May 16, 1961 D. C. ENGELBART 2,984,765

ELECTRIC CONTROLLED INFORMATION-BEARING DEVICE

Filed Nov. 28, 1956

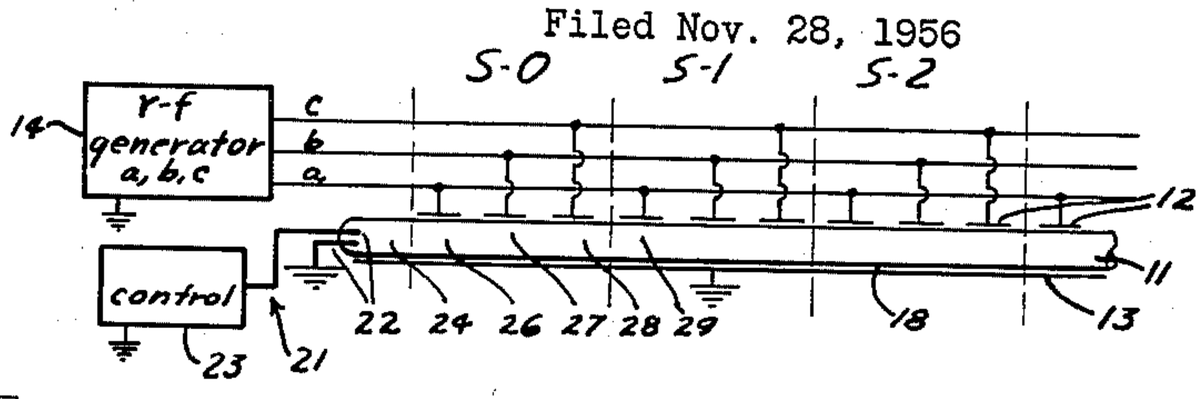

Fig. 4

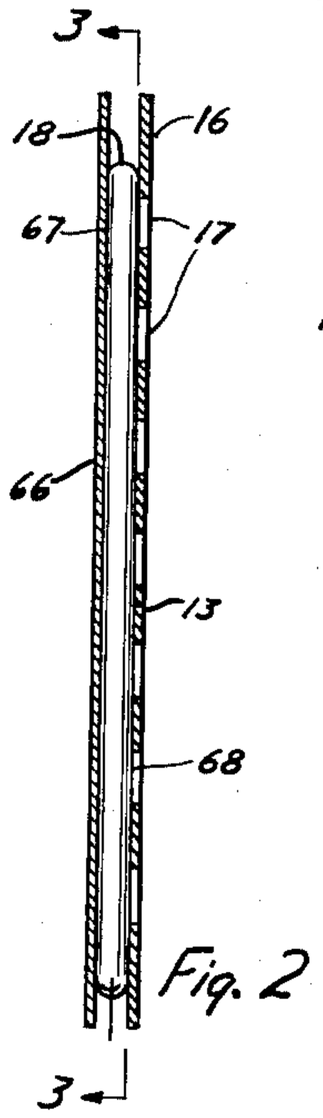

Fig. 2

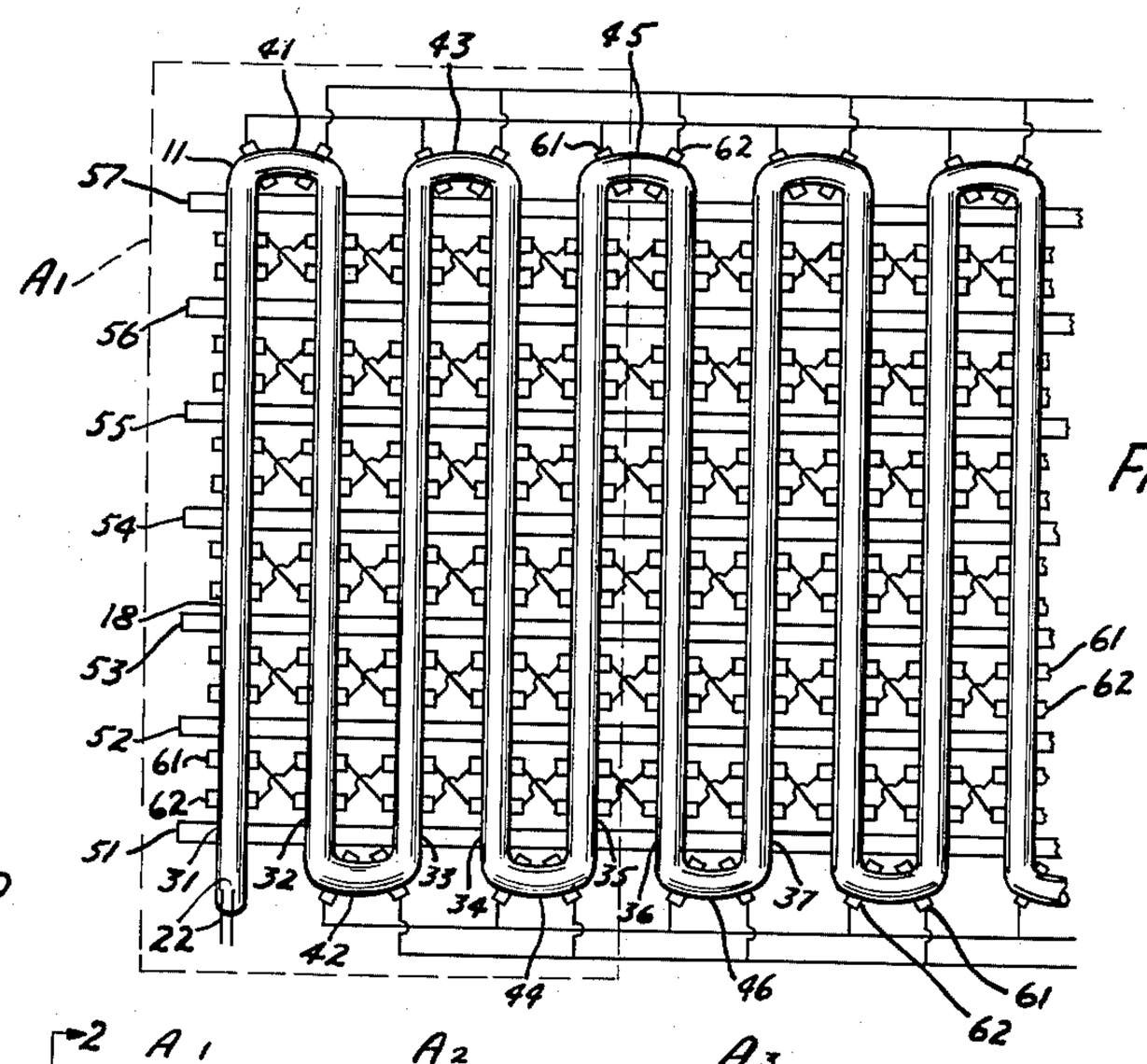

Fig. 3

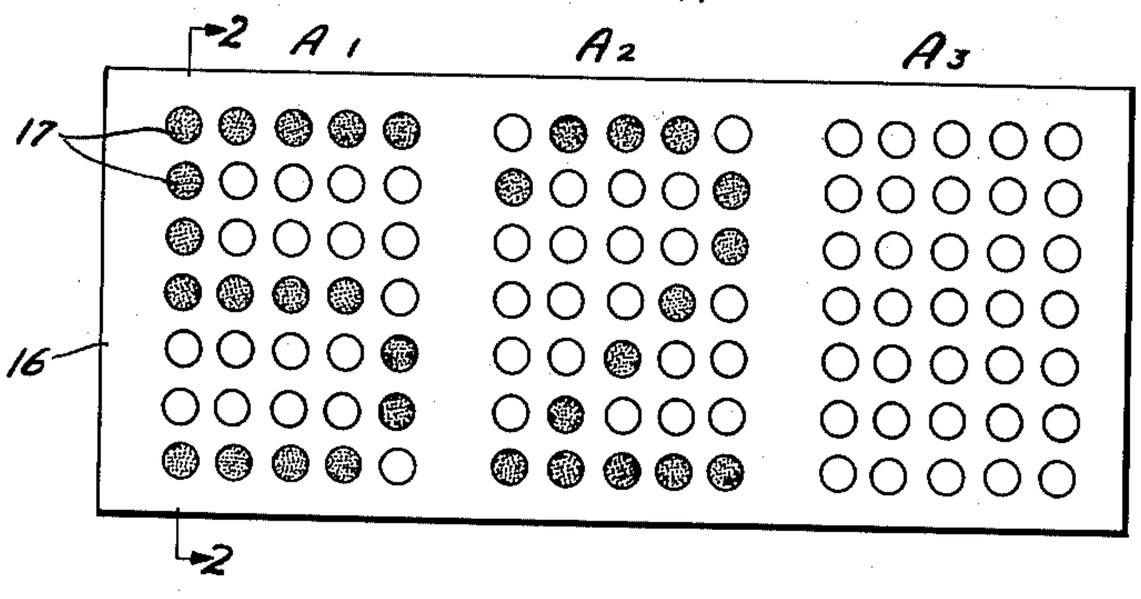

Fig. 1

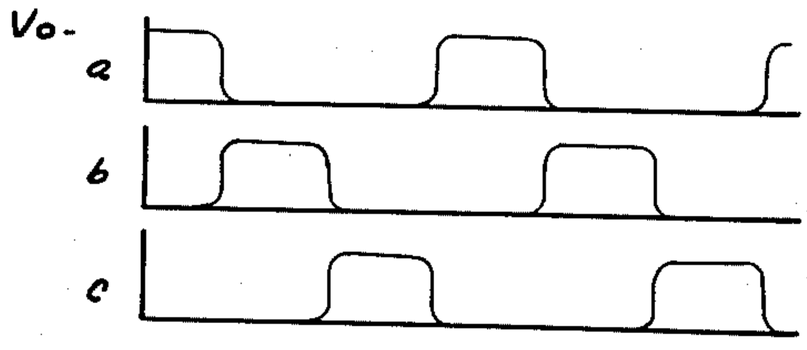

Fig. 5

INVENTOR.
Douglas C. Engelbart
BY Manfred M. Warren
His attorney

United States Patent Office

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ELECTRIC CONTROLLED INFORMATION-BEARING DEVICE

Douglas C. Engelbart, Oakland, Calif., assignor to Digital Techniques, Inc., Berkeley, Calif., a corporation of California

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4 Claims. (Cl. 315—169)

The invention relates to devices and instruments such as arrays of electric lights (filament or gaseous discharge), cathode-ray tubes, counter tubes and the like used in the electric sign, computer and other arts for providing a desired luminous pictorial representation. This application is a continuation-in-part of my copending patent application S.N. 521,555, filed July 12, 1955, since matured into U.S. Patent No. 2,923,853, issued February 2, 1960.

An object of the present invention is to provide a device of the character described which will be highly versatile and flexible in its ability to set up a wide variety of display patterns and display effects in luminous form, and wherein the display, when set up, may be held or stored, or with equal facility may be animated, moved or shifted, at slow or high speeds, as required.

Another object of the present invention is to provide a device of the character above in which it is easy to cascade a plurality of display units in order to present long numbers, words, sentences, etc., and wherein the characters displayed in one unit may be shifted or transferred in sequential fashion to the other units to afford a coordinated succession of letters, words or ideas.

A further object of the present invention is to provide a device of the character described which is of relatively simple and inexpensive construction, and which utilizes a minimum number of parts all of durable form and offering a long and trouble-free life.

The invention has other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by said drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to said drawings:

Figure 1 is a front elevation of an electric control information-bearing device constructed in accordance with the present invention.

Figure 2 is an enlarged cross-sectional view of the device taken substantially on the plane of line 2—2 of Figure 1.

Figure 3 is a cross-sectional view taken substantially on the plane of line 3—3 of Figure 2.

Figure 4 is a diagrammatic representation of a typical serial shifting register which may be used in the present device.

Figure 5 is a representation of excitation voltages used by the shifting register to effect shifting of the display.

The information-bearing device of the present invention consists briefly of a channel 11 of ionizable gas, such as neon, a plurality of sets of electrodes 12 and 13 (see Figure 4) arrayed along the channel 11 in a manner defining a plurality of stations S–0, S–1, et seq., and means 14, here denoted as R.-F. generators *a*, *b* and *c*, energizing the electrodes 12 and 13 for providing a glow discharge or a no-glow at each of the stations S–0, S–1, et seq., to afford

any desired luminous pattern over the length of the channel.

Preferably, the device is deployed over a display area, such as indicated in Figures 1 and 3, as A1, A2 and A3, so as to arrange the stations in a mosaic pattern, such as seen in Figure 1, capable of pictorial representation, and preferably, and as here shown, the channel is arranged to course the area in a manner locating the stations in a uniformly spaced grid.

Definition of the pictorial representation may be aided by the placing over the display channel of a mask 16 which may be constructed as a sheet of opaque material and formed with a plurality of openings 17 registering with the stations S–0, S–1, et seq., so that the luminous spot is visible only at the openings. I have illustrated, in the accompanying drawings, a more or less typical 5 x 7 grid, that is, a display area consisting of five horizontally spaced vertical columns of seven openings each. This 5 x 7 grid arrangement is capable of displaying and defining numbers, and other symbols, as for example the numerals 5 and 2, which show up in the appropriate illuminated openings (shaded) of areas A1 and A2 of Figure 1.

I have found that a pattern of discrete glows or no-glows along the channel of ionizable gas can be readily established by a plurality of longitudinally spaced electrodes and the appropriate energizing of these electrodes. The channel may, for example, be provided by a length of glass tubing 18 containing the low pressure ionizable gas, and the electrodes 12 and 13 may be set either inside or outside the glass envelope. I have further found that by using R.-F. voltage excitation in the order of 20 to 25 megacycles per second and a magnitude of 60 to 150 volts rms., that a glow excitation can be obtained by the use of electrodes placed on opposed outer sides of a glass tube of approximately one-quarter inch O.D. containing neon gas at a pressure of about 15 mm. Hg. The use of externally positioned electrodes physically isolated from the separately hermetically sealed ionizable gas affords many advantages of versatility in design, simplified construction and long life of the unit.

As another important feature of the present invention, the gaseous electronic system of the unit consists of a serial shifting register of the multiple position glow discharge type capable of sustaining and shifting a discrete and selectable pattern of glows along the gas channel. This type of register is more fully disclosed in my copending application Serial No. 521,555, now Patent No. 2,923,853, and depends in its functioning upon four principal characteristics, bistability, localizability, controlled priming, and transfer of high-frequency electrodeless discharge.

Bistability.—Over a certain range of applied operating R.-F. voltage (V*o* in Figure 5) there will exist no glow discharge unless such a discharge was introduced by the priming effect of an adjacent discharge, in which case the applied voltage will sustain glow discharge so long as applied. Thus, there are two stable states, discharge or no discharge, in the gas channel at each of the energized electrodes.

Localizability.—These discharges are restricted to a volume or cell within the channel which is directly under the influence of the excitation electrode, and thus remain localized within the channel so that many independent discharges may exist within the channel at one time.

Priming.—Due to the proximity of adjacent cells, the glow discharge in one cell will effect a spill-over of ionization into the adjacent cell to provide what is called "priming," that is an ionized condition within the adjacent cell which will produce a glow discharge when the operating voltage discussed under bistability is applied.

Transfer.—If the excitation is removed from a (first)

cell, and the adjacent (second) cell is theretofore or immediately thereafter excited, it will be observed that the discharge state (i.e. glow or no-glow) in the second cell will be the same as originally in the first cell. This follows from considering that if (*a*) there had been a glow discharge in the first cell, there would have been a priming action in the second cell, so that when the excitation was there established, a glow discharge would result; but (*b*) if there had been no discharge in the first cell, there would have been no priming of the second cell, and no discharge would be established in the second cell when excited. Thus it can be said that the "bit" of information (glow or no-glow) contained in the first cell has been transferred to the adjacent cell.

Such a shifting register is depicted in Figures 4 and 5 of the drawing wherein the plurality of electrodes **12** are arrayed along the gas channel **11** in juxtaposition to a common (ground) electrode **13** to provide a plurality of discrete and adjacent cells of the character above described. Means **21**, here consisting of a pair of electrodes **22** (shown at the left end of the channel) and controlled voltage source **23** connected thereto, is illustrated for setting or entering a "bit" (glow or no-glow) into cell **24** at the start of the channel. The source **23** may be D.C. or A.C. and controlled by manual or electronic switches. The "bit" in cell **24** is shifted by the application of voltages *a*, *b* and *c* of the form and phasing shown in Figure 5 and which are each connected to every third electrode **12** as shown in Figure 4. Voltage *a* will shift the bit from cell **24** to adjacent cell **26**. Switching successively to voltages *b* and *c* will shift the bit to cell **27** and then to cell **28**. Switching back to voltage *a* will shift the bit to cell **29** and shift a new bit from cell **24** to cell **26**.

One of the manifest advantages provided by the foregoing shifting register is that the switching from voltages *a* to *b* to *c* to *a* et seq. shifts the whole stored pattern as a unit. Thus a pattern of glows and no-glows once entered may be advanced along the channel while retaining the identity of the pattern. Further advantage may be taken of this effect by providing a plurality of coordinated information bearing areas A1, A2, and A3 as shown in Figures 1 and 3, and providing each with a serial shifting register as above described, and connecting and energizing the registers so that the pictorial representation in area A1 may be shifted into adjacent area A2 while a new pictorial representation is shifted into area A1. In a similar fashion, the pictorial representation in area A2 may be shifted into adjacent area A3 while area A2 is receiving the pictorial representation from area A1. It will be observed that this re-creation of stored information in separate display areas, A1, A2 and A3 is here accomplished by the simple switching of the excitation voltages *a*, *b* and *c* and without reference back to or reuse of the basic intelligence and mechanism originally required to set up the information (pattern).

A preferred method of construction of the unit is illustrated in Figures 1 and 3. A single length of tubing **18** may be made of sinuous form to provide a series of parallel vertical runs **31**, **32**, **33**, **34**, **35**, **36**, **37**, et seq., connected at their ends by 180° bends **41**, **42**, **43**, **44**, **45**, **46** et seq. A series of seven station defining electrodes **51**, **52**, **53**, **54**, **55**, **56** and **57** are formed as elongated metal bands extending transversely across the runs **31—37** at equally longitudinally spaced intervals to provide the seven vertically spaced grid points depicted in Figure 1. The "bit" entering electrodes **22** are shown at the lower end of run **31** adjacent to station electrode **51**. Pairs of shifting electrodes **61** and **62** are positioned between each adjacent pair of station electrodes **51—57**, and in a like manner pairs of shifting electrodes are positioned at each of the bends **41—46** to advance the "bit" from the end of one vertical run to the start to the other. The electrodes are connected, as shown in Figure 3, to energize the station and shifting electrodes with the *a*, *b* and *c* voltages to provide a sequential excitation in the manner depicted in Figures 4 and 5.

The metallic strips or bands forming the electrodes **51—57** and **61** and **62** are here accurately and firmly engaged with the wall of tube **18** by mounting the electrodes on a backing plate **66** (of insulation material) presented to the rear side **67** of the tube **18**, see Figure 2. If desired the electrodes may be formed on the plate by the techniques used in the making of printed circuits.

As a feature of the present construction, the front plate or mask **16** may be made of electrical conducting material and mounted in engagement with the front side **68** of the tube **18** so as to provide the common (ground) electrode **13**, the plate **16** being formed with the openings **17** opposite to the station defining electrodes **51—57**.

It will be apparent that the separate glow discharges within the tube are very readily visible and the pattern content of such discharges is readily seen by the eye as a pictorial representation which may be changed or controlled with flexibility and precision thus making the unit adaptable for many display purposes such as displaying the output of computing devices, airplane and ship positions for large combat-information-center platting boards, or a variety of advertising signs. For example, a sign may be constructed much as the present neon type, to illuminate a word, letter or symbol, and by the addition of the electrodes and other elements of the present invention, the illuminated word, etc., can be made to appear to be filled in progressively as though it were being written by the succession of small incremental additions to the total length of glow discharge along the tube. Another important application is to provide a group of parallel register-like tubes so arranged that the matrix of spots, which can be either lit or unlit, will form a numeral, letter, or other pictorial silhouette which can move in either direction along the tubes, hold still, or be entered so fast that a complete change of the display may be effected without the human eye being able to see the process.

While a three line shifting register is here disclosed, it will be understood that other types of shifting registers may be used such as disclosed in my copending patent, aforesaid, and other U.S. patents to Douglas C. Engelbart including U.S. Patent No. 2,869,036 and U.S. Patent No. 2,937,317.

I claim:

1. An information display device comprising: an elongated envelope containing an ionizable medium; a plurality of sets of external electrodes juxtaposed along the length of said envelope to form a plurality of glow discharge stations, said envelope being deployed over a predetermined area to arrange said stations in a mosaic pattern capable of pictorial definition of the information to be displayed as a directly viewable pattern of glow discharges; and high frequency energizing means connected to said electrodes for sustaining glow discharges at selected ones of said stations to form the directly viewable information representing pattern of glow discharges.

2. An information display device comprising: an elongated envelope containing an ionizable medium; a plurality of sets of electrodes juxtaposed along the length of said envelope to form a plurality of glow discharge stations, said envelope coursing a predetermined area to locate said stations in a uniformly spaced grid arrangement capable of pictorial definition of the information to be displayed as a directly viewable pattern of glow discharges; high frequency energizing potential generating means; and means connecting said generating means to said electrodes for sustaining glow discharges at selected ones of said stations to form the directly viewable information representing pattern of glow discharges.

3. An information display device comprising: an elongated channel containing an ionizable medium; a plurality of sets of electrodes juxtaposed along the length

of said channel to form a plurality of glow discharge stations, said channel being deployed over a predetermined area to arrange said stations in a uniform pattern capable of pictorial definition of the information to be displayed as a directly viewable pattern of glow discharges; a mask covering said area and formed with openings registering with said stations; high frequency energizing potential generating means; and means connecting said generating means to said electrodes for sustaining glow discharges at selected ones of said stations to form the directly viewable information representing pattern of glow discharges.

4. An information display device comprising: an elongated channel containing an ionizable medium; a plurality of iterative arrays of electrodes juxtaposed along the length of said channel to form a plurality of glow discharge stations, said stations being arranged in a predetermined pattern capable of pictorial definition of the information to be displayed as a directly viewable pattern of glow discharges; a mask formed of electrical conducting material constituting a common electrode in glow sustaining relation to the electrodes of said iterative arrays of electrodes and having openings registering with said stations; and high frequency energizing means connected to said electrodes for sustaining glow discharges at selected ones of said stations to form the directly viewable information representing pattern of glow discharges.

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