where the pointer **113** is pointed. Thusly, this identifies in the storage location within the computer, the area of interest without requiring any work done by or programming of the computer. Alternatively, a counter in the subsystem control could be employed to count the output words by bytes of the selected display location **11** through **13.** When an output occurs from AnD gate **46,** this output would stop this counter which would identify the byte or bit within the storage locations **11** through **13** that the pointer **113** has identified. It will be understood that the multiplex means **130** has not been shown in FIG. **4** for purposes of clarity. This, however, would be located between the locator **110** or other digital coordinate indication signal lines and the arithmetic unit **141** solely for switching purposes.

In addition to the other features, two channels can be connected from the output of the distributon network **80** to compare these channels in a raster compare unit **120.** The compare unit **120** will compare the signals of the two channels in analog or digital form and by conventional logic will provide an output signal defining the presence and/or magnitude of any difference between the signals.

The subsystem control **20** can be actuated by the station keyboard **100** or processor so as to actuate and control various positions of the system illustrated in FIG. **1.** For example, this control system is connected to graphic generator **30** so as to command the generator to produce alphanumeric symbols as well as to produce displays from data in locations **11, 12** or **13** by reading out from processor **10** into generator **30** and then to a scan converter **40** or **50.** Furthermore, the control **20** is connected to scanner **150** and photographic file **151** to select a predetermined image on the film **151.** Likewise, the subsystem control is connected to tape recorder **160,** and television camera **170** to thereby select images from either of these sources. The image selected from **150, 160, 170** can be, as stated above, synchronous or asynchronous. Other portions of the system controlled by the subsystem control **20** via commands of the keyboard **100** are the switches S1 and S2 to select scan converter **40** and **50,** the channel selector **60** to determine the channel selection, the coordinate compare **140** to effect coordinate compare, and raster compare **120.** In providing coordinate compare, it will be understood that normally the pointer **113** will be manually positioned at the desired point and then the selected coded display from locations **11, 12,** and **13** will be fed into the graphic generator **30.**

OPERATION OF THE INVENTION

When the operator at the remote station S desires a particular display, he actuates ths subsystem control **20** by way of a keyboard **100** which thereby selects an output from one of the storage locations **11, 12** or **13** to be applied to the graphic generator **30.** These storage locations contain binary coded information representing a display. This graphic generator generates XY stroke type electron beam deflection signals and Z intensity or beam gating signals from the binary coded information signals which are then applied to the scan converter **40** or **50.** While this stroke information is applied to the scan converter, e.g., **40,** as shown in FIG. **2,** switches **46***a* and **46***b* are up (and closed) applying deflection signals from the graphic generator **30** to the pairs of deflection coils **42** and **43.** The amplifier **36** is connected to the control grid **41** of the scan converter, which in the preferred embodiment is a conventional vidicon tube **40** operating in darkness. The Z information from **36** being applied to grid **41,** gates on and off the electron beam from cathode **47.** It will be understood that the Z information could be applied so as to gate the cathode **47** directly without being applied to the control grid **41.** During readout, the electron beam emanating from the cathode **47** of the scan converter vidicon tube, sweeps the target **44** in the conventional raster mode (as done with a conventional television pickup). This provides a conventional television raster signal at the output terminal **45.** During readout, switches **46***a* and **46***b* are down (and closed) so that the horizontal and vertical deflection circuits **46** apply conventional raster deflection signals to the pairs of deflection coils **42** (horizontal deflection) and coils **43** (vertical deflection).

It will be noted that, by utilizing the scan converters in this system, various display sources **150, 160** and **170** can be fed into the scan converter although they are asynchronous and may have scans differing from the system output standard. The readout of the converter then delays, synchronizes, and insures the correct scanning sequence of the video signals, since the circuit **46** is driven or synchronized by vertical or horizontal sync signals from generator **74.** Alternately, where feasible, the units **150, 160** and **170** can have their readout synchronously driven directly by the sync signals from **74.** In such a case, the outputs thereof are applied directly to the distribution means or through track selector **60** to the disk storage **70.**

Commands from keyboard **100** to control **20** may directly or indirectly via control programming select the scan converter (**40** or **50**) to be utilized. In addition, commands from keyboard **100** to control **20** condition selector **60** to selectively apply the output of scan converter **40** (or **50**) to one of the tracks TR1 to TRN on disk **72** providing a display for monitor **90.** Thus, it is seen that the graphic generator **30** and the scan converter **40** and **50** are a means to convert binary coded information from the processor **10** into video raster information. This conversion could be achieved by other translation techniques. Such a recording and switching (of unit **60**) is set forth in detail in the above copending application Ser. No. 682,432.

After so recording, this frame of display information continues to be regenerated on disk **72** and displayed on the CRT of monitor **90**. When the operator desired to process corresponding binary coded information in CPU **10**, he does so by way of keyboard **100** through control **20** or by pen feedback using coordinate compare. This information can thereby be modified processed within processor **10**, etc., without disturbing the displayed image as originally provided by this coded information from **11**, **12** or **13**. This is in contrast to other systems that recirculate the binary coded information in unit **10** or in an associated buffer memory to produce the display.

If the operator desires to locate a point on the display, he employs the pointer **113** that develops $X_O Y_O$ coordinate signals of a point on the display. This signal is compared with signals being generated from the graphic generator **30** in the coordinate comparator **140**. This enables identification of intermediate points within displayed symbols or line segments not represented by binary coded information in the processor, without complicated processing within unit **10**. As set forth above, it is generally desirable to identify an area through which a portion of a displayed construction passes, such as shown in FIG. **3**, and identified as W. The processor **10** provides digital signals representing the dimensions of this area in $-\Delta X$, $+\Delta X$, $-\Delta Y$ and $+\Delta Y$. The pointer **113** provides digital X_O and Y_0 information which specifies the position of area W and which are added to the ΔX and ΔY information to define the sides of the window W identified in FIG. **3** as X_L, X_R, Y_U and Y_L. When a trace of the beam on target **44** passes through such a window, there is an output from AND gate **146** which then can effect an indication of the position of the pen relative to the displayable information, without the use of translation in the processor **10**. THis is made possible by comparing the information from pointer **113** with the stroke information in the generator **30**. As stated above, the window W could be made various sizes of a rectangle or even a line. Further, when identifying a line element of the display, this window provides a programmable tolerance limit.

While in accordance with the Patent Statutes, we have described what at present is considered to be the preferred embodiment of our invention, it will be obvious to those skilled in the art that various changes or modifications may be made therein without departing from the present invention.

We claim:

1. Display system comprising:

digital processing means including memory means having binary coded information representative of a visual display;

converter means operative to convert said coded information into non-coded television raster information that can be applied to a television display device for producing a visual display thereon;

cyclic storage means connected to said converter means for cyclically storing said noncoded television raster information, wherein said converter means includes generator means for converting said coding information to non-coded display information, and scan converter means synchronizing said non-coded display information with said cyclic storage means;

television display means;

transducer means for manually identifying by XY coordinate signals a portion on said display and means comparing the signals of said generator means with the XY coordinate signals of said transducer means; and

connecting means for selectively connecting said storage means and said display means to regenerate said non-coded television raster information and effect a continuous application thereof to the visual display on said display means.

2. Display system as set forth in claim **1** wherein said portion of said display is a rectangle determined by a pointer and preselected coded boundary signals in said digital processing means.

3. Display apparatus as set forth in claim **1** wherein said memory means includes a plurality of discrete binary information representative of a plurality of visual displays,

wherein said cyclic storage means stores and cyclically regenerates a plurality of noncoded information, and

means comparing the raster of one display with the raster of another display.

4. A display system for digital and analog information, said system comprising

a digital processor having a plurality of storage locations therein, each of said storage locations having binary coded information representative of a discrete image;

a graphic generator coupled to said digital processor for transducing the binary coded information into X, Y, Z signals capable of deflecting an electron beam;

scan converter means coupled to said graphic generator for converting the X, Y, Z signals into television type raster information of an analog or digital nature;

track selector means connected to the output of said scan converter means;

magnetic storage means connected to the output of said track selector means, said magnetic storage means having a plurality of endless tracks formed thereon for storing and cyclically regenerating raster information received from said scan converter means;

a distribution network connected to an output of said magnetic storage means;

and a plurality of television monitors coupled to said distribution network for displaying the discrete image stored in said digital processor.

5. The display system of claim **4** wherein at least one source of beam directing and intensification or video information is coupled to the input of the scan converter means; and

a selection of alternate video sources including a video tape recorder, television camera, and film scanner are also provided, said sources being coupled directly to the distribution network.

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