

[54] INFORMATION STORAGE ARRANGEMENTS

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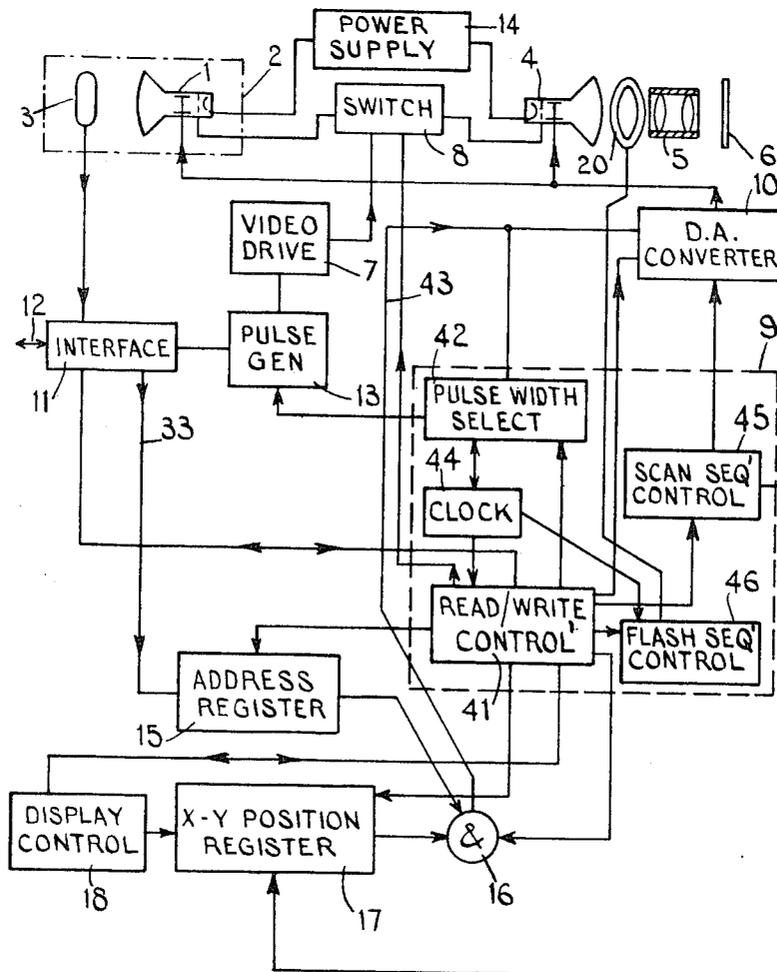
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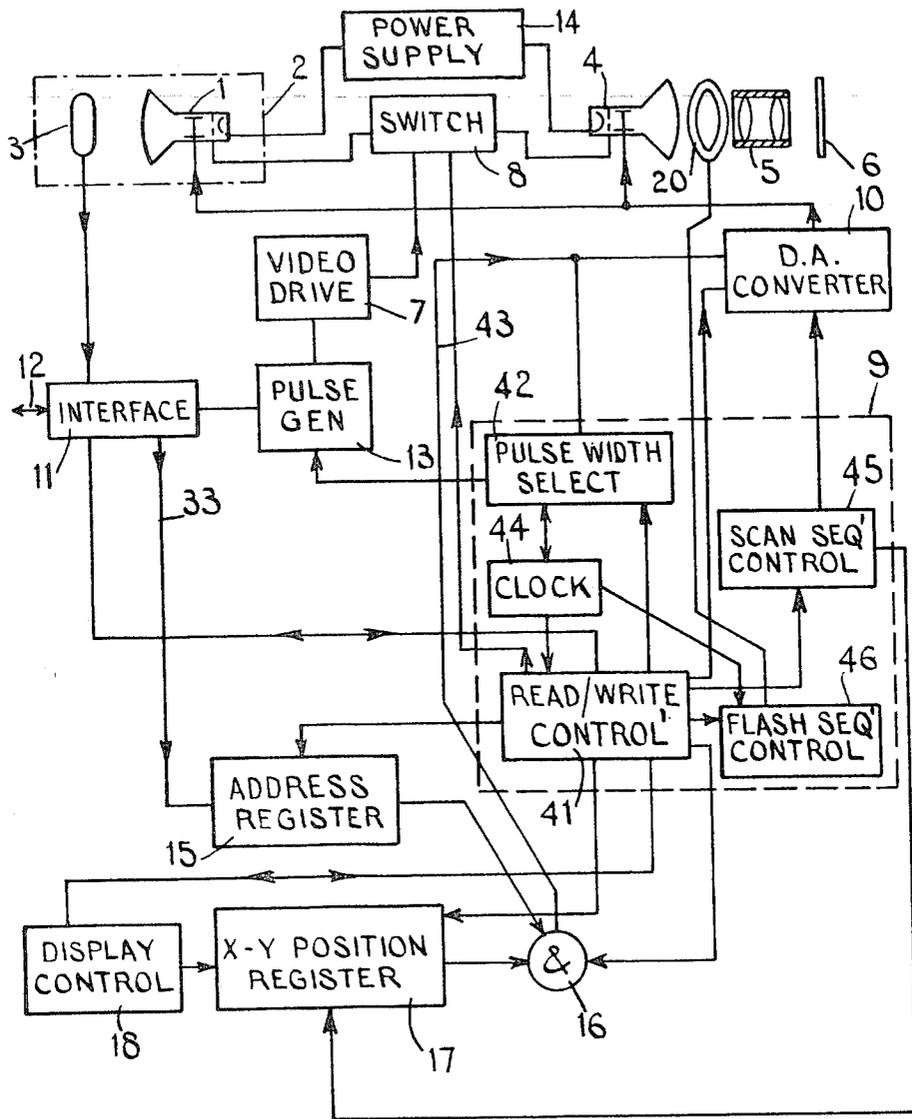
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[57] ABSTRACT

Two storage tubes, one used as a "permanent" data item store, the other as a display tube, share common power supplies and addressing arrangements. The two tubes are dark trace tubes and the beam current supply is arranged to produce writing and reading pulses of beam current which are delivered to the appropriate tube for (a) inserting new data items into the store tube and (b) for reading an item from the store tube and writing a resultant display on the display tube. The scanning of the store tube is cyclic and the data read from the store tube may produce a different display image.

10 Claims, 1 Drawing Figure





INFORMATION STORAGE ARRANGEMENTS

The present invention relates to information storage and display arrangements.

SUMMARY OF THE INVENTION

According to the present invention an information storage and display arrangement includes a first information storage tube arranged to store representations of items of information indefinitely respectively in a plurality of storage locations; a second information storage tube arranged to impermanently display information items in a corresponding further plurality of storage locations; control means including an addressing system common to both tubes for selecting a corresponding storage location in each of the tubes, drive current producing means, a switch operable to apply the drive current selectively to a location in one tube, means for varying the effective drive current applied to the location to read out or to write information, the control means being arranged to operate the switch to apply a drive current to read out information from said location in the first tube and to write information into said location in the second tube in dependence upon the significance of the information read out.

The drive current producing means and the switch may be arranged to apply a reading drive current to said first storage tube during a first part of each step and to apply a writing current to said second storage tube during a second part of each step.

BRIEF DESCRIPTION OF THE DRAWINGS

Apparatus embodying the present invention will now be described with reference to the accompanying drawing which shows diagrammatically a data storage and display arrangement.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, a data storage and display arrangement includes a first information storage tube 1. The tube 1 is a dark-trace CRT of the type described by I. Gorog in an article entitled "Cathodochromic Image Displays" published in the Oct. 1970 edition of "Applied Optics." The tube 1 is mounted within a light-tight enclosure 2 together with a photomultiplier cell 3, which is positioned to respond to light emitted by the tube 1. A second dark-trace tube 4 is provided for the display of information, and this second tube 4 is associated with an optical projection system, represented by a lens assembly 5 and a viewing screen 6.

The two tubes 1 and 4 share a common power supply 14 (shown schematically in the drawing as connected to the cathodes of the tubes) and for this purpose it will be realised that the tubes 1 and 4 are similar. The beam currents for the tubes 1 and 4 are derived, as schematically indicated, from a video drive amplifier 7 through a switch 8. The switch 8 is controlled by a control unit 9, and the arrangement is such that the beam current may be supplied to one or the other of the tubes 1 or 4, but not to both. In a somewhat similar manner a common deflection drive control circuit is provided by a conventional digital-to-analogue arrangement 10 for both the tubes 1 and 4.

The photomultiplier cell 3 has its output connected to an interfacing circuit 11 which is connected to an input/output channel 12 in order that new data to be

stored may be applied to the arrangement and that stored data may be available to an external utilization device, such as a computer. The interface 11 includes control facilities and is connected to the control unit 9 in a manner to be described. The interface 11 also has a connection to a pulse generator 13 which is in turn connected to the video drive amplifier 7 and the pulse generator 13 is also controlled by the control unit 9. In order to locate data items to be inserted into or read from the storage arrangement a conventional address register 15 is also provided and is connected by a channel 33 to the interface 11 to receive address information. The address register 15 is controlled by the control unit 9 and the output of the register 15 is applied through gate 16 to the deflection control circuit 10.

The gate 16 is also connected to receive the output of an X-Y position register 17, which in turn is controlled by the control unit 9 so that the deflection control circuit 10 receives an input from either, but not both, of the registers 15 or 17. The X-Y position register 17 receives an input from the control unit 9 for example, in order to produce a sequence of location addresses to control a recycling scan of the storage locations of the tubes 1 and 4. The register 17 is conveniently a resettable counter. A forcible setting of the register 17 may also be obtained by an auxiliary input from a display control unit 18 such as a character or vector generator. The display control unit 18 is coupled to the main control unit 9 and the unit 9 is then further connected to a flash erasure arrangement represented in the drawing by a flash tube 20.

The control unit 9 includes a group of interconnected logic units in order to permit various operations to take place. As will be explained it is required to read, to write and to erase items of information selectively from the tubes 1 and 4. The control unit 9 therefore includes a read/write controller 41 which is a logic network connected to the display control unit 18 by a two-way channel for the passage of control signals between these two units, in dependence upon the operation required to be performed. A clock pulse generator 44 is included within the unit 9 to provide timing signals and is connected to the controller 41. The controller 41 is also connected by a further two-way transfer channel to the interface 11 to permit control signals to be passed into and out of the storage arrangement over the channel 12.

The address register 15 and the X-Y position register, together with the gate 16, are controlled by the controller 41 in order to address a required location on one or both the tubes 1 and 4. The controller 41 is connected by way of a pulse-width selection network 42 to the pulse generator 13 in order to control the store reading and writing operations as will be described. In addition the flash erasure arrangement 20 is also controlled by the controller 41 by way of a flash sequence control 46.

The operation of the X-Y position register 17 in selecting sequenced locations to be addressed is effected in response to signals derived from a scan sequence control 45, within the unit 9, which, in turn, is operated by the controller 41 to produce incrementing signals at the end of an operational cycle performed in connection with each selected location. The controller 41 also effectively disables the scan sequence control 45 where it is required to introduce a particular address directly into the register 17 from the display control unit 18.

The manner in which the various parts of the control unit 9 co-operate is best described by way of examples. Thus, in one mode of operation, signals representing items of information to be stored are applied to the arrangement concurrently with address-representing signals over the input/output channel 12 in a conventional manner. The read/write controller 41 at this time permits the interface 11 to allow address information to be passed over a channel 33 and registered in conventional manner in the address register 15, and the address is shifted out of the register 15 under the control of the controller 41. The address representing signals, which are in conventional digital form pass through the gate 16 and are converted into beam positioning signals by the digital-to-analogue circuits 10 and applied to the two tubes 1 and 4. At this time, the controller 41 provides a signal to permit beam current to flow in the tube 1 by the operation of the switch 8.

The information item signals received by the interface 11 are passed to the pulse generator 13 which generates a writing current pulse of a width set by the pulse width selector network for each discrete storage location represented by the now-decoded address, the width of a pulse being set, as will be described, in order to read or write an information item. The pulses from the generator 13 are applied through the video drive amplifier 7 to the beam circuit of the tube 1, so that a pulse of beam current, corresponding to each pulse from the generator 13 is permitted to flow in the tube 1 for each selected storage location. The precise item of information written at each location is dependent upon the duration of the corresponding pulse generated by the pulse generator 13, and is either a "disc" or "ring." The forms "disc" and "ring" refer to the appearance of the image formed on the tube face when viewed in ambient illumination, and the particular image formed is dependent upon, the width of the pulse of beam current as set by the pulse width selector network 42 while the amplitude of this current is held constant.

If the current pulse is assumed to be of a particular short duration the material of the screen coating of the tube is excited and a spot of colour is produced. This spot is known as a "disc." If, on the other hand, the pulse width is increased, local head generated in the screen at the centre of the disc causes the image to be erased progressively from the centre outwards, producing a "ring" image. Thus the two states "disc" or "ring," respectively, may be used to indicate the storage of the two binary values one and zero. It is a characteristic of dark trace storage tubes that once formed the colour image will remain indefinitely provided that the tubes are not subjected to heat or light, either of which will cause gradual deterioration of the image. Thus, in the present case, the tube 1 is housed within the light-tight enclosure 2 to protect it from light, and the ambient temperature of the interior of the enclosure 2 is, under normal conditions of operation, sufficiently low that image deterioration is negligible. The use of three pulse widths for reading and writing rings and discs on the face of a dark trace CRT is described in a paper entitled "Dark Trace Digital Storage and Display Conversion" by Albert M. Loshin.

The pulse generator 13 of the present arrangement is capable of generating pulses of three different pulse widths respectively and of a constant amplitude, and the pulse width selector network 42 is arranged to se-

lect a required width of pulse in dependence upon the operation to be performed. The pulse of shortest width is used in conjunction with a reading operation to be described hereinafter, and this pulse causes a phosphorescence at the tube screen without producing a colour image. The pulse of intermediate length produces the "disc" of colour at the screen and the pulse of greatest width produces the colour "ring" at the screen. Thus, the occurrence of a binary zero representing signal on channel 43 from the input channel 12 during a store writing operation is applied to the pulse width selector 42 together with timing pulses from the clock pulse source 44 and a control signal from the control 41 to select a pulse of intermediate width to be generated by the generator 13, and the amplifier 7 causes a pulse of the same width having the requisite amplitude to be applied to the beam current circuit of the tube 1, and this beam current then forms the "disc" at the location specified by the address register 15 and decoded by the converter 10. If the binary digit has the value one, then the greater pulse width is selected and the beam current forms a "ring" at this location. Hence, the tube 1 stores, indefinitely, representations of the digital values from the channel 12.

The second tube 4 is used to provide a visual display. For convenience of explanation a first case will be assumed in which it is simply required to display, on the tube 4, the information stored on the screen of the tube 1. In order to transfer the stored contents of the tube 1 to the tube 4 it is first required to generate a cyclic scan of all the storage locations of the tube 1, in a manner somewhat analogous to the raster scanning system of a television tube system except that each line scan, instead of being performed by a beam spot of substantially constant velocity, is performed by incremental movement of the scanning beam spot.

In this first case the positioning of the beam is performed under control of the X-Y position register 17. The register 17 is conditioned for this purpose by the controller 41 and receives an input from the clock pulse source 44. The scan sequence control 45 provides an initial reset condition and controls the emission of a single address sequence cycle. The steps of the cycle being controlled by the controller 41 to provide reading and writing phases as necessary. Thus, initially the register 17 contains a zero address and this address is increased by unity after each individual scanning operation of the cycle. A simplified operating cycle will be described, and is conveniently considered as including reading and writing phases for each store position.

Initially, with the X-Y position register 17 reset and the address register 15 inhibited from producing an output by the controller 41, the first location address is formed in the register 17 in readiness for a first reading phase. The digital to analogue convertor 10 now derives from this address the required deflection signals and applies these to both tubes 1 and 4. The controller 41 conditions the width control 42 to control the pulse generator 13 to produce a minimum width pulse and the video drive amplifier 7 produces a pulse of beam current. At this point the switch 8 is conditioned by the controller 41 to pass the beam current pulse to the tube 1. It will be recalled that the pulse of minimum width produces only phosphorescence at the face of the tube 1. If the tube 1 is storing a binary 1 at this position the position is occupied by a colour "ring." The phosphorescence is therefore visible in the centre of the ring

and is 'seen' by the photomultiplier tube 3. If, on the other hand, there is a binary zero stored at this position on the face of the tube 1, the position will be occupied by a colour "disc" and the phosphorescence will not be 'seen' by the photomultiplier tube 3. Thus, in dependence upon whether or not a binary 1 is present, a signal will or will not, respectively, be passed by the tube 3 to the interfacing circuit 11. The interfacing circuit 11 and the pulse generator 13 are maintained in synchronism with each selected phase of the scanning cycle by the controller 41 and the interfacing circuit 11 is conditioned, during scanning of the locations, to maintain during a second phase of operation, that condition represented by the occurrence or otherwise of the signal from the photomultiplier tube 3 during the first phase of the transfer.

The control circuit now initiates the second phase and prepares to write the information read from the tube 1 on to the tube 4 the address in register 17 remaining unchanged. The switch 8 is operated to cause the next beam current pulse to be directed to the tube 4, and the pulse generator 13 is now permitted once again to respond to the presence or absence of a signal at the interfacing circuit 11 to generate a pulse of either maximum or intermediate width respectively. However, on this occasion the colour "ring" or "disc," as appropriate, will be formed on the tube 4.

After this writing phase the scan sequence control 45 causes the register 17 to be incremented to select the next location address in the scanning cycle, and the controller 41 again selects a reading phase. This alternation of reading and writing phases continues until the scanning cycle is completed. It will be realised that the scanning cycle described above results in the duplication of the pattern on the storage tube 1 on the display tube 4. However, this duplication is not always to be desired. For example, it may be required to write spots or "discs" on the display tube where, say binary ones are registered on the storage tube 1 and to take no action in the case of binary zeroes. In such a case, which might, for example, be used in connection with character generation or display, the controller 41 is arranged, on the writing phase, to permit the pulse generator 13 to generate only an intermediate-length pulse on the occurrence of a binary one-representing signal at the interfacing circuit 11, and to inhibit the generation of a pulse in the absence of the one-representing signal.

Because the display tube 4 is not contained within a light-tight enclosure the image on the screen of this tube will fade. In a practical case, to be described, it is preferred to illuminate the screen of the display tube with ambient light of relatively high intensity and in this case the fading of the displayed image is more rapid. It is preferred, therefore, constantly to repeat the transfer cycles to regenerate the displayed image, and the control unit 9 is arranged, in the absence of incoming information on the channel 12 repeatedly to initiate new scanning cycles. In practice an interlock is provided between the storage and display arrangement and external utilising apparatus such as a computer, so that information on the channel 12 has a priority, and the repeated scanning is interrupted if new information is present on the channel 12 during a scanning cycle. The new information address is applied to the register 15 and the control unit 9 then, by operation of the controller 41 in response to incoming instruction, permits the new information to be entered into the tube 1 at the ad-

dress specified in the register 15 before cyclic scanning is resumed. Hence the new information would be displayed on tube 4 at the latest on the next succeeding scanning cycle. It will also be appreciated that under some circumstances, where new information is to be written into storage, it may be required completely to erase the image on the screen of the display tube 20. Accordingly provision is then made, within the control unit 9, for the controller 41, upon completion of entry of the new information, to reset the scanning cycle and to apply a trigger signal to the flash tube 20.

Alternatively, the triggering signal may be generated only at the end of a scanning cycle. In this case the address in the register 17 is preserved when the cycle is interrupted, and scanning is resumed at this address until the scanning cycle is complete, when the triggering signal is generated, and erasure of the image on the tube 4 takes place only at the end of a complete cycle, and the next cycle of scanning will present the modified image. A further facility that may be provided, is that if the address modified is later in the cycle than the address at which the interruption occurred, then the address of the modification may be marked and skipped during the completion of the current scanning cycle.

The flash erasure arrangement 20 is conveniently a group of devices each similar to an electronic flash gun for photographic use, the devices being selected to be operated in turn by the flash sequence control 46.

By the use of such an erasure arrangement, it will be realized that the display tube 4 may be used to display information that has been modified on each successive display cycle. Thus, the provision of a number of separate flash devices together with the cyclic distribution described of the triggering signals by the control 46 enables the displayed information to be erased at the end of each display cycle, so that the displayed information may be constantly changing, and this continual modification is then possible without significant reduction in the repetition rate of the display cycles.

In addition to the straight-forward transfer of stored information from the storage tube 1 to the display tube 4 it will also be apparent that other, more complex, modes of operation may be provided. For example, it may be required to display an image only on demand. In this case the controller 41 of the control unit 9 may normally be arranged so that it completes a scanning cycle but does not initiate a new one. A control, such as push button or switch, for example, may then be provided in association with the control unit 9 or the display control 18 to initiate recycling.

Facilities may also be provided to enable an operator to modify the displayed image. Thus, for example, an address may be set up, as on a keyboard for example, and a connection from the keyboard provided to the interfacing circuit 11, so that the keyboard information initiates a priority interruption in the same way that one would be initiated for new data on the channel 12. It will also be realised that any such new information is recorded on the storage tube 1 instead of the display tube 4 by causing the controller 41 to operate the switch 8. The new information is then entered into the tube 1 by overwriting a "disc" within a "ring" or expanding a "ring" to become a "disc" according to the information that is to be written. Because of this facility for overwriting it will be apparent that new information may be stored on the screen of the tube 1 without the need for first erasing the previously stored information.

The foregoing description of operation has assumed a simple application of the apparatus described. It will be realised, however, that other modes of operation are possible, and also that modifications may be made to the apparatus arrangement according to the use to which the apparatus is to be put. For example, in connection with the simple mode of operation described above, instead of providing separate address registers 15 and 17, a single address register such as the register 15 may be used and may be arranged so that its contents are stepped sequentially in the manner described for the register 17. The facility for forcibly setting and resetting this register may then be extended to permit a setting to be dependent upon the new address information applied over the input channel 12. However, in this case it is necessary that the interlock between the external utilising apparatus and the common address register 15 shall then only permit the application of address information from the interfacing circuit 11 to the register between regeneration cycles of the display tube 4, and that the repetitive recycling of the store shall be inhibited during such entry of modifying address information into the register 15, the address register 15, then being reset to zero on the completion of the modification process.

In a further example of operation, however, the two registers 15 and 17 may be provided as described and used to contain different addresses, not to be used concurrently. For example, suppose that the storage tube 1 is used to contain information specifying addresses of only those locations at which a displayed trace is to be written on the tube 4, the addresses of all other locations not being written into the storage tube 1. This situation typically arises where the storage tube 1 is used as a buffer store to contain data to enable a display to be written. In such a case the storage tube 1 will be interrogated, as described, by a regular sequential scan. In this case, however, the information derived from the output of the photomultiplier cell 3 represents a sequence of location addresses, and the scan is interrupted at the end of each address. Since the addresses are of predetermined length, this interruption is conveniently produced by counting the scanning cycle steps in a counter of the required length. The output from the photomultiplier cell 3 then resembles the input of serial addresses to the interfacing circuit 11. The line 33, from the interfacing circuit 11 to the address register 15 enables this register to select the storage location specified by the storage tube 1. It will be apparent that the controller 41 is then conditioned to interrogate the storage tube 1 on the reading phase of a number of steps and to inhibit the writing phase of these steps so that the address is read into the register 15. At this point the X-Y register 17 output is disabled and the address register 15 address output is enabled to select the required location for the display tube 4. At the same time the switch 8 is operated to apply to writing beam current to the tube 4 and an intermediate-length pulse is initiated by the controller. By repeating this process the display tube image is constantly regenerated and is quite different from the image recorded on the storage tube 1. In this case the modification of a displayed image would be obtained locally, for example, by an additional register in the control 9 specifying a new address to be written into the storage tube 1 and applying this new address to the interfacing circuit as though it

were new information appearing on the line 12 to the interfacing circuit 11 and then over the line 33.

In yet another mode of operation, particularly suitable for the display, for example, of alphanumeric characters, the two address registers 15 and 17 may cooperate to provide a display having elements, such as characters, positioned on the display tube 4 in the same relative displacement as is stored information on the storage tube 1, but in which the kind of element displayed is dependent upon the actual information stored in digital form in the corresponding elemental position on the storage tube 1. In this case the address register 15, for example, is controlled as previously noted, to perform a regular cyclic scan of the positions of the storage tube 1. However, the addresses used for the control of the scanning cycle are divided for practical purposes into two parts: a more significant part which specifies a coarse location on a tube face, and a less significant part which specifies one of a number of storage item areas at that coarse location. The controller 41 is also modified to operate in a slightly different manner. Thus the interrogating scanning cycle is divided into a number of steps, and after each of these steps the scan is temporarily halted while a display writing sequence is carried out. During this writing sequence, the output lines from the interfacing circuit 11 to the controller 41 are connected to the lines from the controller 41 to the display control 18. In order to illustrate the operational sequence, let it be assumed that the register 15 is the register used to control the store scanning sequence and that an address in the register 15 is the first address of a group concerned with a single one of the scanning cycle steps. The more significant digits of this address specify an area of the storage tube 1 in which are stored those bits associated with the steps to be considered. The output of the register 15 is applied to position the beam of the storage tube 1, and the less significant digits of the sequential address within the group cause these stored bits of the current step to be read out to the interfacing circuit 11. The interfacing circuit 11 is arranged in this case to register the group of stored bits read out during the step. Thus, at the end of the step, the interfacing circuit 11 is registering the stored bits of the group of locations interrogated within the step. At the end of the step, store interrogation is halted and these bits are presented, via the additional register in the controller 41, to the display control unit 18, which is, in this case, a character generator. The applied bits represent, in coded form, a character to be generated. The output of the unit 18 is applied to the register 17, and the controller 41 then permits the register 15 and 17 selectively to control the beam position of the display tube 4. Thus, the more significant digits from the register 15 are permitted to provide a coarse beam position and the less significant digits derived from the register 17 provide the fine beam positioning signals so that on a number of phases of a writing cycle, the actual character represented by the bits derived from the storage tube 1 is written in a similar position on the face of the display tube 4, under control of a succession of signals derived from the character generator which forms the display control 18. At the end of the writing of this character, the contents of the register 15 are incremented to change the more significant digits to specify a new "coarse" location, and the store scanning and character writing phases of the cycle are repeated for a new character.

It will be clear that the read/write controller 41 is a network of logic elements arranged to co-operate to control the operational cycles of the storage and display tubes as may be required for the particular sequence of tasks to be performed. Thus, in the simplest case, where the steps of a store scanning cycle can be broken down into a number of phases, the controller 41 may simply consist of a number of, for example, bistable stages connected to form a recirculating counting chain. In this case the count may be stepped from one stage to the next by the application of clock pulses. Each stage may then be connected to gate elements arranged to condition control lines to produce the required operations in the successive phase. For example, in the simple scanning case the stages would successively permit the stepping of the scan sequence control by one increment; the next stage would condition the generation of a reading pulse, and so on. The stepping of the count along the stages would be made conditional in the conventional manner on the successful completion of the current phase of operation. In more complex cases, the controller would also include gating arrangements to permit the skipping of various stages according to the operation to be performed; and the skipping gates would be controlled, in turn by operation signals derived from, for example, the display control unit 18, as by the actuation of operation control lays. The development of such a control chain for the controller 41 will readily be understood by those skilled in the art.

In order to enable the display from the tube 4 to be viewed in high ambient light, it is preferred to employ a projection illuminating system in connection with the tube 4.

It will be realised that the foregoing arrangement is particularly suitable for use in an interactive graphical display terminal, and in this case it will be appreciated that the storage device from which information relating to items to be displayed is derived need not be a second dark trace tube, similar to the storage tube 1. Indeed, in such a case, the permanent nature of the storage offered by the tube 1 may well not be necessary. Hence, the information store for such a terminal may consist of other known digital buffer storage devices, such as storage core matrices or MOS devices.

It will also be realised that the display tube may be operated under conditions in which the electron beam deflection signals are first staticised and then a pulse of beam current is allowed to flow in the tube to produce a dark spot (as opposed to a "ring"). Used in this way a display is traced out as a succession of discrete dots on the tube face. Alternatively, the display tube, particularly when used as described to display characters, for example, under control of a character generator such as 18, may display an outline traced by a moving electron beam. In this case the spot movement speed in conjunction with the beam intensity must be arranged so that a dark trace is formed but so that the beam current in relation to the writing speed does not form a double outline, which would result from attempting to trace out the character with a "ring" forming current.

Finally, it will be realised that the continued overwriting of different binary digits in the storage tube will tend to produce a dark border round every bit storage position, resulting from the formation of rings at such positions. It may then be desirable to arrange to erase the storage tube completely at predetermined intervals

to prevent excessive ring growth, and in order to perform this erasure a flash tube arrangement may be provided in association with the storage tube 1. In this connection it is also to be appreciated that a pair of storage tubes 1 may be used, and a change-over arrangement provided such that one storage tube is used to accept and store new information while the other tube is completely erased in readiness for a new storage cycle. Because these two tubes are not required to be scanned at the same time, it will be appreciated that they may share common power supplies.

We claim:

1. An information storage and display arrangement including a data item storage tube having a plurality of data item storage locations each capable of storing indefinitely an item of data; a data item display tube having a plurality of data item display locations corresponding respectively to the locations of the storage tube, each display location being capable of displaying an item of data impermanently; and control means connected to both tubes including a common location addressing system arranged to select respectively corresponding locations in both tubes concurrently, means for producing beam current control signals, and switching means connected to said beam current control signal producing means and arranged to apply a beam current control signal selectively to only one of the tubes to permit a predetermined beam current to flow to that location specified by said addressing system only in the selected tube, the predetermined beam current permitted to flow being effective to read out a data item from or to write a data item into the specified location in dependence upon the control signal, the control means being arranged to operate said switching means and said control signal producing means to read out a data item from the specified location in said storage tube and to write a data item into the corresponding specified location of said display tube in dependence upon the significance of the data item read out.

2. An arrangement as claimed in claim 1 in which the control means includes data item receiving means arranged to receive a data item read out from the storage tube and means responsive to the received data item to control said beam current control signal producing means to produce a writing beam current to write a data item into the corresponding location of the display tube.

3. An arrangement as claimed in claim 2 in which an information channel is connected to said receiving means, the receiving means also being arranged to receive input information items from the channel.

4. An arrangement as claimed in claim 3 in which the control means is arranged to condition the beam current control signal producing means and the switching means to apply a writing beam current to said first tube and to interrupt the cyclic sequence to write an input item into said storage tube.

5. An arrangement as claimed in claim 1 in which the addressing system includes a register and display control means arranged to select a particular location address, the display control means being connected to the control means to condition the beam current control signal producing means to produce a modified drive current to modify a data item displayed on the display tube at said particular location.

6. An arrangement as claimed in claim 5 in which the beam current control signal producing arrangement is

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further conditioned to produce a modified drive current to modify a data item stored in said storage tube at said particular location.

7. An arrangement as claimed in claim 1 in which the control means further includes scanning sequence control means arranged to cause the addressing means to scan all the locations of a tube in a regular cyclic sequence of steps.

8. An arrangement as claimed in claim 7 in which said scanning sequence control means is further arranged to repeatedly regenerate data items displayed on the display tube.

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9. An arrangement as claimed in claim 8 in which the control means includes means for interrupting the regular cyclic sequence.

10. An arrangement as claimed in claim 9 in which the control means is arranged to condition the beam current control signal producing means and the switching means to apply a reading beam current to said storage tube during a first part of each step and to apply a writing beam current to said display tube during a second part of each step.

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