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PERFORATING MECHANISM

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FIG. 1

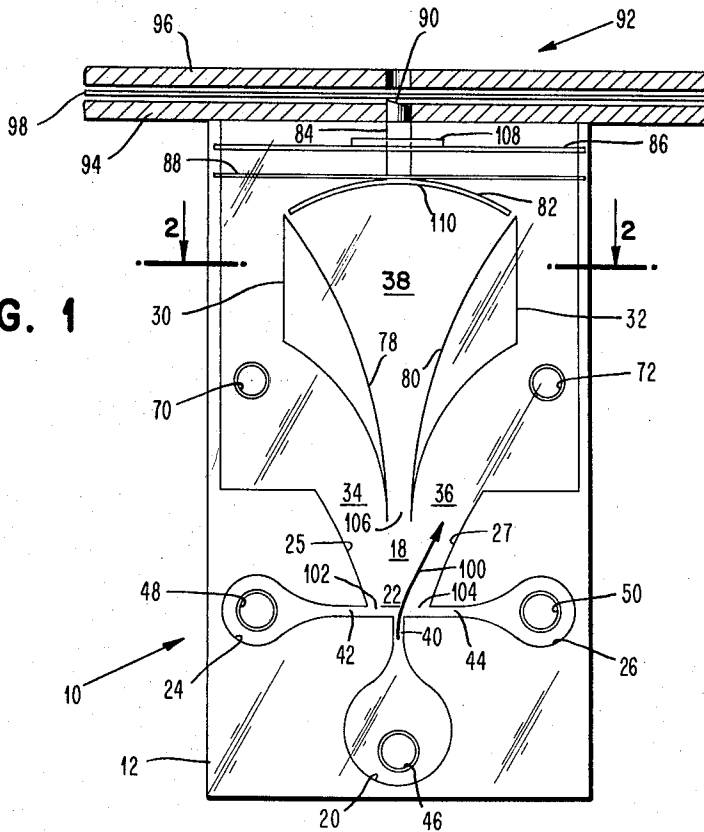
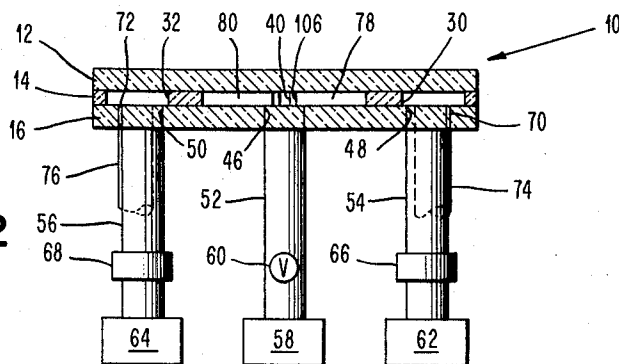


FIG. 2



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PERFORATING MECHANISM

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The invention generally relates to a perforating mechanism, and more particularly to a punching device operating in combination with a fluid amplifier.

As is well known to those familiar with data processing devices, data may be recorded or stored as a combination of holes punched in a record medium such as a card or tape.

Conventional punches, which are generally of the mechanical or electromechanical type have several disadvantages. Such punches are constructionally complicated and have many moving parts, particularly those employing lever systems for the transmission of punch energy from the place where the energy is generated to the place where it is used for punching. Generally, these punches cannot operate at high speeds while still keeping wear and maintenance with reasonable limits.

Further, a recording medium is usually provided with a number of holes at the same time and in a certain pattern as determined by a set of punches, which are pre-set in a certain pattern in accordance with signals received. If efficient use is to be made of the available recording area, the perforations, and accordingly the punches, must be closely stacked. Many types of prior art devices, however, do not permit a close stacking of the punches since their construction is not compact enough.

It is an object of the invention to provide a punching device operative on fluid principles.

It is a further object of the invention to provide a punching device which permits close stacking of the punches.

It is a further object of the invention to provide a punching device having, apart from the punch proper, no moving parts.

The punching device according to the invention comprises a bistable fluid amplifier and a punching mechanism proper. The fluid amplifier serves to selectively direct a fluid pulse into a nozzle. Adjacent the nozzle there is located a dish like body carrying the punch. Upon the application of a signal, the fluid amplifier directs its power stream into the nozzle. The fluid pressure front propagating through the nozzle impinges on the dish causing it to move outwardly, thereby perforating a record medium situated in close proximity to the punch. Punch retracting means are provided to retract the punch and ready the device for receiving a subsequent fluid energy pulse.

These and other objects and advantages of the invention will become apparent from the following description and the accompanying drawings in which:

FIG. 1 illustrates a plan view of one embodiment of the invention.

FIG. 2 illustrates a cross-sectional view taken along the lines 2-2 in FIG. 1 and rotated over 180°.

Referring to FIGS. 1 and 2 of the drawing, a punching device 10 is formed by three flat laminae 12, 14, and 16. Lamina 14 is positioned between laminae 12 and 16 and is tightly sealed between them by suitable means such as screws or cement (not shown). The laminae 12, 14 and 16 may be of any metallic, plastic or other suitable material. For purposes of illustration, laminae 12, 14 and 16 are shown as being of a clear plastic material.

The lamina 14 has a cut-out section, obtained, for example, by means of a cutting or stamping operation. The entire cut-out section is designated as a configuration

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18. The cut-out section or configuration 18 includes a fluid supply inlet 20, a chamber 22, two control stream inlets 24 and 26, and a substantially rectangular portion 28. Two dams 30 and 32, extending between the laminae 12 and 16, define within the rectangular portion 28 two power stream outlets 34 and 36 and a nozzle 38.

The inlets 20, 24 and 26 form constricted supply and control orifices 40, 42 and 44 respectively, all opening into chamber 22. The term orifice as used herein includes orifices having parallel, converging or diverging walls of any conventional shape.

The supply inlet 20 and the control stream inlets 24 and 26 communicate with bores 46, 48 and 50 respectively made in lamina 16. Bores 46, 48 and 50 may be internally threaded to receive tubes 52, 54 and 56 respectively, which may be externally threaded. The end of the tube 52, extending from lamina 16 is attached to a source 58 of fluid under pressure. The fluid under pressure may be air or other gas, or water or other liquid. The above applies equally to the nature and properties of the fluid used for the control stream inlets 24 and 26. Fluid flow regulating devices, such as a valve 60 may be used in conjunction with the fluid source 58 so as to insure a constant flow of fluid at a desired pressure. Such fluid regulating devices are of conventional construction.

A source 62 of the fluid under pressure provides the control stream at the inlet 24. The control stream at inlet 26 is provided by a source of fluid 64. Numerals 66 and 68 respectively, represent any means, such as pressure transducers, which cause a fluctuation or variation in pressure in the control fluid carried in tubes 54 and 56 respectively.

The power stream outlets 34 and 36 communicate with bores 70 and 72 respectively, in lamina 16. These bores may be internally threaded to receive tubes 74 and 76 which may be externally threaded. The tubes 74 and 76 may be considered return conduits to the low pressure side of the fluid system. Alternatively, the tubes 74 and 76 may extend the bores 70 and 72 respectively to a location where a work function is to be performed. For example, the tubes 74 and 76 may be connected to a control system to produce signals, indicating that the card should be stopped or continue its progress through the perforating mechanism.

The nozzle 38 has two curved inner walls 78 and 80. The ends of these walls are bridged by a dish 82 which substantially closes off the outlet orifice of the nozzle 38. The dish 82 supports on its one side a punch 84. Punch 84 is slidably supported by a guiding element 86 permitting the dish 82 with the punch 84 to travel along the longitudinal axis of the device. A leaf spring 88 serves to return the punch to its starting point when it has reached the end of its stroke.

The punch 84 which may have a rectangular cross section, is seen to have a cutting edge 90. The width of the punch may be equal to or smaller than the thickness of lamina 14. The width of the punch may be made very small so that rectangular perforations of very small width may be produced allowing close spacing of the perforations.

The perforating mechanism 10 may be connected to a card supporting and card guiding structure 92, comprising the guide plates 94, and 96, with the record card 98 illustrated as passing therebetween.

The operation of the device as described is as follows: Fluid flowing from source 58, entering the device 10 through inlet 20 is assumed to be at a certain pressure above atmospheric pressure. As the stream of fluid is reduced in cross-sectional area by the inlet orifice 40, its velocity increases. The stream of reduced cross-sectional area 100 leaving orifice 40 and travelling through cham-

ber 22 is called the power stream of the device. It will be noted in FIG. 1 that the walls 25 and 27 of chamber 22 are off-set with respect to power stream orifice 40 creating two off-set regions 102 and 104. These off-set regions, combined or not with a suitable curvature of the walls 25 and 27 allow the power stream to maintain its flow through whichever one of outlets 34 and 36 toward which it is diverted by a control stream, the direction of flow continuing even though the control stream is subsequently terminated. This stability or "memory" property is a result of the occurrence of a boundary layer effect in the off-set region, viz. a low pressure region at one side of the power stream 100 and the pertaining wall of the chamber. The power stream is said to be "locked-onto" the wall in question.

Assume for the purpose of explanation that the power stream 100 is locked onto wall 27. The power stream will leave the device through outlet 36, opening 72 and tube 76. If a control stream pulse issues from control stream orifice 44, the boundary layer lock-on effect upon the power stream in the region 104 is counteracted to the extent that the power stream leaves wall 27 and switches over to the other side of the chamber 22 where it will lock onto wall 25. During the switching motion from wall 27 to wall 25, the power stream enters nozzle 38 through inlet orifice 106 and travels as a pressure front through the nozzle. When the pressure front strikes the dish 82, the dish will move outward and axially, causing punch 84 to punch a hole in the card 98. While moving outward, dish 82 is restrained by a leaf spring 88, which simultaneously serves to return the dish (and thereby to retract the punch) to its quiescent position, illustrated in the drawing. An abutment 108 may be provided to limit the effective stroke of the punch 84.

If the curvature of the walls 78 and 80 of the nozzle 38 is exponential, the pressure front travelling through the nozzle will extend from wall to wall and perpendicularly thereto, as follows from the teachings of aerodynamics, particularly as applied to the flow of fluids through nozzles. Therefore, in a preferred embodiment of the invention the concave portion 110 of dish 82 is given a curvature parallel with the curvature of said pressure front. Thus, the important advantage is obtained that the pressure front strikes the dish 82 with its full front, providing highest impact energy.

It will be appreciated that the perforating mechanism according to the invention has several advantages over prior art devices. Pure fluid devices are basically of planar construction so that they are ideally suited for sandwich-type stacking, and in addition, lend themselves very well to miniaturization. Accordingly, a large number of

punches may be stacked along the width of, for example, a tabulating card, allowing a close spacing of the perforations.

Of course, it is understood that the device according to the invention and as described need not necessarily be two-dimensional, but that it may have a third dimension of substantial magnitude.

Also, the device according to the invention has no moving parts, as compared with electromagnetically operated devices.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A fluid amplifier for actuating a punch element comprising a pair of fluid outlets, a power fluid source, means for switching said fluid from said fluid source from one of said fluid outlets to the other, a chamber disposed intermediate said pair of fluid outlets in the path of said power fluid during a switching operation, a movable driving element connected to said punch element disposed within said chamber to receive fluid pressure from said fluid source during a switching operation whereby said driving element actuates said punch element.

2. The invention as set forth in claim 1 wherein said dimensions of said chamber tapers from a relatively narrow area at one end to a relatively wide area at the other end, said power fluid being directed to enter said chamber through said narrow area, and said driving element is disposed towards said wide area.

3. The invention as set forth in claim 2 wherein said chamber varies exponentially and said driving element includes a concave portion facing said chamber.

4. In combination with a fluid amplifier having a pair of outlets and a source of fluid, a chamber disposed intermediate said pair of outlets receiving said fluid during the interval when said fluid is switched between said pair of outlets, a movable element disposed within said chamber, and means for switching said fluid between said pair of outlets to actuate said movable element during said interval.

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