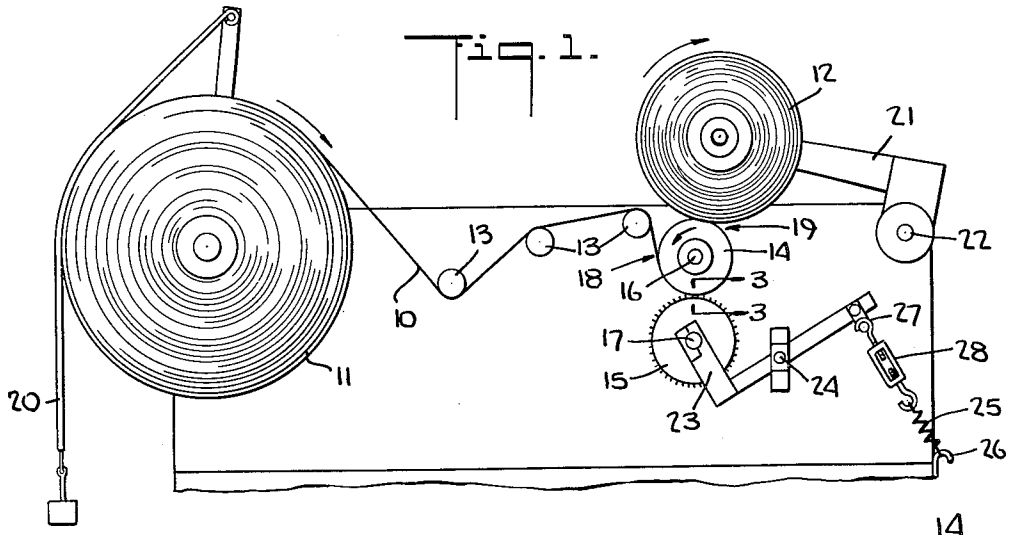
Jan. 22, 1963 J. W. WATERS 3,074,303

APPARATUS FOR FORMING MINUTE APERTURES IN CIGARETTE PAPER

Filed June 13, 1960

Fig. 1.



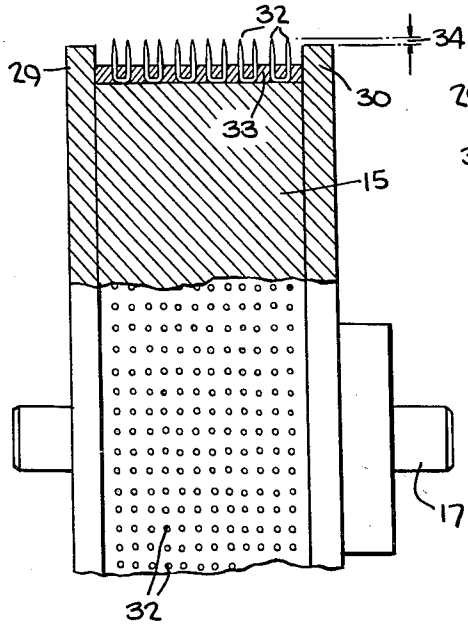


Fig. 2.

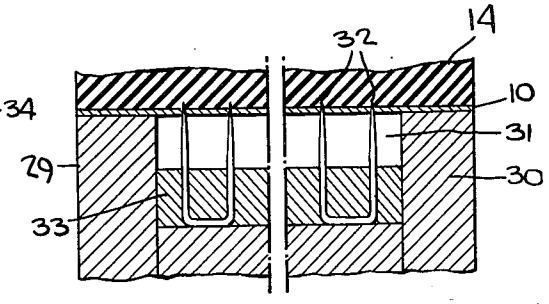


Fig. 3.

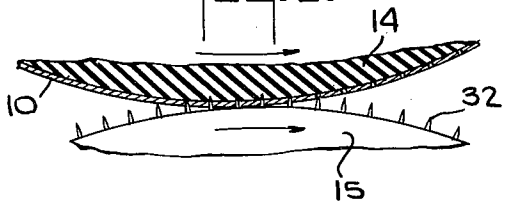


Fig. 4.

INVENTOR:
JOHN WILLIAM WATERS
BY
Frederick Breitenfeld
ATTORNEY

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APPARATUS FOR FORMING MINUTE APERTURES IN CIGARETTE PAPER

John William Waters, Old Bridge, N.J., assignor to Kimberly-Clark Corporation, Neenah, Wis., a corporation of Delaware

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1 Claim. Cl. 83—347)

This invention relates generally to an apparatus for perforating paper, and has particular reference to the formation of minute apertures in cigarette paper or the like to increase its porosity.

It is known that an increase in the porosity of cigarette paper is desirable to enhance its smoking qualities, and that the formation of minute perforations can be made to achieve this result without destroying the suction of the cigarette. However, the procedures heretofore proposed have not always produced results as effective and reliably uniform as desired. If even some of the holes are larger than a predetermined maximum, the suction of the cigarette becomes impaired; and if the perforations are too small the desired porosity improvement is not attained.

It is a general object of this invention to provide a novel apparatus by means of which cigarette paper can be treated economically and in a thoroughly reliable and accurately controllable manner, on a commercial scale, to form a multiplicity of spaced apertures or perforations, imperceptibly minute, which materially enhance its smoking qualities. The improved apparatus achieves the desired result without resort to electric sparks or other electrical phenomena, and without subjecting the paper to any abrasive treatment which might impair its normal texture, fineness, appearance, or other qualities.

Because of the unusual thinness of cigarette paper (usually a little over one-thousandth of an inch) it has heretofore been found to be unsatisfactory to employ ordinary puncturing instruments such as needles or pins. However, by means of the present improved apparatus, the relatively simple expedient of mechanical perforation by pointed pins can be safely and reliably restorted to. The degree of penetration of a multiplicity of pointed pins into and through a web of cigarette paper can be accurately determined and controlled, with correspondingly reliable and effective results. The holes produced can be minute but not excessively so, there will be no danger of over-size openings, and the paper can be punctured cleanly and with no tearing.

The paper resulting from the treatment is of unusual character since it can be made to have porosity of uniformly predictable magnitude while leaving its surface texture intact, and unabraded. The apertures, while effective to increase the inherent porosity by as much as ten times its original value, are completely imperceptible when the paper is part of a cigarette, and even when the paper is examined separately its apertured nature is difficult to perceive except by holding it against a strong light or by microscopic examination.

While the invention is primarily intended for use in the treatment of cigarette paper, it may be applicable for other purposes as will be readily understood.

One way of achieving the objects and advantages of the invention is illustrated in the accompanying drawings, in which—

FIG. 1 is an elevational view, of diagrammatic nature, of an apparatus constructed in accordance with this invention;

FIG. 2 is a fragmentary enlarged edge view, partly broken away and in section, of the pin-carrying roller;

FIG. 3 is a cross-section, of still greater enlargement, substantially along the line 3—3 of FIG. 1; and

FIG. 4 is an exaggerated end view of the nip of the rollers depicted in FIG. 3.

In FIG. 1 I have shown a strip of cigarette paper 10 traveling from a supply reel 11 to a take-up reel 12. During its longitudinal advancement it passes over appropriate guide rollers 13 and between a pair of treatment rollers 14 and 15. The roller 14 is mounted for rotation on a shaft 16 and is provided with a flat peripheral surface composed of rubber or rubbery substitute or other suitable resiliently yieldable material. The roller 15 is mounted for rotation on a shaft 17 parallel to the shaft 16 so that the rollers 14, 15 are in rolling engagement.

The web 10 is so guided that it remains in non-slip contact with the yieldable-surface roller 14 for a substantial circumferential extent in advance of and beyond the nip of the rollers 14, 15. This is shown in FIG. 1, wherein it will be observed that the web 10 comes into contact with the roller 14 at 18 and remains in contact with it until it encounters the take-up reel 12 at 19.

To achieve the desired web advancement a driving means (not shown) is applied to an appropriate reel or roller. Preferably the rotative force of an electric motor or other driving instrument is applied to the shaft 16. The roller 15 is preferably mounted for free rotation on its shaft 17. A friction brake device 20, of known kind, may be associated with the supply reel 11 to allow the web to be controllably withdrawn. The take-up reel is preferably mounted on a movable arm or support 21 (shown pivoted at 22 in FIG. 1, by way of example) to allow for the gradual increase in diameter as the web is wound upon it.

The roller 15 is also supported on a movable mounting and I have illustratively shown the shaft 17 journaled between arms 23 pivoted on a fulcrum 24. By means of a tension spring 25 or equivalent means, anchored at 26 and connected to the mounting arrangement at 27, the mounting is yieldably urged in a direction which presses the rollers 14, 15 together; and by the provision of an adjustable turn-buckle 28 or its equivalent the pressure may be altered to suit.

The pin-carrying roller 15 is provided with at least one pair of axially spaced ribs or rider rings 29, 30 and the periphery of the roller is thus provided with a channel 31 between these rings. Within this channel there are a multiplicity of radial pins 32. Any appropriate means may be employed to support the pins within the channel, and I have found it satisfactory to provide the pins in the form of U-shaped elements extending through and projecting from one surface of a fabric strip 33 which may be adhesively secured to the base of the channel 31. The pins may be arranged in rows or in accordance with any other suitable pattern, and the parts are so proportioned that the pointed ends of the pins 32 project radially by a predetermined minute amount beyond the ribs 29, 30. This excess of projection is indicated on an exaggerated scale at 34 in FIG. 2.

As the paper web 10 passes between the rollers 14, 15, it is engaged by the ribs or rider rings 29, 30 as shown in FIG. 3, and the pointed ends of the pins are thus enabled to penetrate the web only to an accurately controllable minute extent. The pointed ends are of course tapered for a distance exceeding the thickness of the paper, and thus a variation in the extent of penetration (governed by the excess projection 34 and also by the pressure between the rollers) can be utilized as an accurate means for controlling the sizes of the aperture produced.

Depending upon the thickness and nature of the paper to be treated, and the results desired, the dimensions and proportions of the apparatus may be varied. The relationships and proportions shown in the drawings are

course exaggerated for the sake of clarity. By way of example only, and in order that the nature of the apparatus may be understood, these dimensions have proven satisfactory in practice: For cigarette paper having a thickness between 0.00128 and 0.00150 inch, the pins may be 24-gauge staples mounted in a cloth having a thickness of about ⅛ inch and projecting from the cloth by an equal amount. There may be about 120 pin points per square inch, although a considerably larger concentration may be desirable under certain circumstances. The smooth-faced roller **14** may have a diameter of about 4 inches. The pin-carrying roller **15** may have a diameter of about 6 inches, the riding rings **29**, **30** may each be about ¼ inch wide, the channel **31** between them may be about ¼ inch deep, and the pin points may project radially beyond the ribs (the distance **34**, FIG. 2) by about 1½ thousandths of an inch.

In operation, since the paper web is held in non-slip engagement with the surface of the driven roller **14**, and since the free rotation of the roller **15** establishes a similar non-slip relationship between the surfaces of the spaced ridges and the paper, the effect is to pierce the pin tips into and through the web as the paper passes through the nip of the rollers. There is no tearing as the tips are withdrawn because the penetration is restricted in extent. The result is that a multiplicity of minute apertures is produced, the paper remaining otherwise intact. Despite the fact that they are imperceptibly minute, these apertures enhance the smoking qualities of the cigarette paper because of its increased porosity. By way of example, cigarette paper having an inherent normal porosity of 60 seconds (measured by Emil Greimer Porosity Meter) will manifest a porosity of only 9 seconds, after having been subjected to a perforating apparatus of the character described. This means that the porosity of the apertured paper has been increased six-fold. Heavier papers can be caused to manifest the same or greater improvement in porosity. For example, a paper having a normal porosity of 200 seconds can be altered to a porosity of about 20 seconds by perforating as described.

Of primary importance is the simplicity of the apparatus, making it possible to install it in a standard cigarette-making machine so that the cigarette paper can be treated as it travels from a supply roll to the point of cigarette manufacture.

It will be understood that the details described may in various respects be altered or modified without necessarily departing from the spirit and scope of the invention as expressed in the appended claim.

What is claimed is:

Apparatus for forming minute apertures in a web of cigarette paper, comprising a pair of rollers in rolling engagement, means for directing the web so that it passes between them, the first of said rollers having a flat surface of resiliently yieldable material, the second roller of said pair having axially spaced ribs and a channel between them, the diameter of said ribs being greater than the diameter of said second roller in the region of said channel and the spacing of said ribs being less than the length of said first roller whereby only the peripheries of said ribs engage the surface of said first roller while the base of said channel is maintained in spaced relation to said first roller, and the spacing between said ribs also being less than the width of said web whereby said ribs engage said web as it passes between the rollers, a length of flexible sheet material about equal in width to the width of said channel secured to the base of said channel, and a multiplicity of radial pins mounted within said channel and projecting radially by a predetermined minute amount beyond said ribs, whereby the web is pierced by said pins to an accurately limited extent as it passes between the rollers, said pins being carried by said sheet and projecting only from one face thereof whereby when said sheet is placed in said channel with its other face against the channel base said pins will project radially from said base, and said pins being U-shaped elements, the bases of said elements lying between said flexible sheet and the base of said channel, and the arms of said elements extending through said flexible sheet.

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