

Jan. 11, 1955

M. O. SCHUR

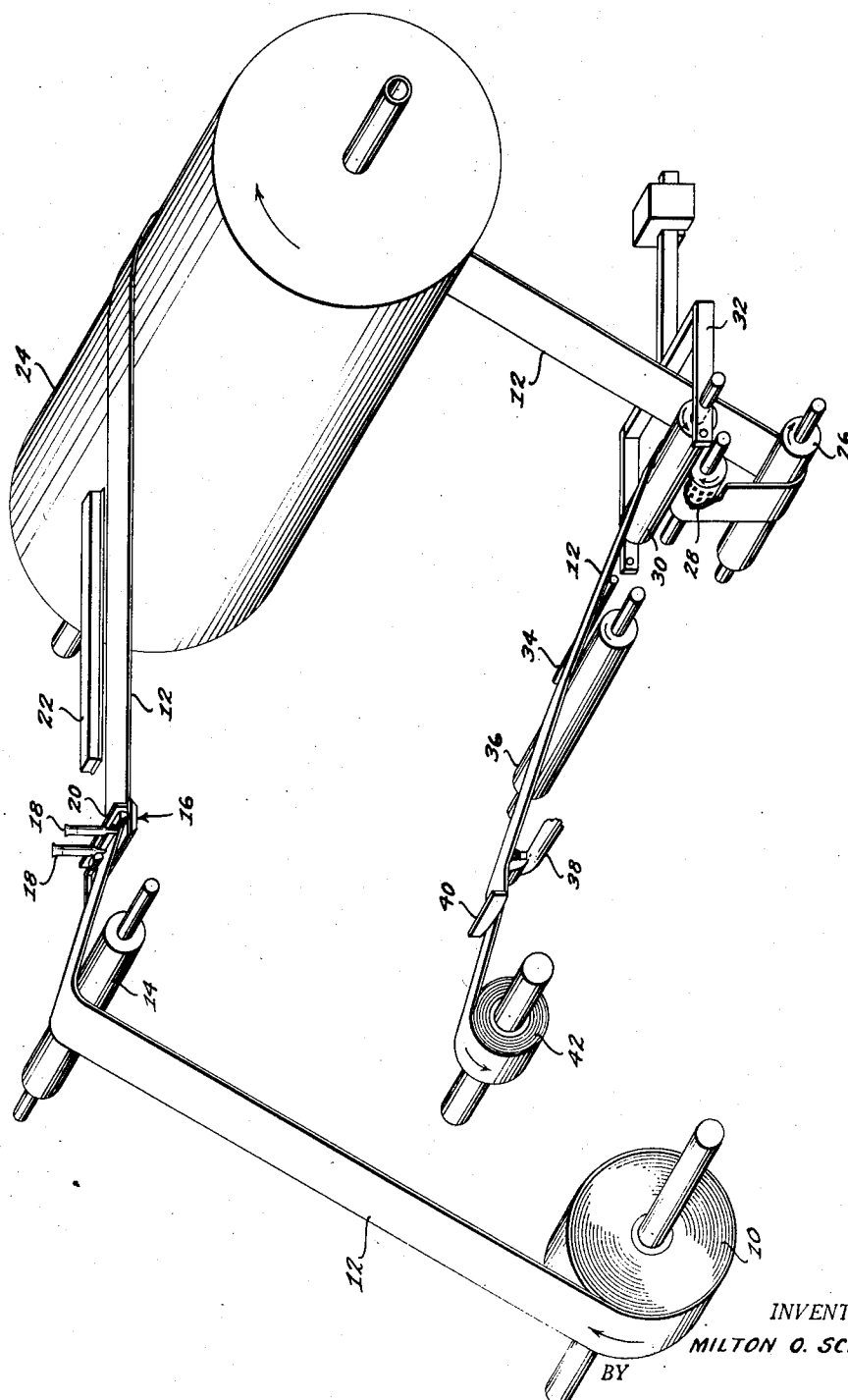
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APPARATUS FOR FORMING PERFORATED TEA BAG PAPER

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4 Sheets-Sheet 1

*Fig. 1*



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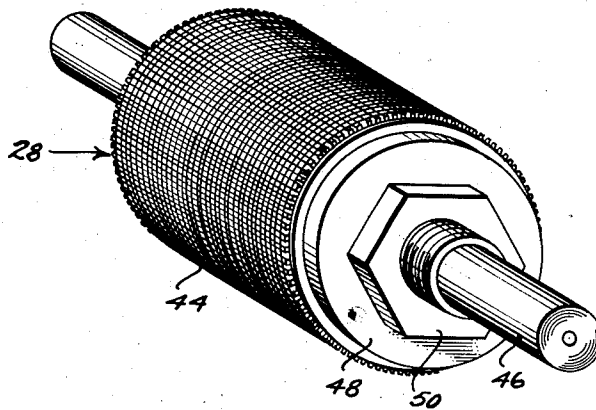
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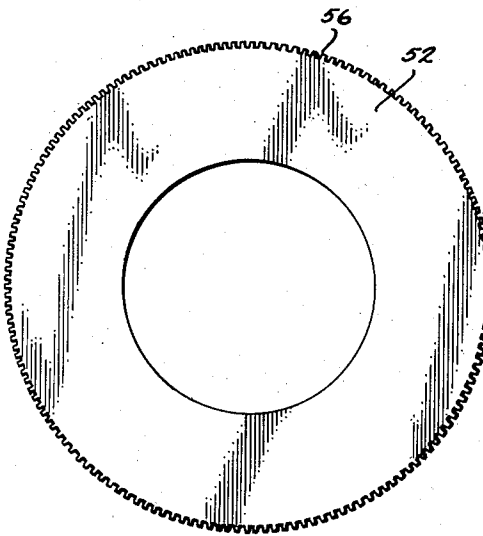
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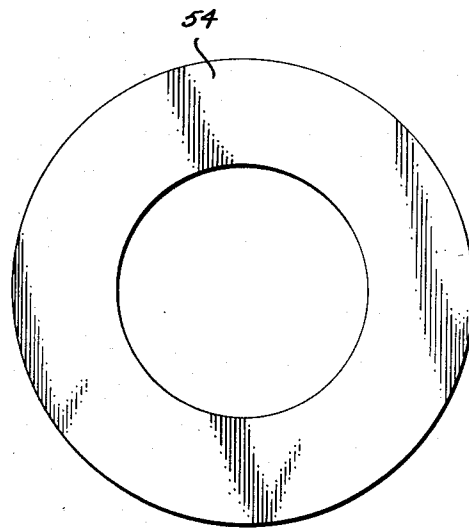
*Fig. 2*



*Fig. 3*



*Fig. 4*



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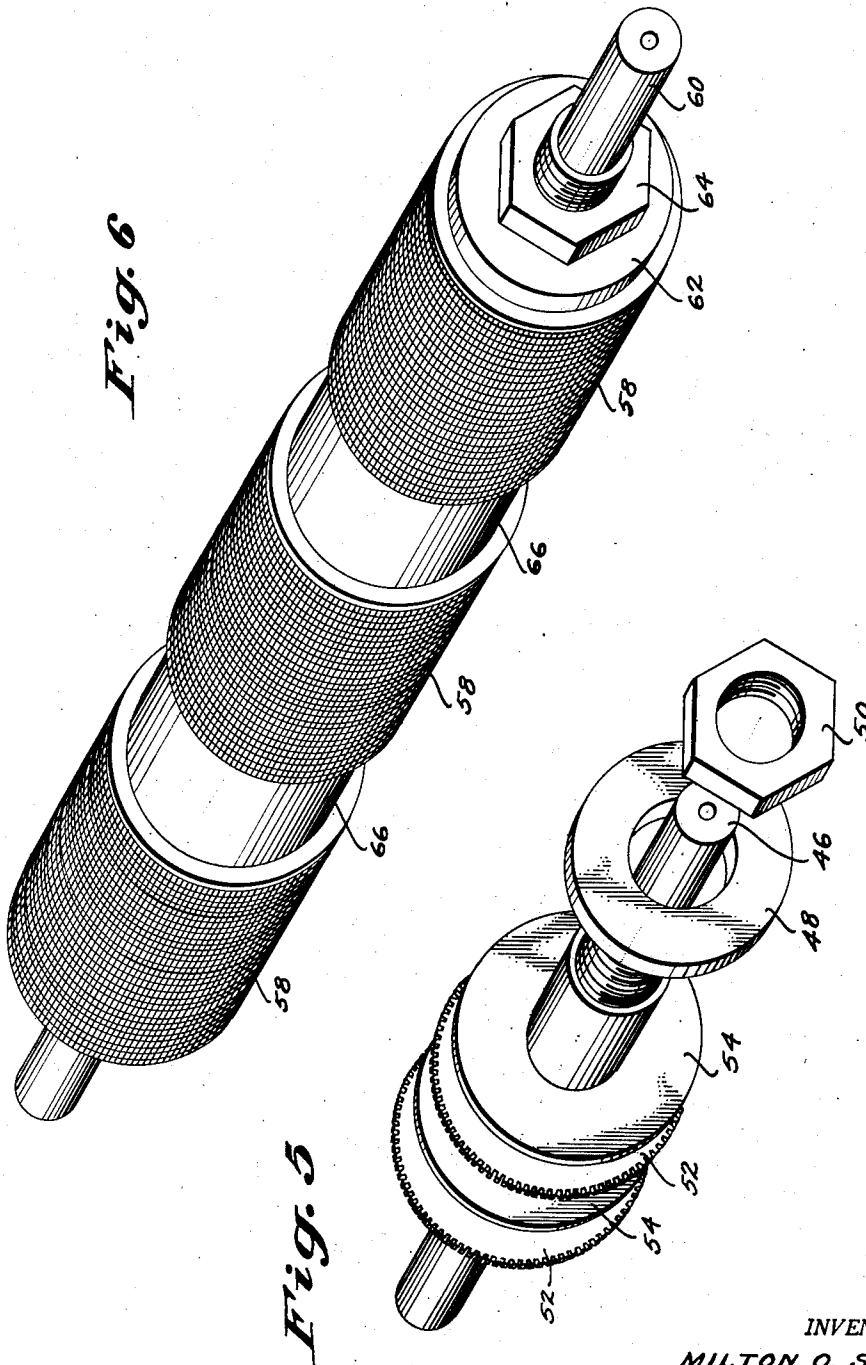
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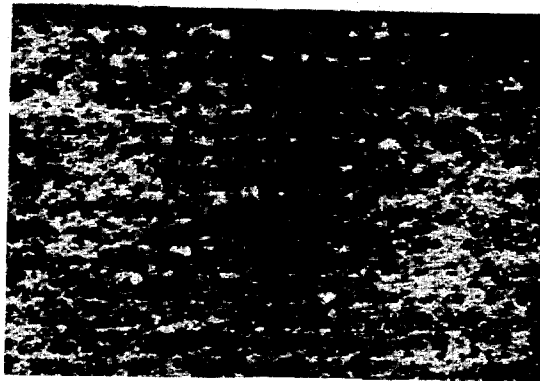
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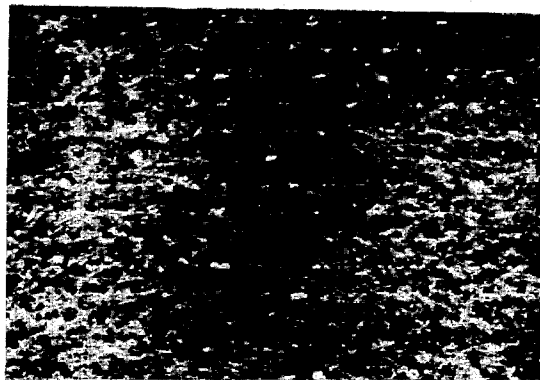
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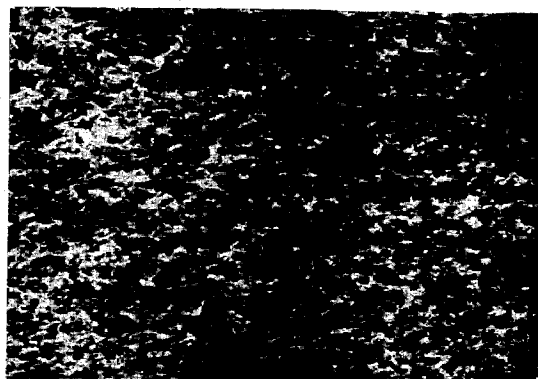
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*Fig. 7*



*Fig. 8*



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*Fig. 9*

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## APPARATUS FOR FORMING PERFORATED TEA BAG PAPER

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Application September 13, 1950, Serial No. 184,560

6 Claims. (Cl. 164—99)

This invention relates to paper adapted for forming tea bags and the like, and more particularly to a perforated tea bag paper and to an apparatus for perforating this paper.

In my prior copending application Serial No. 123,060, filed October 22, 1949 (now abandoned), a tea bag paper is disclosed that is made from a lightweight, wet-strengthened, tissue sheet having a coating of a heat-sealing resin applied thereon and perforated with a large number of restricted openings to impart sufficient porosity to the sheet. The present invention constitutes an improvement of the perforated tea bag paper disclosed in my above noted prior application with regard to the manner in which the perforations are formed.

A particular feature of the present invention is the production of a perforated tea bag paper with the necessary large number of perforations ruptured in the paper, but with the paper substantially free of flap portions of any sort adhering at the ruptures forming these perforations.

In the tea bag paper disclosed in my above noted prior application the perforations are purposely formed with regularly occurring projected areas of the paper sheet at the ruptured portions which provide flap portions in the nature of covers or shields or baffles for the perforations that prevent sifting of the ground tea leaves. According to the present invention I am able to provide perforations in the tea bag paper of my prior application that are sufficiently small in size so that no problem with sifting of the ground tea is encountered, and which, being free of flap portions, avoid any difficulty with introduction of extraneous paper particles into tea as it is brewing in the usual manner by leaching from the tea bag in hot water. Moreover, I have found that with perforations formed in accordance with the present invention the rate of leaching or extraction of the tea is very substantially improved.

Briefly described, the apparatus provided by the present invention for forming these perforations comprises a perforating roll having teeth spaced on its peripheral surface which are of uniform rectangular cross section from the face to the root thereof. This perforating roll is arranged to run against a rubber covered backing roll and thereby form a nip through which the tea bag paper sheet may be run for perforation. With the large number of fine perforations required in the tea bag paper, it is not possible to cut or punch the perforations in the sheet in the usual manner but the above noted arrangement of a perforating roll and opposed backing roll in accordance with the present invention results in rupturing the perforations in the sheet with almost comparable results. That is, the perforations are ruptured in the sheet cleanly for the most part with relatively few flap portions remaining at the ruptures forming the perforations.

An important factor contributing to this result is the formation of the teeth on the perforating roll with a uniform cross section, so that the size of perforation obtained is independent of the pressure applied for weighting the perforating roll against the backing roll, and this pressure may accordingly be regulated with attention only to providing the conditions that result in the best perforating action.

Another feature of the teeth formed on the perforating roll according to the present invention is that the cross sectional dimension of the teeth is made at least 50 per

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cent greater in a direction circumferentially of the roll than longitudinally thereof. The significance of this feature is that it results in characteristically disposing any flap portions left adhering at the perforation ruptures so that they are hinged on an axis parallel with the direction of travel of the paper during perforation, and may accordingly be removed easily by the subsequent action of means such as a reversely driven brush roll, or a stationary brush and associated suction means, or both, as will be explained more in detail presently.

It should also be noted that this dimensional form of the perforating roll teeth results in a stronger perforated tea bag sheet, because the direction of travel of the paper for perforation will naturally be in its machine direction, and with the long dimension of the perforating roll teeth oriented in this direction fewer of the long fibers of the paper sheet will be cut to impair its strength.

These and other features of the present invention are described further below in connection with the accompanying drawings, in which:

Fig. 1 is a schematic illustration in perspective of an apparatus incorporating the perforating means of the present invention;

Fig. 2 is a further perspective view of the perforating roll;

Fig. 3 is a plan view of one of the peripherally toothed discs employed in forming the perforating roll shown in Fig. 2 according to the preferred embodiment of the present invention;

Fig. 4 is a corresponding plan view of the intermediate spacing discs used in association with the toothed discs shown in Fig. 3;

Fig. 5 is a perspective view illustrating the manner in which the perforating roll shown in Fig. 2 is built up with the toothed discs and spacing discs shown in Figs. 3 and 4;

Fig. 6 is a perspective view showing a perforating roll similar to the one shown in Fig. 2, but adapted for perforating tea bag paper in multiple strips;

Fig. 7 is a photolithograph of the actual photomicrographs of the tea bag paper after being acted upon by the perforating roll of the present invention, the side of the paper shown being the side opposite to the one running in contact with the roll; and

Figs. 8 and 9 are corresponding photolithographs showing the perforated tea bag, respectively, after it has been acted upon by a reversely driven cleaning roll, and then further acted upon by a stationary brush and suction means.

Referring now in detail to the drawings, and more particularly at first to Fig. 1, the reference numeral 10 indicates a supply roll of the lightweight, wet-strengthened tissue sheet adapted for use as tea bag paper in accordance with the disclosure in my above noted prior application. The web 12 being withdrawn from the supply roll 10 is shown as being of a width suitable for forming a single strip of tea bag paper, although a wider sheet might be used as well with corresponding changes otherwise in the apparatus for forming the tea bag paper in multiple strips, as will be pointed out further below.

As disclosed in the above noted copending application, the tissue sheet of the type employed in forming the web 12 may be produced in the usual manner on a conventional Fourdrinier paper machine from kraft pulp or other suitable pulps, the significant point being that inexpensive pulps, such as kraft, can be used with excellent results. The weight of the tissue sheet produced in this manner should come within the range of about 10 grams to 30 grams per square meter, and advantageously within the range from about 15 grams to 25 grams per square meter; and the sheet should be wet-strengthened in the course of formation by incorporating in the furnish a suitable wet-strength resin, such as melamine, or by impregnating the sheet in a conventional size press with a solution of urea-formaldehyde resin.

The web 12 is trained from the supply roll 10 upward and over a guide roll 14 to a coating station 16 at which a heat-sealing resin may be applied as also disclosed in my prior application, there being shown in the drawing a pair of metering containers 18 from which the resin may be supplied at a regulated rate behind a knife appli-

cator or doctor blade 20 against which the paper web 12 runs. The tissue sheet forming the web 12 may be made heat-sealable, in accordance with the disclosure of my prior application, by a coating of vinyl resin, such as vinyl butyral. This coating may be applied in restricted areas, if desired, to correspond only with the locations at which the web 12 is finally to be heat sealed in forming tea bags therefrom, but usually it will be more convenient to make an overall coating application of the vinyl resin in an amount of about 15% to 20% based on the dry weight of the coated paper. Beyond the coating station 16, the web 12 may be suitably trained beneath a source of infrared heat, as at 22, and then over a heated drying drum 24, to dry the resin coating.

From the drying drum 24, the web 12 is passed downwardly under a guide roll 26 and then through the nip formed by a perforating roll 28 formed in accordance with the present invention, and a rubber covered backing roll 30 which is adjustably weighted in opposed relation to the perforating roll 28 by suitable means as indicated by the reference numeral 32.

The perforated web 12 may then be passed over a spreader bar as at 34, over a reversely driven brush roll as indicated at 36 for removing flap portions adhering at the ruptured perforations, past a stationary brush and associated suction means as illustrated at 38 for further removal of flap portions and cleaning of the web 12, under a further spreading device as at 40, and finally rewound in roll form at 42.

The form of perforating roll 28 employed according to the present invention is illustrated further in Fig. 2 of the drawing in which the peripherally toothed body of the roll as at 44 is shown mounted on a mandrel 46 between retaining collars 48 and jam nuts 50 (compare Fig. 5). The body 44 of the perforating roll 28 could, if desired, be made as a solid unit, but it is preferably formed in accordance with the present invention of an alternating series of toothed discs 52 (see Fig. 3) and intermediate spacing discs 54 (see Fig. 4), the diameter of the spacing discs 54 being not greater than the root diameter of the teeth 56 formed at the periphery of the discs 52.

The teeth 56 in the discs 52 may be machined after the alternating series of discs 52 and 54 have been placed on the mandrel 46, as illustrated in Fig. 5, and locked in place between the retaining collars 48 and jam nuts 50, by cutting or milling spaced grooves parallel to the mandrel axis in the peripheral surface of the result in roll body 44. Usually, however, the teeth 56 may be formed with greater facility and to better advantage by stamping or die cutting them in the individual discs 52 beforehand, in which case they may be assembled on the mandrel 46 without any attempt to align the teeth 56 of the individual discs 52.

In forming the perforating roll 28 in this manner, the toothed discs 52 may suitably be cut from shive stock of about 0.007" thickness, with teeth 56 having a width of about 0.011", and with a spacing of at least comparable width provided between the teeth 56. The spacing discs 54 may in turn be formed from a material such as spring steel having a thickness at least about as great as the spacing provided on the discs 52 between the teeth 56. This arrangement makes it possible to provide easily a very high density of teeth 56 on the peripheral surface of the perforating roll 28, and thereby obtain the large number of tiny ruptured openings in the tea bag paper necessary for providing a satisfactory extraction rate.

In order to provide an extraction rate which is acceptable in tea bag paper, I have found that the teeth 56 should be formed with a density of at least 500 teeth per square inch, with each tooth of a size such that the corresponding number of perforations ruptured in the paper will form an open area of at least 5 per cent of its total area (excluding unperforated heat-sealing margins, of course). A perforating roll 28 formed with toothed discs 52 and spacing discs 54 in the dimensions noted above results in spacing the teeth 56 with a density of 837 per square inch, and provides a corresponding density of ruptured perforations in the tea bag paper forming an open area of 7.0 per cent of its total area.

Fig. 6 of the drawings shows a modified arrangement of a perforating roll of the type just described above that is adapted for large-scale production by means of a plurality of roll bodies 58 for forming multiple strips of tea bag paper simultaneously. The roll bodies 58 are formed in this instance just as the single roll body 44 described above, and are mounted in the same way on a mandrel 60

between retaining collars 62 and jam nuts 64, with the addition of spacing sleeves 66 between the roll bodies 58. The dimensions of the roll bodies 58 and the spacing sleeves 66 are determined by the width of the perforated area and the width of the unperforated sealing margin desired in the finished tea bag paper strip. After perforation in multiples with a roll of this sort the tea bag strips are separated by slitting at the middle of the unperforated areas.

Actual illustrations, magnified in size, of tea bag paper formed in accordance with the present invention are shown in Figs. 7, 8, and 9 of the drawings, and in each case the direction of travel of the tea bag web during processing was horizontally to the left as seen in the drawings. In Fig. 7, the tea bag paper is shown just after perforation with a roll such as the roll 28 described above, and it will be noted the paper even at this point has very few flap portions (as indicated by the strikingly highlighted areas) adhering at the ruptures forming the perforations. Also, it will be noted that the ruptured perforations are longer in the direction of web travel than they are wide, and that the flap portions that appear are characteristically hinged on an axis parallel to the direction of web travel, as previously mentioned above. This characteristic disposition of the flap portions that are present after the perforating roll is passed makes them particularly susceptible to removal with any convenient means for brushing the web in a direction opposite to its travel, which may be used in association with an air moving device, such as an air blower or such means, for carrying away the removed flap portions and thereby cleaning the web of extraneous paper particles.

This is illustrated by Fig. 8 of the drawings, in which the perforated tea bag paper is shown after subsequent brushing with a reversely driven gabardine covered roll as described above and illustrated in the drawings at 36. A gabardine cover has been found to provide a very effective brushing action with the lightweight tissue sheet from which the tea bag paper in the present case is made, and it will be seen in Fig. 8 that a still smaller number of adhering flap portions appear than in Fig. 7. Fig. 9 shows the tea bag paper after it has been further acted on by a stationary brush and associated suction means as indicated in the drawings at 38, and after which it will be noted the sheet is substantially free of any adhering flap portions at all.

Perforated tea bag paper formed according to the present invention, as illustrated in Figs. 7, 8 and 9, is further disclosed and is claimed in copending application Serial No. 448,608, filed August 9, 1954, which application is a continuation-in-part of divisional application Serial No. 345,843, filed February 17, 1953, as a division of the present application, and which divisional application has now been abandoned in favor of the aforesaid copending continuation-in-part application Serial No. 448,608.

I claim:

1. A perforating apparatus for tea bag paper comprising a rubber covered backing roll, a perforating roll, means for weighting said backing roll in opposed relation to said perforating roll, and means for training and drawing a continuous web of said tea bag paper through the nip formed by said perforating roll and opposed backing roll, said perforating roll having solid teeth spaced on the peripheral surface thereof with a density of at least about 500 teeth per square inch, and said teeth having substantially flat outer faces the edges of which form cutting edges and being rectangular in cross section and of uniform cross section from the outer face to the root thereof with a length from outer face to root sufficient for perforating said web, whereby said teeth act against said rubber backing roll to rupture perforations with a corresponding density in said tea bag paper and the uniform cross section of said teeth results in forming said perforations consistently in a size corresponding with the size of said teeth independently of any variations in the weighting of said backing roll.

2. A perforating apparatus for tea bag paper as defined in claim 1 and further characterized in that an air moving device is disposed for acting on said web beyond the nip of said perforating roll and opposed backing roll to remove flap portions adhering at the perforation ruptures and for cleaning said web.

3. A perforating apparatus for tea bag paper as defined in claim 1 and further characterized in that the

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cross sectional dimension of said teeth is at least about 50 per cent greater in a direction circumferentially of said roll than longitudinally thereof.

4. A perforating apparatus for tea bag paper as defined in claim 1 and further characterized in that means are disposed beyond the nip of said perforating roll and opposed backing roll for brushing said web at the face thereof trained in contact with said backing roll.

5. A perforating apparatus for tea bag paper as defined in claim 1 and further characterized in that a gabardine covered brush roll is disposed to run in contact with said web beyond the nip of said perforating roll and opposed backing roll.

6. A perforating apparatus for tea bag paper as defined in claim 5 and further characterized in that a stationary brush and associated suction means is disposed to act on said web face beyond said gabardine covered roll for further removal of adhering flap portions and for cleaning said web.

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