

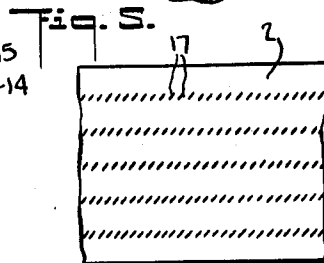
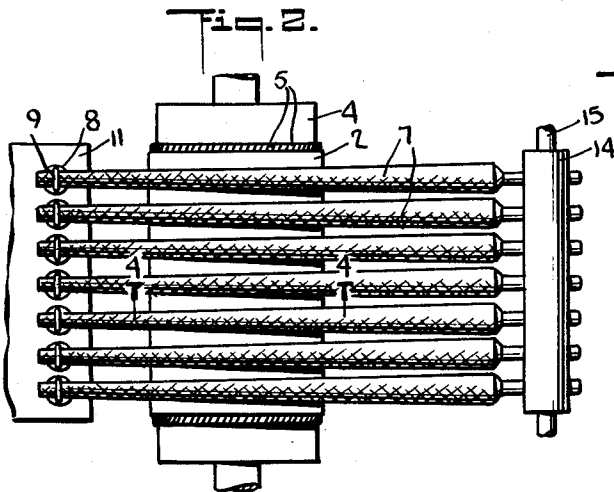
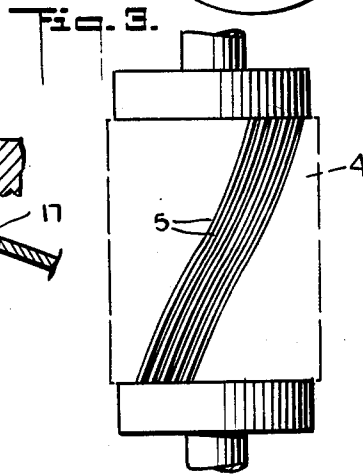
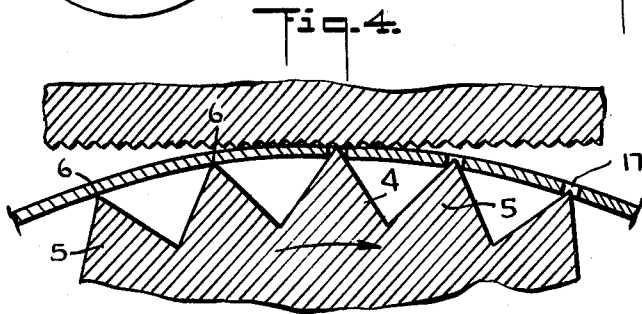
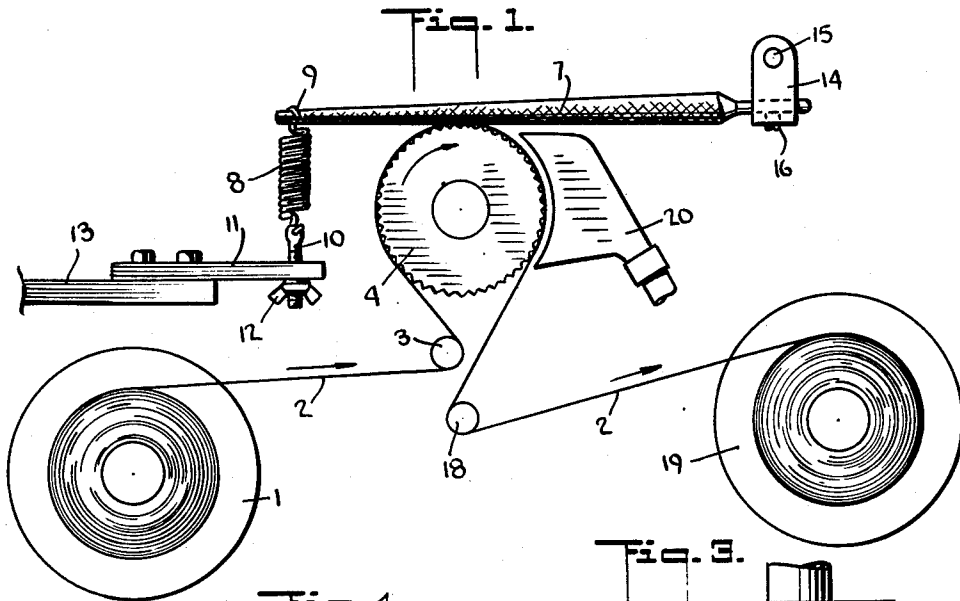
Feb. 2, 1960

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2,923,052

APPARATUS FOR FORMING PERFORATIONS IN PAPER BY ABRASION

Filed Dec. 21, 1955



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2,923,052

**APPARATUS FOR FORMING PERFORATIONS
IN PAPER BY ABRASION**

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Application December 21, 1955, Serial No. 554,564

10 Claims. (Cl. 29—76)

This invention relates generally to a method and apparatus for perforating paper, and more particularly to the formation of a multiplicity of relatively small openings or slots in a paper sheet.

The invention is admirably adapted to form perforations in paper of the kind used in making tea bags, but is of course applicable to paper intended for filtering purposes and having numerous other uses.

The expedients heretofore commonly resorted to in forming perforations in paper have proven to be expensive, and deficient in numerous respects. For example, punching operations are generally impractical where minute apertures are wanted, and piercing procedures employing pointed or attenuated needles or the like suffer from the disadvantage that in forming the holes the paper is not removed but merely bent over, as a result of which the holes frequently re-close and thus the desired permeability of the paper to the passage of liquids is impaired.

It is a general object of the present invention to provide a method and apparatus by which paper can be perforated in the desired fashion without recourse to punching or ordinary piercing or slitting operations, and without engendering the disadvantages heretofore encountered. The present method and apparatus achieves the desired result in an entirely new way that is speedy, reliable, economical, and thoroughly practical for either small or large scale operations.

It is a more particular object of the invention to provide a method and apparatus by which the perforated paper can be produced continuously in web form for subsequent severance into sheets of the required size, the holes or apertures in the sheets being sharply defined, though minute in size.

Briefly stated, the invention involves the formation of holes by an abrasive action upon one face of the paper while the other face is maintained in non-slip contacting engagement with a plurality of closely spaced unyielding linear edges of metal or the like. In the preferred embodiment of the invention these edges are defined by linear knurling on a rotating roll, and the abrasion is achieved by an attenuated elongated abrasive element such as a metal file of circular or equivalent narrow cross-section. The knurling on the roll is preferably at an appreciable oblique angle relative to the axis of the roll, while the file or its equivalent is arranged at substantially right angles to the roll axis, hence at an angle to the oblique edges or ridges of the knurling. Thus the file abrasively forms minute openings in the paper web at the spaced points where the web contacts with the apices of said ridges.

With these and other objects in view, I have devised the arrangement of parts and method steps described hereafter, and more particularly pointed out in the claims appended hereto.

In the accompanying drawing, wherein an illustrative embodiment of the invention is disclosed,

Fig. 1 is a front elevational view of a paper-perforat-

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ing apparatus constructed in accordance with the invention;

Fig. 2 is a plan view of the same;

Fig. 3 is a plan view of an illustrative linearly knurled embossing roll;

Fig. 4 is an enlarged cross-sectional view through a portion of the embossing roll and a portion of one of the abrasive elements, and

Fig. 5 is a face view of a portion of the paper web, showing the apertures produced therein.

Referring to the drawing, and more particularly to Fig. 1, 1 indicates a supply roll or bobbin, containing a substantial supply of the unperforated paper 2 in the form of a continuous web. The paper generally used for the purposes heretofore mentioned may be a relatively thin tissue, but the invention is applicable to heavier papers too. The paper is drawn from the supply on the bobbin 1 and then guided by roller 3 to and around a rotative, knurled-surfaced embossing roll 4. This roll, composed preferably of metal, has its peripheral surface linearly knurled to define a plurality of similar, obliquely-arranged lengthy rib-like teeth 5. When the travelling paper web 2 passes about the roll 4 it rests in firm contact with the apices 6 of the teeth 5 as shown in Fig. 4, and the speed of travel of the web 2 is the same as the linear peripheral speed of the rotating roll 4, whereby a non-slip contact is maintained.

Located adjacent to the roll 4 are a plurality of abrading elements in the form of a gang of round or similarly narrow elongated files 7 arranged in parallel relation. They are resiliently urged toward the knurled periphery of the roll 4 by means of the coil springs 8. Each of the coil springs 8 is provided at one end with a loop 9 embracing an end of one of the files. The opposite end of the spring is secured to the end of a screw 10 adjustably threadable through a supporting plate 11 secured to a fixed element 13 of the apparatus. By manipulation of the wing nut 12 on each of the screws 10, the tension of the springs can be regulated.

The opposite ends of the files 7 are supported in a holder or bracket 14 which is pivotally mounted at 15. A set screw 16 in the bracket holds each of the files against longitudinal and rotative movement. By pivotal movement of the file-holding bracket 14, the gang of files is maintained against the paper web under pull of the springs 8.

The operation is as follows: As the paper web 2 passes from supply bobbin 1 around the embossing roll 4 in contact with the knurled periphery of the same and under the files 7, the files abrade the paper at the points where the paper contacts with the apices 6 of the teeth 5. The oblique arrangement of the teeth 5 on roll 4 enhances the abrasive action and the paper is abrasively worn through at these points to result in the production of uniformly-spaced apertures or slot-like openings 17 in the paper web, as shown in Fig. 5.

As the perforated web continues its movement it leaves the roll 4, and passes under guide pin 18 to be wound up on the motor-driven take-up spool or bobbin 19. Adjacent to the roll 4, and beyond the point where the perforating operation takes place, a suction nozzle 20 may be provided by means of which the fuzz and paper particles dislodged by the abrasive action of the files may be drawn away. The perforated paper on the take-up bobbin may be subsequently cut into sheets of the required shape and size to meet particular requirements.

The linear knurling shown in the drawings creates ridges that extend along helical lines at an angularity of about 30 degrees to the roll axis. This angularity may be varied to suit requirements as will be understood. Similarly, while each stationary abrading element or file is preferably parallel to the direction of web travel, this

exact disposition of these elements is not always necessary. Of course the ridges on the roll 4 and the abrading elements cooperating with them should not ordinarily lie parallel to each other, since it is the angularity between them that contributes to the effectiveness of the operation described.

In general, it will be understood that many of the details herein described and illustrated may be modified by those skilled in the art without necessarily departing from the spirit and scope of the invention as expressed in the appended claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A paper-perforating apparatus comprising a rotative embossing roll provided with a linearly knurled peripheral surface, means for holding a travelling paper web in non-slip contact with said surface, a plurality of spaced rigid stationary abrasive elements mounted adjacent to the roll and the paper web, means for pivotally supporting each abrasive element at one end thereof, and resilient means for urging the other end toward the roll so that the abrasive elements are urged into frictional contact with the paper web whereby relative movement between the web and the abrasive elements will abrasively produce apertures in the paper.

2. In a paper-perforating apparatus, a roll having a linearly knurled peripheral surface, means for moving a paper web over the roll, a gang of files arranged in spaced relation and in parallel relation adjacent to the roll and paper web, means for pivotally supporting the files at one end, and means adjacent to the other end for urging the files toward and into contact with the web movable over the roll.

3. A paper-perforating apparatus including a knurled roll, means for moving a paper web thereover, a pivotally mounted, non-rotating file urged toward the roll and into contact with a portion of the web, and means for rotating the roll.

4. A paper-perforating apparatus comprising a gang of pivotally-mounted files, a knurled roll, means for moving paper over the roll between the roll and the files, and means for resiliently urging the files toward and into contact with the paper.

5. A paper-perforating apparatus comprising a rotative roll having a face provided with knurling that

presents a series of relatively closely spaced linear edges, means for guiding a travelling paper web to and around said roll in non-slip contact with said edges, a stationary elongated attenuated abrading element arranged tangentially adjacent to the roll with its axis substantially perpendicular to the axis of the roll, and means for maintaining said element in operative contact with the exterior surface of the web to form abraded perforations in the web in the regions that are sandwiched between said linear edges of the knurling and said abrading element.

6. A paper-perforating apparatus as defined in claim 5, in which the knurlings are arranged along helical lines at an angularity of about 30° to the roll axis.

7. A paper-perforating apparatus comprising a rotative roll provided with a linearly knurled peripheral surface, means for holding a travelling paper web in non-slip contact with said surface, a plurality of substantially parallel linear abrasive elements adjacent to said roll, and means for supporting said elements so that they will bear against the exposed face of the paper web, the lines of knurling on said roll extending crosswise with respect to the axes of said abrasive elements so that each of said elements produces a series of apertures in the paper at longitudinally spaced intervals along the web.

8. A paper-perforating apparatus as set forth in claim 7, said knurlings extending obliquely with respect to the roll axis, and said abrasive elements lying substantially parallel to the direction of advancement of the paper web.

9. A paper-perforating apparatus as set forth in claim 7, in combination with a means for adjusting the pressure of said abrasive elements against the paper web.

10. A paper-perforating apparatus as set forth in claim 7, said abrasive elements being metal files presenting attenuated file edges toward the paper web.

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