

Sept. 10, 1968

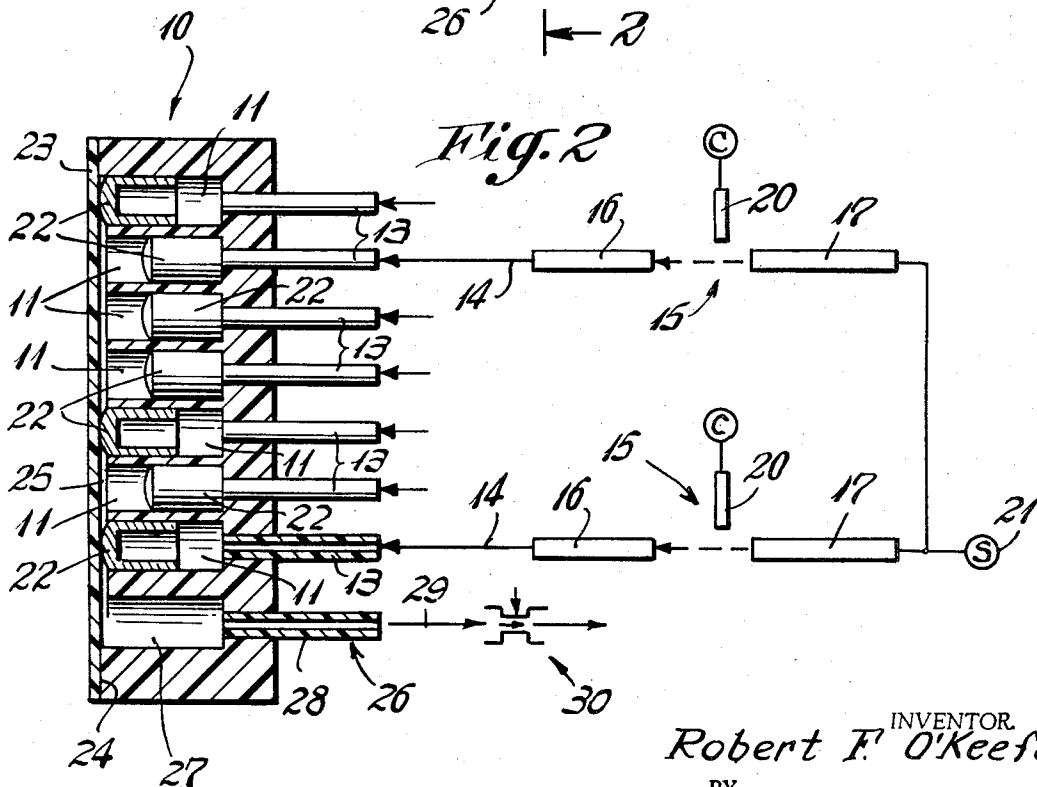
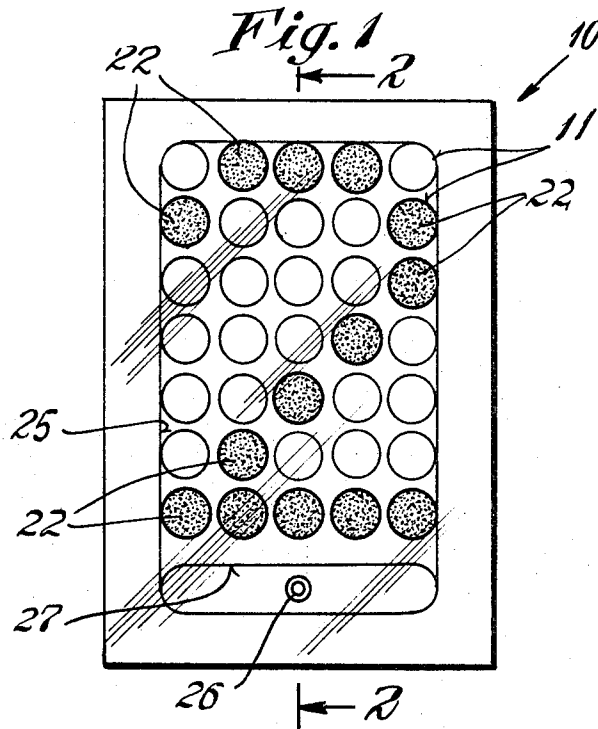
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3,400,478

COMPOSITE CHARACTER DISPLAY DEVICE

Filed Oct. 21, 1966

2 Sheets-Sheet 1



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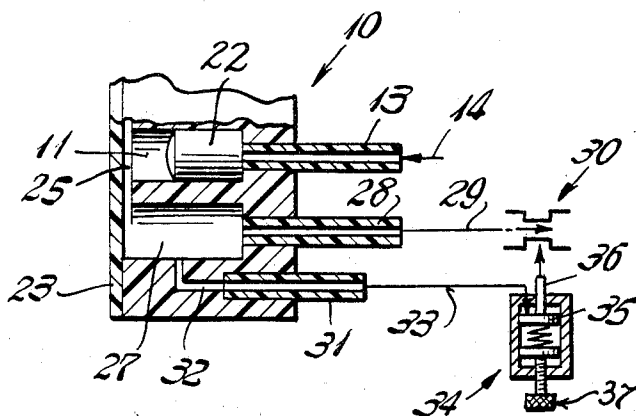
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COMPOSITE CHARACTER DISPLAY DEVICE

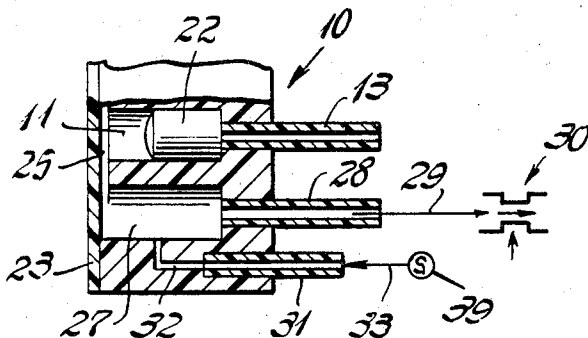
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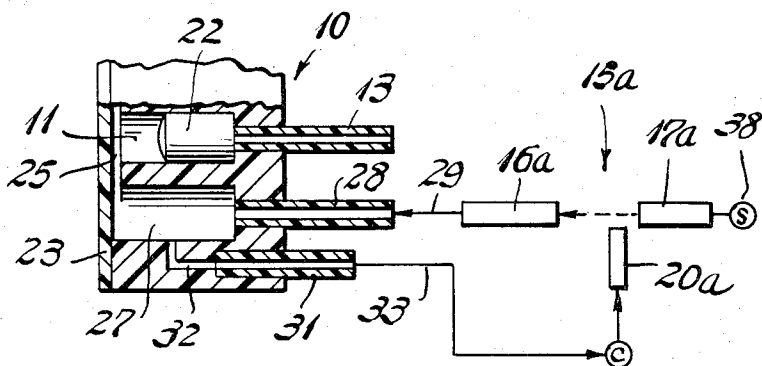
*Fig. 3*



*Fig. 4*



*Fig. 5*



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**COMPOSITE CHARACTER DISPLAY DEVICE**  
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## ABSTRACT OF THE DISCLOSURE

A display device comprising a body including a plurality of fluid passages each having a display element freely movable therein between a forward position wherein it is viewable and a retracted position wherein it is normally hidden from view and fluid control means for controlling the positions of the said display elements between each of said positions whereby the display elements may be made to a desired character to be visibly defined.

This invention relates to a fluid operated display device. More particularly the invention relates to a novel arrangement of display elements and the fluid operated control therefor.

In conventional types of pressure operated display devices the movement of the individual display elements either towards or away from their respective display positions is apt to be sluggish or slow and hence may not be suitable for relatively high speed operations wherein a rapid succession of characters are to be visibly generated at a display plane. The relatively slow action of the display element movement is due in some cases to the fact that gravity is relied upon to move the element in one direction, or because a close sliding fit is provided between the walls of the display elements and the respective passages in which they are located which in turn tends to retard movement of the display elements.

The primary object of the invention is to provide an improved display device wherein the individual display elements are arranged so as to be capable of moving into and out of their respective display positions at a very rapid rate.

Another object of the instant invention is to provide an improved fluid operated display device wherein fluid pressure is utilized to drive each display element both towards and away from a display position.

Another object of the instant invention is to provide a novel fluid operated display device wherein fluid pressure is supplied to a selected group of a plurality of display elements so that the elements in said group may be urged to their respective display positions and so that a portion of said fluid pressure is conducted past the display elements so as to urge the remaining display elements to their respective retracted positions.

Another object of the invention is to provide a novel fluid operated display device having a plurality of display elements which are continuously biased toward their normal retracted positions and which may be selectively displaced to their display positions against this biasing action.

A further object of the invention is to provide a novel fluid operated display device wherein a plurality of individual display elements may all be simultaneously reset to their retracted positions when desired by the timed application of fluid pressure to the forward ends of said elements.

Other objects of the invention will become apparent as the disclosure progresses.

In the drawings:

FIG. 1 is a front elevational view of the instant display apparatus.

FIG. 2 is a side elevation view taken in partial section along section line 2—2 of FIG. 1 and diagrammatically illustrates a first fluid control means for the instant invention.

FIGS. 3, 4, and 5 are fragmentary sectional elevational views each corresponding to FIG. 2 and each illustrating the construction and arrangement of a second, third, and fourth embodiment respectively of the instant invention.

The display device shown in FIGS. 1 and 2 comprises a main body 10 having a plurality of cylindrical bores or passages 11 formed therein, said passages each being substantially circular in cross section and extending in substantially mutual parallel relation from the left side (as seen in FIG. 2) of the main body 10. The right hand end of said passages respectively communicate with tubular fittings 13 that are secured in suitable bores formed in said main body 10, each fitting in turn being respectively connected, through suitable tubing or the like 14, to a fluid control unit 15. All of the control units or devices 15 are similar and each preferably comprises a laminar-turbulent flow type of fluidic device that includes a collector 16, an emitter 17 and a control means 20; each emitter being connected to a common fluid pressure source 21, and each collector being connected to the associated tubing or line 14. Conventional type turbulent amplifiers may be used here as the units 15.

Slidably disposed in each of said passages 11 is a cylindrical cross sectional display element 22 that is axially movable between a rearward retracted or right hand position (as seen in FIG. 2) and a forward display or left hand position. The retracted position is determined by engagement of each display element with the bottom or right hand end (as seen in FIG. 2) of its associated bore 11 while the said display position is determined by engagement of each display element with the inner surface of a transparent cover plate 23 that is sealingly secured by any suitable means against the marginal area 24 of the adjacent left hand face of the main body 10, this main body face being centrally recessed as at 25 so that all of the said forward ends of said passages 11 communicate with each other. The cross sectional area of each display element 22 is slightly less than that of the respectively associated passage 11, this dimensional relation thus affording a slight clearance between the walls defining each passage and its associated display element thereby permitting a fluid pressure bleed or by-pass from one end of each passage 11 to the other end thereof to take place when a pressure differential therebetween exists.

As shown in FIG. 1 the array of passages and display elements define a "7 by 5" type of display matrix wherein various characters may be successively represented by the sequential advancing of selected groups of display elements to their display positions against said transparent cover plate 23 while the remaining display elements are located in their respective normal retracted non-visible positions. One selected group of display elements which has been moved to display position is shown in FIG. 2 as defining the numeral "1." As will be apparent many other alpha and/or numeric characters may be similarly defined by advancing appropriate other selected groups of elements 22 to display position.

A fluid exhaust connection 26 is provided for the instant device, this connection including a laterally elongated chamber 27 formed in the lower left hand portion of said main body. The forward end of chamber 27 communicates with the said recess 25 while the rearward end

thereof communicates with the tubular fitting 28 that is constructed and arranged in a manner similar to that of said fittings 13. Fitting 28 is connected through suitable tubing or the like 29 to a conventional type variable fluid flow restriction means 30 that may be manually set to establish different effective exhaust conditions.

When it is desired to display a first character a first predetermined set of control units 15 are operated to their respective effective "on" conditions so that fluid flows into the rearward ends of the associated passages 11 and displaces the related elements 22 to their respective display positions where they are visible through the transparent cover plate 23 and thereby collectively define a predetermined character such as the character "2" illustrated in FIG. 1. These selected and forwardly displaced elements 22 are held in their display positions by the continued operation of the associated fluid elements. In view of the above noted clearance between the walls of each element 22 and its associated passage 11 some of the fluid pressure behind each displaced element bleeds past said element and this collective fluid flow past all the selected elements moves into the forward ends of the bores 11 associated with the non-selected display elements so as to thereby bias the said non-selected display elements towards their respective retracted positions. The clearance between the walls of these non-selected elements and their associated bores 11 allows some of the fluid pressure to bleed or by-pass to the surrounding atmosphere through the fittings 13, lines 14 and the fluidic collectors 16 of the respectively associated control devices 14, while most of said fluid pressure escapes through the exhaust connection 26 and restriction means 30. Said means 30 is set so that the exhaust back pressure is high enough to readily bias the said non-selected display elements to their retracted positions while not being high enough to interfere with the pressure action holding the selected elements 22 in their display positions. It will thus be seen that the operation of the selected fluidic control devices 15 serves not only to move the selected display elements 22 to display positions but also to maintain the non-selected display elements in their respective retractive positions.

When the next character is to be displayed the corresponding fluidic control devices 15 are operated to their effective "on" conditions so that the respective selected display elements are moved to display positions, or are retained therein if already in the display position from the previous displayed character. By this action all the remaining display elements are again urged toward their retracted positions or are displaced thereto if they were in their display positions from the previously displaced character. Thus the sequential operation of selected groups of control devices 15 will cause successive characters to be visibly displayed.

As will be apparent several display devices each similar to that described in FIGS. 1 and 2 may be collectively used in close proximity and simultaneously operated so as to visibly display multi-letter words and/or multi-digit numbers.

An alternate embodiment of the control means for the instant invention is illustrated in FIG. 3. Here the construction, arrangement and operation of all the parts are similar to that illustrated and previously described in connection with FIGS. 1 and 2 except that an additional tubular fitting 31 is provided on the main body, this fitting communicating with said recess 27 through a suitable conduit line 32. Fitting 31 is connected through a line 33 to the upper portion of an air motor 34, the latter including a piston 35 and piston rod 36. The piston is adjustably spring biased to an upper position and is displaceable downwardly against the spring bias action by the application of fluid pressure through the line 33. The piston rod 36 is connected to the variable restriction means 30 so as to control the setting of the latter, this arrangement constituting a feed back control means for the setting of said restriction means. The operation of the apparatus of FIG. 3 is similar to that described above in connection

with FIGS. 1 and 2 but with the added feature that the effective exhaust back pressure in said recess 27 is continually monitored and controlled by the pressure responsive operation of the air motor 34. In this way a relatively constant fluid pressure may be maintained in the said recess 25 and in the forward ends of said passages 11 thus operatively insuring at all times the application of a proper force on the various display elements in their forward and retracted positions regardless of the particular number of control units 15 that happen to be operated during any given character display action. A suitable adjusting means 37 may be provided for the air motor 34 so that the unit may be manually adjusted to afford the desired operative fluid pressure level for chamber 25.

A third modification of the control means of the instant invention is illustrated in FIG. 4. The construction and arrangement of all the parts of the FIG. 4 apparatus are similar to that illustrated and described in connection with FIG. 3 except that a different fluid connection is made to the line 33. Here the line 33 is operatively connected to a supplementary source 39 of fluid supply pressure and the only connection to the variable restriction means 30 is through line 29.

In the operation of the FIG. 4 device fluid pressure from the supplementary source 39 continuously supplies fluid pressure to the forward ends of said passages 11 through line 33, fitting 31, line 32 and recesses 27 and 25. This supplemental supply of uniform fluid pressure serves to continuously bias all of said elements towards normal retracted positions, some of the fluid flow exhausting thru the by-pass for each element 22 and remaining fluid flow exhausting through the restriction means 30. The variable restriction means 30 is here set so as to afford an exhaust back pressure such that when the control devices 15 of a selected group are operated to their effective "on" conditions the fluid pressure exerted on the respectively associated display elements will be great enough to overcome the normal rearwardly biasing exhaust back pressure created by source 39 under the control of restriction means 30 and to move said selected elements to their display positions; the same type of fluid by-pass or bleeding occurring here past the various display elements as previously described. As soon as the control devices of said selected group are restored to the effective "off" conditions said continuous rearward biasing fluid pressure from source 39 will cause all the display elements to be urged to and/or retained in their normal respective retracted positions. Thus here a supplemental fluid pressure at a relatively low uniform pressure level continuously biases the display elements to their retracted positions while a relatively high fluid pressure is selectively applied to displace selected elements to their display positions against said continuous biasing action.

A fourth embodiment of the control means for the instant invention is illustrated in FIG. 5. Here the construction and arrangement of all the parts are the same as that described in connection with FIG. 3 except that different fluid connections to the lines 29 and 33 are provided. Line 29 is connected so as to be controlled by a fluid control unit 15a that is similar to the previously described control units 15, and line 33 is connected to the control 20a of the unit 15a, the latter being supplied with fluid pressure from a supplemental fluid pressure source 38. By this arrangement fluid pressure is normally supplied from unit 15a, to line 29, fitting 28, and recesses 27 and 25 so as to normally bias all the display elements 11 to their retracted positions in the same manner similar to that explained in connection with FIG. 4. When and if however, this fluid biasing pressure exceeds a predetermined level the fluid pressure in line 33 will cause the control 20 of unit 15a to initiate a signal which in turn will shift the unit 15a to its effective "off" condition thereby causing the said biasing pressure for elements 11 to drop until the pressure in line 33 decreases to a level which terminates the control signal so as to permit the unit 15a to be restored

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to its effective "on" condition. Under these operating conditions the feed back control for the unit 15a tends to cause the latter to maintain a substantially uniform predetermined fluid biasing pressure in the said forward ends of said passages 11. The resultant uniformity of fluid pressure supplied for biasing said elements 11 thus affords a more uniform performance of the display device particular in the area of response times and cyclic speeds of operation.

Since many changes could be made in the several embodiments of the invention as particularly described and shown herein without departing from the scope of the invention, it is intended that the embodiments be considered as exemplary and that the invention not be limited except as warranted by the following claims.

What is claimed is:

1. A fluid operated display device: comprising a main body defining a plurality of passages; a display element operatively disposed in each of said passages for movement between a forward display position and a retracted position; a plurality of fluid conduit means communicating with said passages respectively; and means for applying fluid pressure to selected ones of said display elements so as to urge said selected ones of said elements to their respective display positions and for applying fluid pressure to the remaining display elements so as to urge said remaining elements to their respective retracted positions;
2. Apparatus as defined by claim 1: additionally comprising back pressure regulating means for regulating the fluid pressure applied to the passages associated with said remaining display elements.
3. Apparatus as defined by claim 1: additionally comprising means for simultaneously and continuously biasing all of said display elements to their retracted positions.
4. A fluid operated display device: comprising a main body; said main body having a plurality of passages formed therein, the forward end of each of said passages terminating adjacent a display region of said main body; a display element slidably disposed in each of said passages, each display element being movable in its associated passage between a display position adjacent the forward end of the passage and a retracted position adjacent the rearward end of said passage; each of said elements and its associated passage being provided with a fluid by-pass whereby fluid introduced into one end of a passage may bleed to the other end of said passage; means interconnecting all of the forward ends of said passages together so that fluid leaving the forward ends of any of said passages may flow into the forward ends of all the other passages; and means for selectively applying fluid pressure to the rearward ends of said passages whereby selected ones of said elements may be driven to their display positions while the remaining elements may be driven to their retracted positions by fluid flow past said elements.
5. Apparatus as defined by claim 4: additionally comprising back pressure regulating means for regulating the fluid pressure applied to the passages associated with said remaining display elements by the fluid bleed past said selected display elements.
6. Apparatus as defined by claim 5: additionally comprising feed back control means operated in response to the

fluid pressure in said passages associated with said remaining elements for controlling said regulating means.

7. Apparatus as defined by claim 4: additionally comprising supplementary means for applying fluid pressure simultaneously to the forward ends of all of said display elements so as to uniformly urge the same toward their retracted positions.
8. Apparatus as defined by claim 7: additionally comprising feed back control means responsive to the pressure in the forward ends of said passages for controlling said supplementary means.
9. A fluid operated display device: comprising a body means defining a plurality of passages; a display element mounted in each of said passages for movement between display and retracted positions; biasing means for continuously biasing all of said display elements to one of said positions; control means for applying fluid pressure so as to displace selected ones of said display elements to the other of said positions against the action of said biasing means thereby causing a desired character to be visibly defined; and feedback control means for controlling the operation of said biasing means.
10. Apparatus as defined by claim 9 wherein said biasing means urges said elements to their retracted positions, and wherein said control means causes said selected ones of said elements to be displaced to their display positions.
11. In a fluid operated display device: body means defining a plurality of passages; a display element mounted in each of said passages for movement between display and retracted positions; each of said passages and its associated display element being provided with a fluid by-pass; fluid control means selectively operable to successively displace predetermined groups of said display elements to display positions; an exhaust connection for said body means for exhausting fluid flowing through said by-passes; and settable restriction means in said exhaust connection to regulate the fluid exhaust back pressure.
12. Apparatus as defined by claim 11 additionally comprising feedback means responsive to the said exhaust back pressure for varying the setting of said restriction means.
13. A fluid operated display device; comprising body means defining a plurality of passages; a display element mounted in each of said passages for movement between display and retracted positions; fluid pressure biasing means adapted to apply fluid pressure to one end of all said passages for continuously biasing all said display elements to one of said positions; and fluid pressure control means for applying fluid pressure to the other ends of selected ones of said passages so as to displace selected ones of said display elements to the other of said positions against the action of said fluid pressure biasing means thereby causing a desired character to be visibly defined.
14. Apparatus as defined by claim 13 wherein said fluid pressure biasing means applies a fluid pressure above atmospheric pressure and urges said elements to their retracted positions, and wherein said fluid pressure control means causes said selected ones of said elements to be displaced to their display positions.
15. A fluid operated display device; comprising body means defining at least one passage therein; a display element mounted in said passage for movement between display and retracted positions; fluid pressure biasing means adapted to apply fluid pressure to one end of said passage for continuously

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biasing said display element to one of said positions;  
and

fluid pressure control means operable upon actuation  
to apply fluid pressure to the other end of said pas-  
sage so as to displace said display element to the  
other of its said positions against the action of said  
fluid pressure biasing means thereby causing a de-  
sired unit of information to be visibly defined.

16. Apparatus as defined by claim 15 wherein said  
fluid pressure biasing means applies a fluid pressure above  
atmospheric pressure and urges said element to its said re-

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tracted position, and wherein said fluid pressure control  
means upon actuation causes said element to be displaced  
to its said display position.

#### References Cited

##### UNITED STATES PATENTS

3,249,302 5/1966 Bowles.

EUGENE R. CAPOZIO, *Primary Examiner.*

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