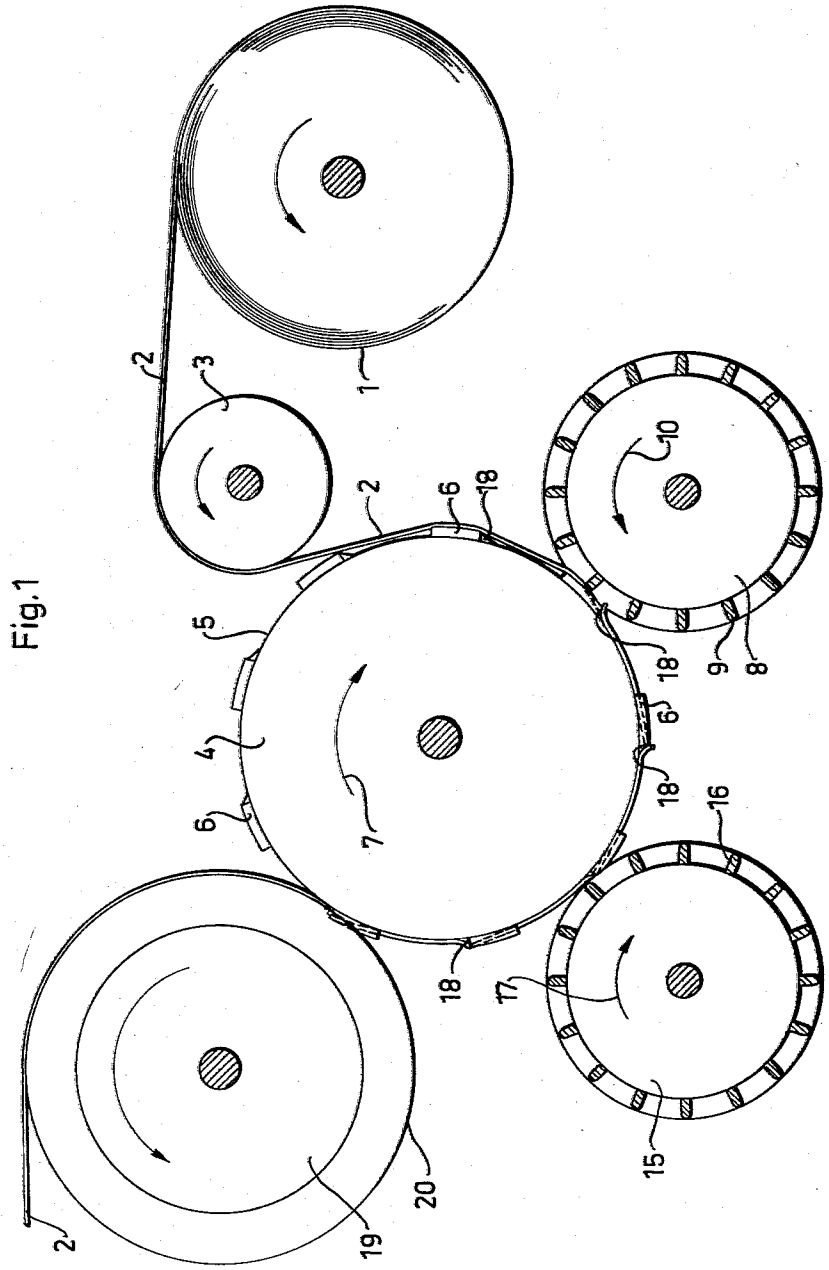
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Fig. 1



MEANS FOR PERFORATING PAPER AND THE LIKE

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Fig. 2

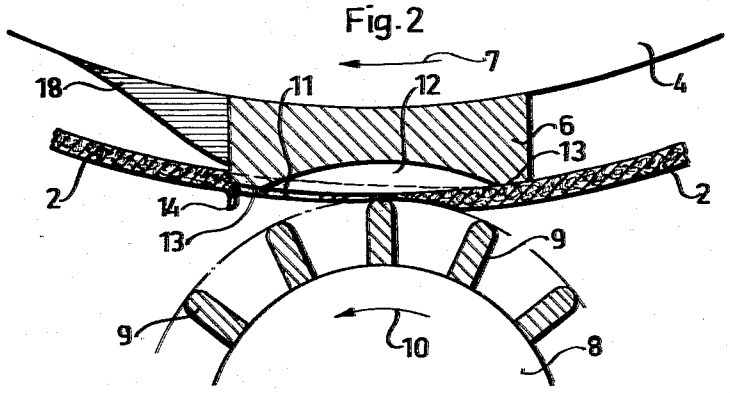


Fig. 3

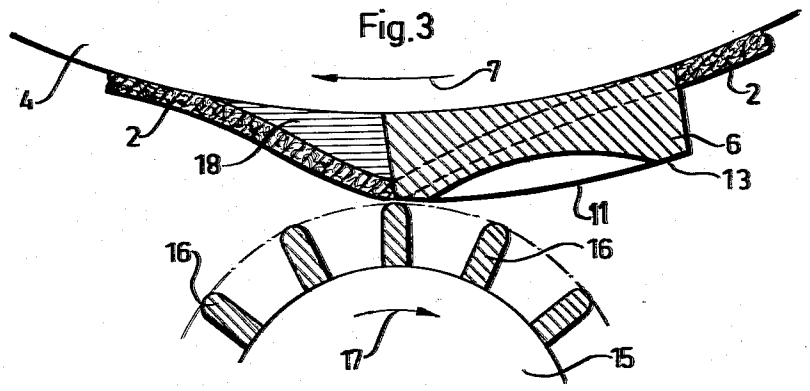
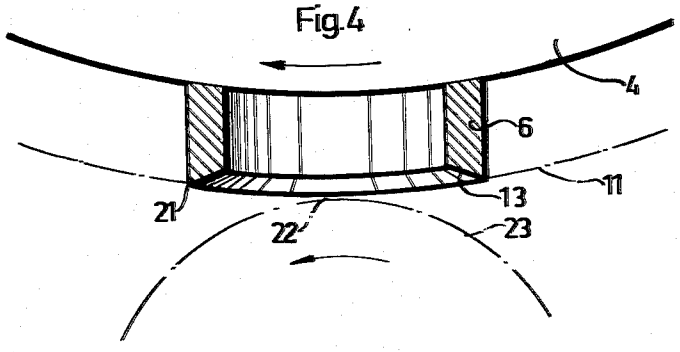


Fig. 4



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Fig. 5

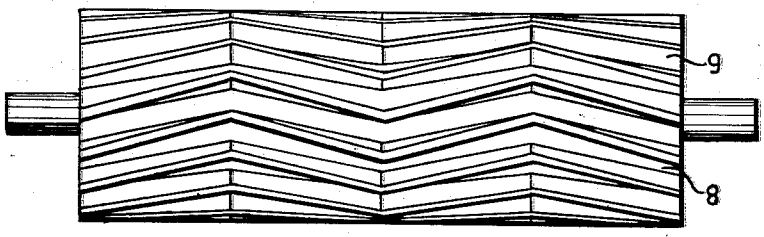
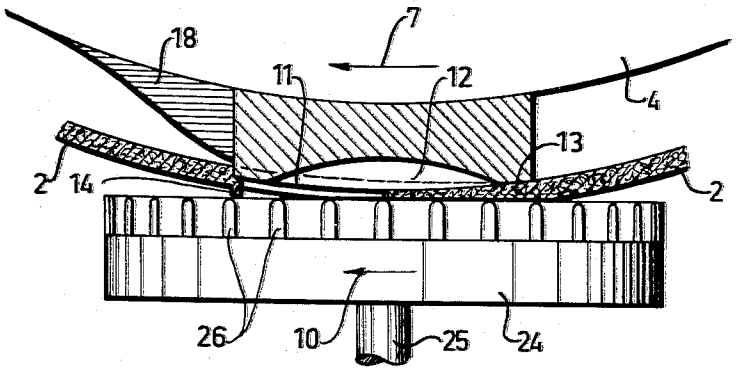


Fig. 6



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MEANS FOR PERFORATING PAPER AND THE LIKE

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3 Claims. (Cl. 90—11)

The present invention refers to such methods for the perforation of paper and the like, such as book-keeping leaves and hole cards, wherein the paper is advanced in contact with a rotating pattern roll, having relief-like portions in the form of studs of a shape corresponding to the shape of the perforated apertures, the perforations being produced by means of one or more rotating tools acting upon the paper at those portions thereof which bear against the end surfaces of said studs. It is known to produce perforations by means of cutting and grinding tools operating to work off the perforated portions of the paper, while the paper is advanced continuously together with the pattern roll past the tools. The present invention relates to a new method of producing perforations by means of rotating tools. The invention is principally characterized by the fact that the paper is pressed against the pattern roll, so that rupture indications are formed in the paper along the edges of the studs, whereupon the compressed portions of the paper are severed by being torn off along said rupture indications. According to a practical embodiment of the invention the paper is compressed between the studs of the pattern roll and a pressing tool in the form of a roll, rotating in a direction such that adjacent portions of the pattern roll and the pressing roll move in the same direction. The peripheral speed of the pressing roll is then greater and preferably many times greater than that of the pattern roll, so that the paper, while being compressed, is subjected at the same time to a frictional force acting in a tangential direction. Said frictional force may be of such magnitude that the compressed portions are torn off immediately along the rupture indications, thereby causing the compressed portions to be removed successively in minute parts according as the processing of the paper proceeds.

The invention is illustrated in the accompanying drawings which by way of diagrammatic representation show a form of embodiment of a perforating machine, constructed according to the invention.

FIG. 1 is a view in elevation of the mutual arrangement of the essential parts of the perforating machine. FIGS. 2 and 3 are sectional views on a larger scale of the two tools by means of which the paper is operated upon, these views also showing the studs in operative positions relatively to said tools. FIG. 4 shows a modification of a stud. FIG. 5 is a view in elevation of the pressing tool shown in FIGS. 1–3. FIG. 6 shows another embodiment of the pressing tool.

As shown in FIG. 1, a paper web **2** wound onto a supply roll **1** is adapted to be advanced over a freely running roll **3** and further round the circumference of the cylindrical surface **5** of the pattern roll **4**. The roll is provided with radially projecting studs and/or pins **6**, preferably of steel, which are arranged in positions corresponding to the desired positions of the perforation apertures on the paper web and which have end surfaces corresponding to the shape of the perforation apertures. The studs are of a height above the cylindrical surface **5** of the roll, which is only slightly greater than the thickness of the paper. The relative thickness of the paper is shown on an exaggerated scale in the drawings.

The studs **6** have a cylindrical envelope surface and a cross-sectional shape corresponding to the form of the perforation apertures. The pattern roll is driven continuously in the direction indicated by the arrow **7** and entrains the paper web through the friction between the studs and the paper.

During the rotation of the roll **4** the paper web first meets with a pressing tool **8** in the form of a roll parallelling the pattern roll and provided with pressing members rigidly arranged on the cylindrical surface thereof or milled out from the roll, said pressing members taking the form of projecting ribs **9**, cams or the like of steel having a rounded, preferably semi-cylindrical end surface and adapted to operate upon the paper at those portions thereof which bear against the studs **6**. As will be seen from FIG. 5, the ribs extend parallel in an oblique direction along the pressing roll and alternately in different directions, whereby the laterally directed forces acting upon the paper are equalized. The pressing roll **8** rotates in a direction opposed to that of the pattern roll, as shown by the arrow **10**, the peripheral portions of the pressing roll and the pattern roll then running in the same direction. The pressing roll, however, has a peripheral speed many times greater than that of the pattern roll.

As will appear from FIG. 2 the end surfaces **11** of the studs **6** coincide with a projected cylindrical surface coaxial to the axis of the pattern roll. The end surface **11** is provided with a bowl-shaped cavity **12**, so that an annular edge portion **13** is formed, which has an outer sharp edge and an inner obtuse or rounded edge. The cavity **12** has for its object to reduce that portion of the paper bearing against the stud, which has to be processed for the production of a perforation aperture.

When a stud **6** reaches the working range of the pressing roll **8**, the portion of the paper supported by the stud will be subjected to an intermittent working by the round edges of the ribs **9**, transversely extending strips of the paper being then compressed successively. The portion of the paper meeting with the cam will thus be compressed to a successively decreasing thickness, which has its lowest value in the position of the rib coinciding with the plane through the axes of the pattern roll and the pressing roll, in which position the thickness of the paper is a fraction of the initial thickness. Through the compression the paper is weakened, and a rupture indication is formed along the outer sharp edge of the stud. At the same time the paper is acted upon by a tangentially directed frictional force created by the pressure of the ribs. Under certain conditions depending on the thickness and the strength of the paper and on the nature of the surface thereof, the compressed portions of the paper might be torn off from the stud through said frictional force, the severing then taking place partly in a direction transversally of the stud and partly along the weakened edge line. In the following it will be assumed, at first, that the perforated apertures are formed in this manner directly by the action of the pressing roll. However, the portion of the paper lying close to the meeting edge of the stud will not always be uniformly cut in this manner along the edge line of the stud, as it may happen that a torn-up lug **14** is let at this point of the edge of the aperture. To remove this lug and, besides, to bring about a trimming of the aperture edges, a rotating tool **15** is provided in a position which is angularly displaced relatively to the pressing roll in a forward direction. This tool consists, like the pressing roll, of a cylindrical part provided with ribs **16** arranged in a similar manner as the ribs **9**. The outer edges of these ribs **16** move in a cylindrical surface, which nearly touches the cylindrical surface **11** of the studs. The tool **15** rotates in the direction indicated by the arrow, the ribs **16** thus moving in a direction opposed to that of

the paper 2. As is the case with the ribs 9, the ribs 16 may have a rounded cylindrical edge, but they may also be formed into a cutting edge. When the portion of the paper already perforated reaches the tool 15, the remaining lug will be cut off, so that the edge of the aperture becomes entirely uniform at this point too. To ensure that the paper is in such a position relatively to the fore edge of the stud that the lug can be cut off by the ribs 16, a supporting head 18 is provided in front of every stud, having an outer sloping surface supporting the paper in a position such that the edge of the aperture cannot be pressed further down than by an amount corresponding approximately to the initial thickness of the paper. After the paper has moved past the other tool 15, it is brought round the circumference of a guide roll 19, and further to a rewinding drum, not shown. The roll 19 may preferably have a lining 20 of resilient material on the cylindrical surface, and may be so arranged that the paper is pressed by said lining against the cylindrical surface 5 of the pattern roll 4, whereby the aperture edges about the studs are smoothed out.

The tangentially directed frictional force exerted by the pressing roll 8 has a tendency to displace the paper relatively to the studs of the pattern roll in the forward direction. To prevent such displacement the paper web may be checked in its movement, for instance by braking the guide roll 3 or the supply roll 1. It is also suitable to oppose the breaking power by exerting a tractive force on the paper in the direction of advancement, for instance by means of the guide roll 19, for the purpose of preventing the paper from sliding relatively to the pattern roll during the motion intervals when the pressing roll is inoperative.

In case the tangentially directed frictional force exerted on the paper by the ribs of the pressing roll is not sufficient to tear off the compressed portions of the paper, the perforated apertures will be formed when the paper moves past the rotating tool 15, which is so arranged and devised that it may act upon the paper in a tangential direction with so great a force that the portion of the paper weakened through the foregoing compression and left on the surface of the stud, will be torn off the stud through the influence of the ribs 16, said portions being then torn off along the weakening line running round the edge of the stud. In place of a tool 15 with ribs or knives, a roll of rubber with a smooth cylindrical surface may be made use of, which brings about the frictional engagement necessary for the separation of the aperture portion of the paper.

In the arrangement described, the ribs 9 of the pressing roll will operate upon the paper intermittently and will thus bring about a certain impact effect, which facilitates the tearing off of the compressed paper strips. Obviously, such an effect may also be brought about by the surface of the pressing roll being corrugated or slitted, the projecting portions having rounded edges. It is also possible, however, to provide the pressing roll with a smooth cylindrical working surface of a diameter such that the surface nearly touches the outer cylindrical surface 11 of the studs 6. Under certain conditions, a pressing roll of this type with a smooth surface may also exert a sufficient frictional force on the paper to enable the formation of the perforation apertures by tearing off the compressed portions of the paper. In such case, however, it might be suitable to cause the pressing roll only to bring about a compression of the paper, so that embossments are made by depressing the studs into the paper, the removing of the compressed aperture portions of the paper being then effected by means of the tool 15 in a manner similar to that hereinbefore described. In such case, the pressing roll 8 obviously need not have a peripheral speed exceeding that of the pattern roll, but may have the same peripheral speed, so that both rolls perform a rolling motion on one another.

In the latter case it will be found suitable to form the stud 6 in the manner shown in FIG. 4. As distinguished from FIGS. 1–3, where the annular surface portion 13 coincides altogether with the cylindrical surface 11, the corresponding edge portion of the stud is here bevelled off inwardly, so that the edge 21 lying on the cylindrical surface 11 forms a cutting edge with an acute angle. In the example shown, the annular surface 13 forms the end surface of a hollow cylinder. It is essential that said cutting edge does not cut through the paper but only brings about a rupture indication. Consequently, the pressing roll must not touch the edge, but there must be a clearance 22 between the cylindrical surface 23 of the pressing roll and the edge or the cylindrical surface 11, said clearance corresponding to the desired compression of the paper. The separation of the compressed aperture portion is then effected by means of the other tool 15.

The pressing tool shown in FIG. 6 has the shape of a plane circular disk 24, which is rotatable about an axis 25 extending at right angles to the axis of the pattern roll, and which on the side thereof facing the pattern roll is provided with radially arranged ribs 26 of the same kind as the ribs 9 of the pressing roll 8. As will be seen from FIG. 6, such a tool will operate in the same manner as the pressing tool 8, so that the paper is successively compressed against the end surfaces of the studs, the strips of the compressed portions being torn off along the edge line weakened through the compression. If desired, the tool may be given a conical shape, the ribs being then arranged on a conical surface in the same manner as the teeth of a bevel gear wheel.

Thus, the pressing tool is essentially characterized by the fact that its actuating parts lie in a surface of rotation touching the paper web, whereas a clearance is provided between said surface of rotation and the path of movement of the end surfaces of the studs, said clearance corresponding to the wanted degree of compression of the paper, so that the studs will not cut through the paper but only cause a weakening of the paper along the outer edges of the studs.

The invention is not limited to the perforation of paper but may obviously be applied also for the perforation of other materials such as plastic and metal foils in the form of sheets or bands.

What is claimed is:

1. A device for the perforation of paper and the like in web form comprising, in combination, a rotatable patrix roll provided with relief-like portions having end surfaces which correspond to the shape of the perforations to be made, means for feeding the paper in contact with the end surfaces of said patrix roll, and at least one rotatable tool positioned adjacent said patrix roll to engage said paper to work off the portions of the paper engaged and supported by said end surfaces, said tool being provided with working surfaces free from sharp edges and said tool being rotatable about an axis which is at right angles to the axis of said patrix roll, the working surfaces of said tool working in contact with the end surfaces of the relief-like portions whereby compression between the surfaces is obtained.

2. A device for the perforation of paper and the like in web form comprising, in combination, a patrix roll rotatable in a first direction and provided with relief-like portions having end surfaces which correspond to the shape of the perforations to be made, means for feeding the paper in contact with the end surfaces of said patrix roll, and a pair of rotatable tools positioned adjacent said patrix roll in circumferentially spaced-apart relationship to engage said paper to work off the portions of the paper engaged and supported by said end surfaces, said tools being provided with working surfaces free from sharp edges, the tool which lies upstream with respect to the paper feed being rotatable in a second direction which is opposite to said first direction and the other tool being rotatable in said first direction, said upstream tool being rotatable about an axis which is at right angles to the axis of said patrix roll, the working surfaces of said up-

stream tool working in contact with the end surfaces of the relief-like portions whereby compression between the surfaces is obtained.

3. A device for the perforation of paper and the like in web form comprising, in combination, a patrix roll rotatable in a first direction and provided with relief-like portions having end surfaces which correspond to the shape of the perforations to be made, means for feeding the paper in contact with the end surfaces of said patrix roll, and a pair of rotatable tools positioned adjacent said patrix roll in circumferentially spaced-apart relationship to engage said paper to work off the portions of the paper engaged and supported by said end surfaces, said tools being provided with working surfaces free from sharp edges, the tool which lies upstream with respect to the paper feed being rotatable in a second direction which is opposite to said first direction and the other tool being rotatable in said first direction, said upstream tool being

rotatable about an axis which is at right angles to the axis of said patrix roll, the working surfaces of said upstream tool working in contact with the end surfaces of the relief-like portions whereby compression between the surfaces is obtained, and the end surfaces of said relief portions having a circular shape and being disposed on a cylindrical rotation surface coaxial with the patrix roll.

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