Nov. 3, 1970 S. SCHMIDT 3,538,308

PUNCHING DEVICE COMPRISING MATRICES HAVING APERTURE COMBINATIONS

Filed Sept. 3, 1968 3 Sheets-Sheet 1

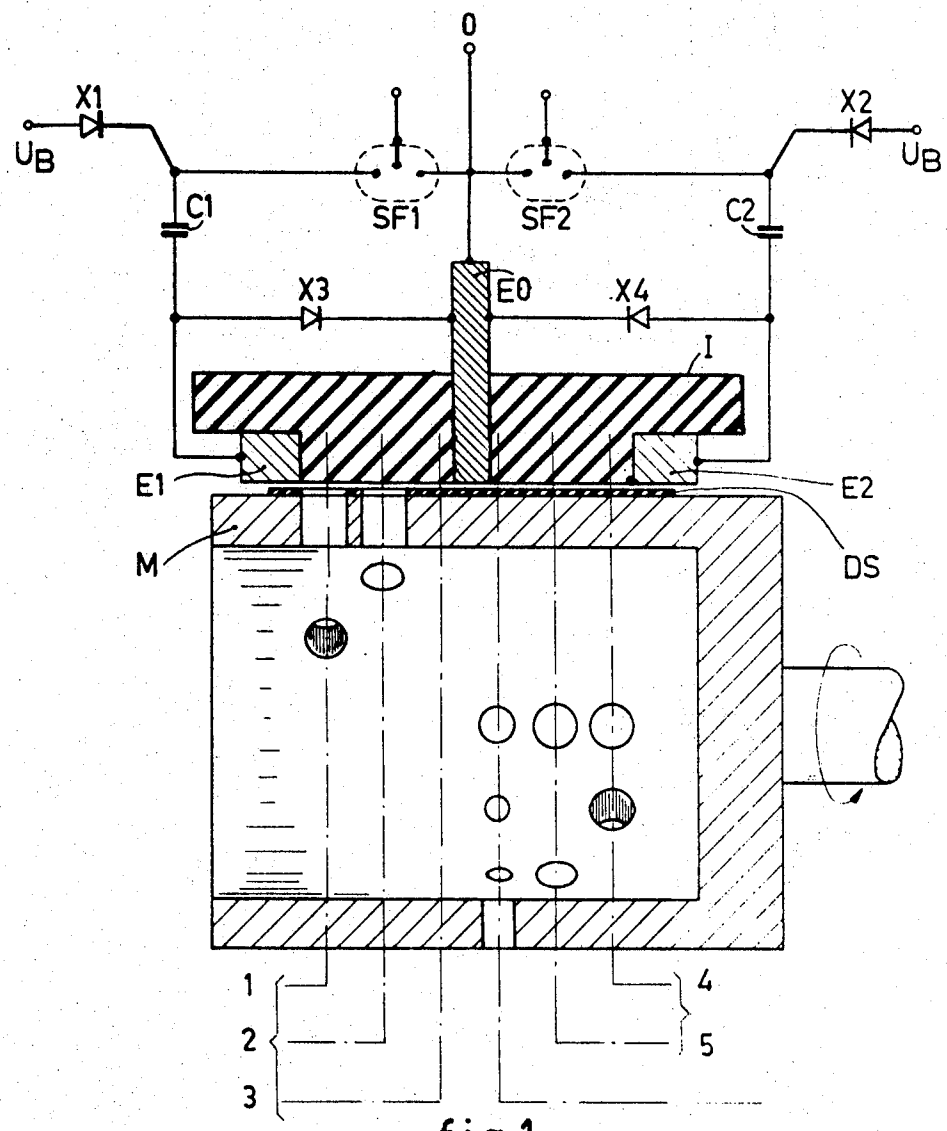


fig.1

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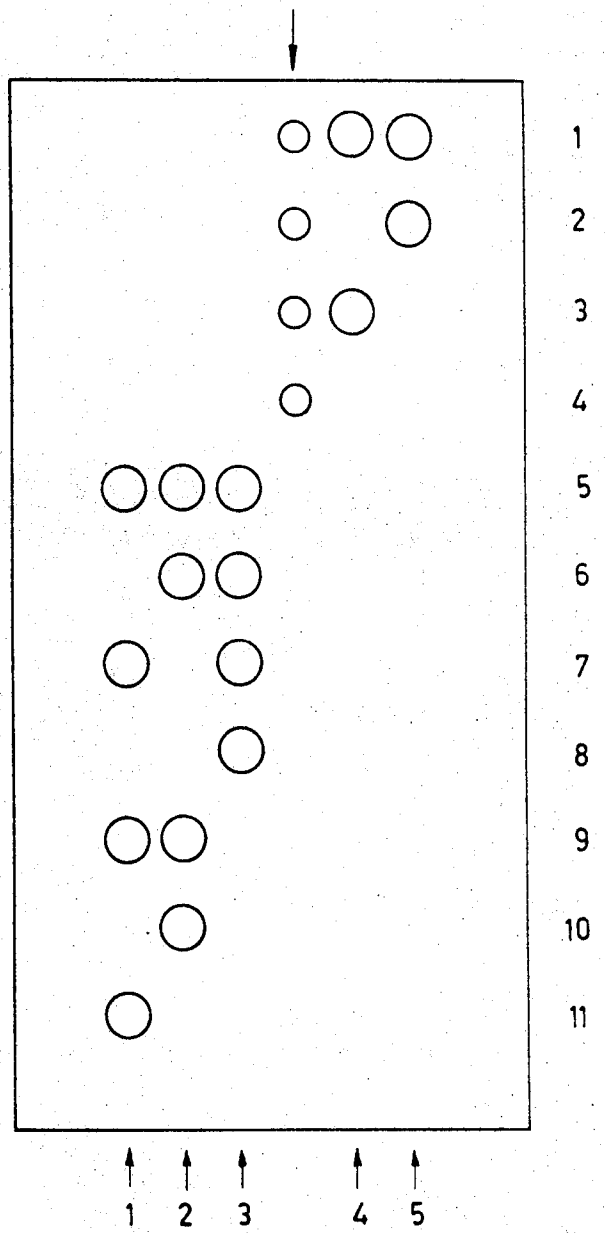


fig.2

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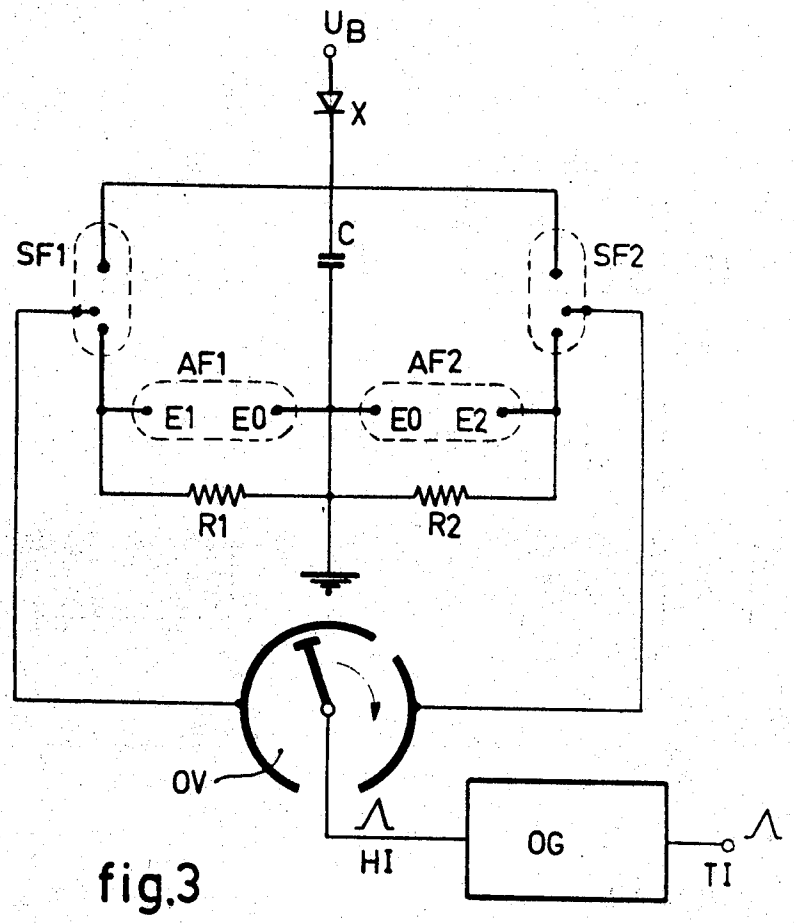


fig.3

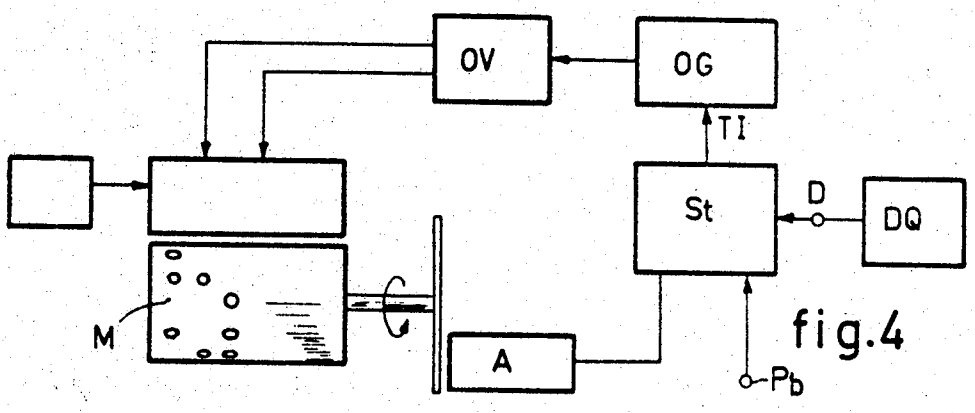


fig.4

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3,538,308

PUNCHING DEVICE COMPRISING MATRICES HAVING APERTURE COMBINATIONS

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Int. Cl. H05b 7/18
U.S. Cl. 219—384 6 Claims

ABSTRACT OF THE DISCLOSURE

A spark discharge device for punching perforations in a carrier where a matrix containing several sets of apertures is positioned adjacent a spark gap so that one set of the apertures is aligned with the spark gap. The length of the spark gap is approximately the distance across the widest set of apertures. The single spark is used to selectively punch one or more perforations simultaneously in the carrier when the carrier is placed between the matrix and the spark gap.

The invention relates to a device for punching perforations in a carrier by means of pressure waves produced by means of spark discharges, said carrier forming a boundary of the discharge space and being swept by the pressure waves against an apertured matrix.

From Dutch patent application No. 6,616,392 a device of the kind set forth is known, in which a stationary matrix is employed which is provided with a row of identical, equidistant apertures. For each punching operation a selection is made from the available spark gaps with the aid of one or more spark gaps to be ignited independently of each other (the number of spark gaps is equal to the number of apertures of one row and the number of perforations in the carrier is equal to the number of discharges) so that a perforation is made only at the place on the carrier located opposite to an ignited spark gap and opposite to an aperture in the matrix.

If the apertures of the matrix are comparatively close to each other there is a risk for the pressure waves associated with the ignited spark gaps to be effective not only at the area of the selected apertures but also at the area of the non-selected apertures. This means that the pressure wave occurring in each spark gap has to remain definitely localized. Moreover, the number of required spark gaps is equal to the number of apertures of one row and structurally this cannot be achieved in a simple manner, if the number of apertures of one row is comparatively great.

The object of the invention is to avoid said disadvantages.

The invention is characterized in that several series of apertures are formed in the matrix. Each series has different combination of apertures. The matrix is adapted to be displaced parallel to the carrier in a direction in which any of said aperture combinations can be disposed to a position opposite to the spark discharge space. A single spark is generated across the space occupied by an entire series of apertures. Therefore the location of the perforations in the carrier is independent of the prescribed location of a spark as disclosed in prior art devices.

It should be noted that from Dutch patent application No. 6,610,469 a printing device is known in which a rotatable drum is adapted to move along a discharge space and a carrier located between the discharge space

and the drum. The discharge space is formed by a number of adjacent spark gaps to be ignited independently of each other. The drum is provided on the periphery with rows of signs extending parallel to the drum axis. The signs of one row are identical, whereas the signs of rows located at different places on the drum periphery are different. Each spark gap covers only one sign of a row so that this also involves the difficulty of a satisfactory localization of the pressure waves in order to avoid the possibility of a non-selected sign being also printed on the carrier, while the number of required spark gaps is great.

The invention will be described more fully with reference to the drawing, in which:

FIG. 1 is a sectional view of the device according to the invention,

FIG. 2 is a developed view of a matrix used in a device according to the invention,

FIG. 3 shows diagrammatically an electric circuit arrangement comprising an ignition pulse divider used in a device according to the invention, and

FIG. 4 is a block diagram of a complete device according to the invention.

An advantageous embodiment of a device according to the invention (see FIGS. 1 and 2) intended for perforating a conventional carrier for five information tracks, comprises two adjacent spark gaps; the spark gap shown in FIG. 2 on the left-hand side covers the aperture tracks **1**, **2** and **3** on the matrix M extending over two pitch distances, whereas the other spark gap covers the aperture tracks **4** and **5**, extending over one pitch distance, while it may cover a "reference track," if any. Said five aperture tracks together provide ten different series of aperture combinations, seven of which are located on the aperture tracks **1**, **2** and **3** (not eight because the combination "no perforation" is not usable as a practical result), and three of which are located on the aperture tracks **4** and **5**. In order to utilize as fully as possible this number of combinations, the two spark gaps have to be adapted to be ignited independently of each other, that is to say, they have to be coupled each with its own discharging circuit (FIG. 1), each circuit comprising a discharging capacitor (so-called parallel operation). It will be obvious that under given conditions also series operation may be useful, in which case the two spark gaps have only one common discharging capacitor and one ignition electrode (see the circuit diagram of FIG. 3).

In order to pass continuously along the aperture combinations, the matrices may be constructed in the form of cylindrical tubes, discs or tapes. In FIG. 1, which is a sectional view of the basic device, the matrix M is cylindrical. FIG. 2 shows a developed view of the matrix cylinder M having eleven aperture combinations. The paper tape DS is shown in FIG. 1 in a section at right angles to its direction of length. It is located between the rotatable matrix cylinder M and the two operative spark gaps producing the pressure and comprising an electrode E1 and an electrode E2 respectively and a common electrode EO as well as an insulator I. Upon a discharge across these spark gaps a slide spark is produced on the side of the insulator I facing the paper tape DS. The discharge circuit includes, apart from the operative spark gap, a capacitor C1 and a capacitor C2 respectively, which are charged through the charging diodes X1 and X3, X2 and X4 respectively by the supply voltage U_B, and a control-spark gap SF1 and a control-spark gap SF2 respectively.

In the case of pure series operation as in the arrangement of the aperture combination shown in FIG. 2 one common capacitor C and one charging diode X are sufficient for the two discharging circuits, as is shown

in the circuit diagram of FIG. 3. The electrodes E1, E2 and EO of the operative spark gaps AF1 and AF2 are indicated only symbolically and shunted by resistors R1 and R2 respectively. The resistors R1 and R2 may be given by the conductibility of the operative spark gaps. They ensure that prior to the ignition the full voltage is operative across the control spark gaps.

FIG. 3 shows in addition that, when an ignition divider OV is used, only one ignition generator OG is required which produces the high-voltage pulse for the ignition of one of the control spark gaps SF1 and SF2.

FIG. 4 shows a block diagram of the perforator. By means of electronic control *St*, which may be constructed in various ways, the trigger pulse TI for the ignition generator OG is obtained from the punching instruction P*b* of the incoming information (data D from the source DQ) and from the position of the matrix cylinder M. The position of the matrix cylinder M may be sensed electro-optically or magnetically (A). The igniting high-voltage pulse HI released by the trigger pulse is conducted to the trigger electrode of each control spark gap through the ignition divider OV. The control spark gap is ignited and the capacitor is discharged via the control and operational-spark gaps. Owing to the discharge such a high pressure (for example, a few hundred atmospheres) is produced instantaneously (within, for example 0.2 μsec.) across the operative spark gap that the tape is punched. There are punched those apertures which correspond to the aperture combination located at the instant of discharge just on the side of the tape opposite the spark gaps. If apertures have to be made, for example, in the tracks **1**, **2** and **5**, first the discharge across the operative spark gap AF2 (electrodes EO and E2) has to be started when the second aperture combination (FIG. 2) is opposite the operative spark gaps. When subsequently by the rotation of the matrix cylinder M the ninth aperture combination is in the punching position, the discharge across the operative spark gap AF1 (electrodes EO and E1) has to be started.

Instead of the stationary slide spark gaps described above known spark gaps may be used in which the electrodes or the insulator or both are movable in order to reduce, to distribute or to eliminate completely the erosion of the electrodes and the insulator. Particularly with these comparatively complicated spark gaps the prolongation of the spark gaps obtained by the invention and the reduction of the required number of spark gaps provide a considerable simplification of the construction. Furthermore known discharging circuits may be used in which the control and operative spark gaps form a single unit. In order to ensure a satisfactory ignitibility of the slide spark gaps, that is to say a low breakdown voltage and comparatively long sparks, semiconductors may, as is known, be used for the insulator part along which the spark has to slide.

The paper tape is moved by steps in the simplest case. It is, however, possible to have the paper tape driven continuously. Then the punching place is not fixed, but it varies with the aperture combination to be punched within the distance between two successive aperture combinations.

The punched paper particles scattering away with high speed are collected by plates in the matrix cylinder and conducted away. For this purpose an air stream may be employed.

What is claimed is:

1. A device for punching perforations in a carrier, comprising a matrix having a plurality of series of apertures, at least one of said series comprising a plurality of apertures, means for producing a spark having a length at least as great as the distance across the widest series of apertures, and means for moving the matrix to selectively position each of said series of apertures adjacent said spark gap producing means, whereby a carrier placed between the matrix and the spark gap producing means is driven by the pressure wave associated with a spark from said spark producing means against a selected series of apertures in the matrix and is perforated thereby.

2. A device as claimed in claim **1**, wherein the matrix is constructed in the form of a perforated cylinder adapted to rotate about its axis.

3. A device as claimed in claim **1** wherein said spark producing means comprises two aligned spark gaps, having a length approximately equal to one-half the distance across the widest series of apertures, and means for independently igniting each of said sparks between said spark gaps.

4. A device as claimed in claim **3**, wherein the series are arranged in groups, the series of each group having different aperture combinations selected from a restricted series of the total of possible aperture combinations, and the series of each group being associated with a spark track intended only for series of said group.

5. A device as claimed in claim **4**, further comprising means for synchronizing said spark producing means generates a spark solely in response to the alignment of a series apertures with said spark producing means.

6. A device as claimed in claim **3**, wherein said means for producing two aligned sparks comprises a single capacitor, circuit means for charging said capacitor to a voltage lower than that necessary for producing a spark, means for connecting said capacitor to both of said spark gaps, a voltage source having sufficient voltage to ignite said sparks, and commutating means for selectively connecting said voltage source to each of said spark gaps to ignite a selected spark and thereby discharge said capacitor.

References Cited

UNITED STATES PATENTS

3,183,518	5/1965	Henry et al.	219—384 X
3,351,740	11/1967	Heuer	219—384
3,428,782	2/1969	Schmidt	219—383

FOREIGN PATENTS

270,140	11/1964	Australia.
6616392	5/1967	Netherlands.

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U.S. Cl. X.R.

83—177; 283—12