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APPARATUS FOR PERFORATING PAPER
AND OTHER SHEET MATERIALS
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2,707,744

FIG. 1.

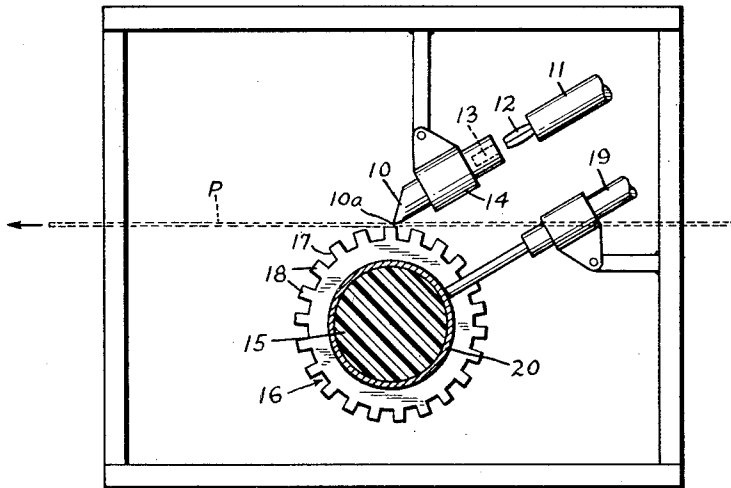
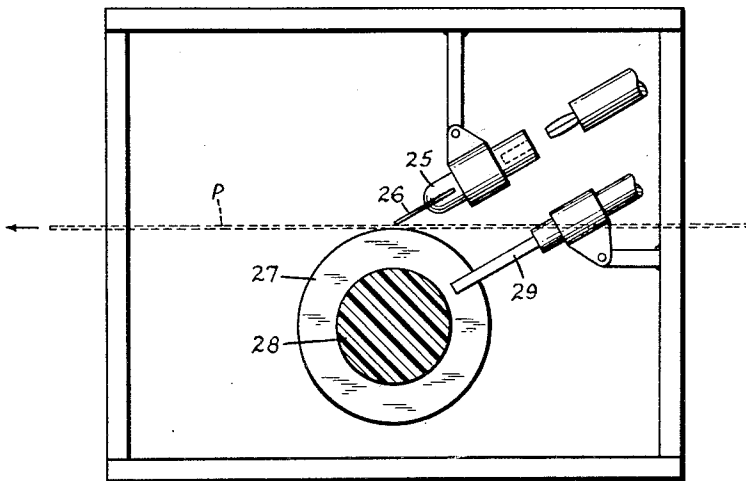


FIG. 2.



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APPARATUS FOR PERFORATING PAPER AND OTHER SHEET MATERIALS

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5 Claims. (Cl. 219-19)

This invention relates to methods and apparatus for perforating paper and the like and it relates particularly to the formation of perforated tear lines in check books, tickets, postage stamps, tear top cartons, tear strips, and the like.

Heretofore, the perforated tear lines in check books, postage stamps, cartons and so forth have been formed by means of dies, punches, slitting discs, or knives and the like. The equipment for making such perforations is complicated and is expensive to maintain because the slitting or punching devices must be made of hardened steel and the like, and must be sharpened frequently to maintain them in condition for cutting and punching the paper without tearing it. Moreover, the prior continuously operating devices are capable of producing only straight rows of perforations and cannot be adjusted to produce sinusoidal, zig-zag or other non-linear perforated lines. Moreover, the dust which is produced by the slitting operation or the punching operation is inflammable and creates a serious fire and explosion hazard.

In accordance with the present invention, I have provided a means whereby rows of closely spaced perforations or slots or slits can be formed in straight lines, curved lines, or in different patterns as may be desired. Such lines of perforations can be made without dies, punches or other cutting tools or machines and without the creation of fire hazard.

More particularly, in accordance with the present invention I have produced an apparatus and method for making slots or rows of perforations by means of electric sparks or arcs. The apparatus and method embodying the invention constitutes an improvement over prior methods and apparatus by means of which perforation of material was accomplished by means of spark or arc discharges of irregular and random spacing to render the material porous without substantially weakening it.

The new equipment embodying the present invention is simple in construction and involves principally two electrodes between which a spark discharge or arc occurs. One electrode is fixed in position and can be of substantially any desired shape and size. The other electrode is a thin edged member located on the opposite side of the paper from the fixed electrode. The spark discharge takes place between the two electrodes and is maintained in a controlled position by means of the thin edged electrode so that movement of the paper between the electrodes results in a sharply defined row of perforations or a slit, as may be desired.

Through the use of my new spark or arc perforating equipment, it is possible to perforate sheets of paper, leather, fabric, or the like continuously and at high speed and to obtain a uniform arrangement of perforations and slits which weakens the material to enable it to be torn along the lines so formed. The perforating operation does not produce any dust or other inflammable material so that fire hazard and damage to equipment are to a large degree avoided.

For a better understanding of the present invention,

reference may be had to the accompanying drawing in which:

Fig. 1 is a view in side elevation of a typical perforating device of the type embodying the present invention for use with direct current with parts shown in section; and

Fig. 2 is a view in side elevation and partly in section of a modified form of device for use with alternating current.

As illustrated in Fig. 1 of the drawing, my perforating device may include a top electrode 10 of pencil-like or cylindrical cross section having a chisel-like end 10a. The electrode 10 is adapted to be connected to one terminal 11 of a source of direct current by means of a disconnectable plug 12 fitting in a socket 13 in the electrode. The electrode 10 is held detachably in an insulated bracket or sleeve 14 so that the end of the electrode is adjacent to or rests against the surface of the web of paper P or the like to be perforated. The web P may be guided beneath the electrode 10 by suitable rollers and the like not shown. Below the web P is a shaft 15 formed of an insulating material, such as, for example, the phenol-formaldehyde condensation product known as "Bakelite." The shaft is supported in suitable bearings, not shown, and may be rotated by a motor or the like, not shown. Mounted on the shaft 15 are one or more metal collars or disks 16 of a very thin, knife-edge cross section. The electrode 16 is adjacent to or bears against the undersurface of the paper in line with the electrode 10. As shown, the rim of the electrode 16 may be provided with a series of notches 17 which define interposed teeth 18, the ends of which are adjacent to or bear against the web P. The rotary electrode 16 is connected to the other terminal 19 of the power source by means of a commutator or slip ring 20 mounted on the shaft 15 and electrically connected to the electrode 16. The terminal 19 may be provided with a carbon brush or the like engaging the slip ring 20.

The opposite terminals 11 and 19 of the power supply may be supplied with a high potential direct current in the manner disclosed in the Meaker and Yonkers United States Patent No. 2,365,576, so that as the paper moves along between the electrodes 10 and 16, an arc or spark is formed between their adjacent portions. Inasmuch as a continuous arc will be formed between the ends of the teeth 18 and the electrode 10, short slits will be formed in the web P opposite the teeth 18. However, at the notches 17, the arc will be interrupted by the wider spark gap so that unslit or unperforated paper portions will be left between the ends of the slits. The slits form a weakened line along which the paper or the like can be torn.

It will be understood that an automatically operated switching means may be provided, if desired, to interrupt the current flow between the electrodes at any stage of the operation. Thus, a microswitch may be provided for operation by means of a cam driven with the web P to interrupt the current at intervals to leave imperforate portions in the web between the ends of the slits.

A similar perforating device may be provided for use with alternating current. In this device, the top electrode 25 has a flange 26 somewhat wider than the diameter of the electrode 25 resting on top of or adjacent to the web P and overlying the lower electrode disk 27 which is carried by the insulating shaft 28. A brush 29 connected to one terminal of an alternating current source bears against the side of the wheel electrode 27. The upper electrode 25 is connected to the opposite terminal of the current source. The alternating current does not set up a continuous arc, but instead causes a spark to jump between the electrodes for each current reversal. By suitably varying the frequency of the current and

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moving the paper web relative to the electrodes, the sparks will produce a row of separate holes or perforations spaced desired distances apart as may be required.

The above-described modification may also be provided with a circuit interrupting mechanism whereby the paper or the like may be provided with aligned but spaced apart rows of perforations. Moreover, the wheel electrode 27 in both modifications described above may be, if desired, provided with a corrugated edge so that as the wheels rotate, the spark or arc follows the edge of the wheel to produce a wavy line of perforations in the paper. These lines may be sinusoidal, angular, zig-zag or the like as may be required. Any of these configurations and many others may be produced by varying the configuration of the rim of the wheel 16 or 27. In this way, it is possible to make distinctive perforations and to follow different contours or patterns.

The apparatus is simple in structure and can readily be modified and kept in repair at low cost and with a minimum of equipment. Thus, for example, if the electrodes become eroded through continued use, it is easy to split the electrode 16 or 27 radially, remove it from the shaft and replace it with another similar or different wheel-like or knife-edge electrode.

While it is preferred to use a rotary sharp edge electrode, like the electrode 16 and 27, it will be understood that a fixed knife-edge electrode may be used. Such a knife-like electrode can be moved back and forth as well as transversely of the paper to produce wavy lines of perforation in or through the paper and to equalize the erosion along the length of the electrode.

From the preceding description it will be apparent that I have provided a very simple method of perforating paper to form tear lines and weakened zones therein and that the apparatus can be modified depending upon requirements for use with either alternating current or direct current. Moreover, the apparatus is susceptible

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to other modification as indicated above. Accordingly, the form of the invention described herein should be considered as illustrative and not as limiting the scope of the following claims.

I claim:

1. An apparatus for perforating sheet material comprising a first electrode having a knife-like edge, a second electrode having a broader end opposing the first electrode and forming therewith a gap, means to feed a sheet of material through the gap between said electrodes, means to supply high potential electric current to the electrodes to create an electrical discharge across said gap to puncture said sheet material, and means to interrupt said discharge intermittently to leave imperforate portions between the punctures.

2. The apparatus set forth in claim 1, in which said first electrode is a disk-like member having notches in its edge to vary the width of said gap, and the means to supply current to the electrodes is a source of direct current.

3. The apparatus set forth in claim 1, in which the means to supply current is a source of alternating current and the first electrode is a thin disk member.

4. The apparatus set forth in claim 1, in which said first electrode is a thin disk-like member and comprising a shaft supporting said disk for rotation, and means connecting said disk-like member to said means to supply current.

5. The apparatus set forth in claim 1, in which said first electrode is a rotatably mounted disk having a wavy edge and said second electrode is a blunt metallic rod resting on the surface of said sheet material.

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