March 11, 1969 O. F. LICIS 3,431,915

TREATMENT OF RECONSTITUTED TOBACCO SHEET

Filed Sept. 1, 1966

FIG. 1

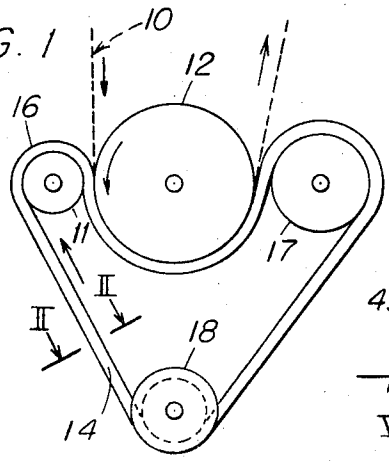


FIG. 5

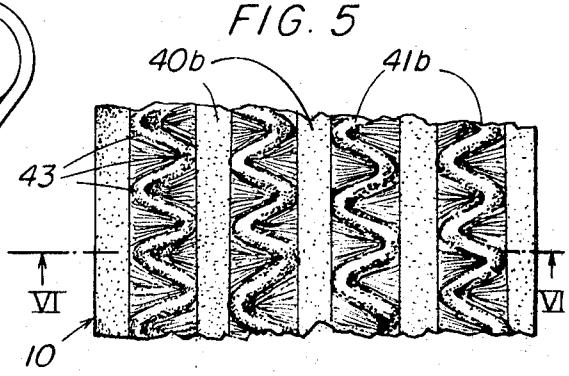


FIG. 6

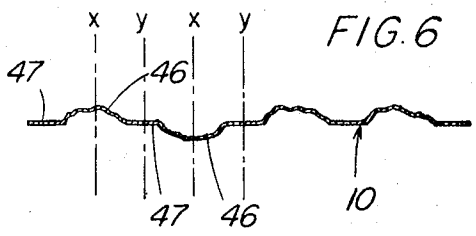


FIG. 2

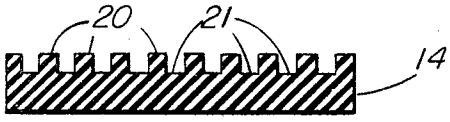


FIG. 3

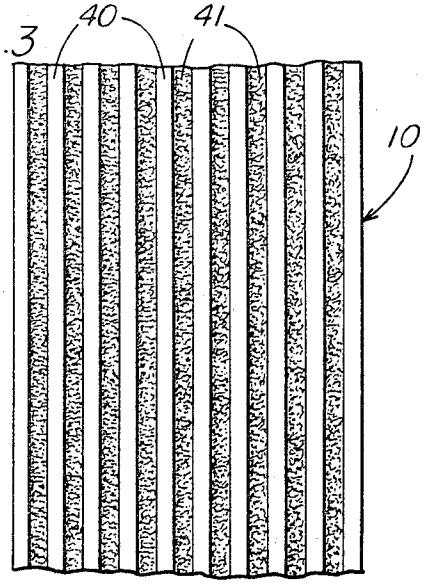
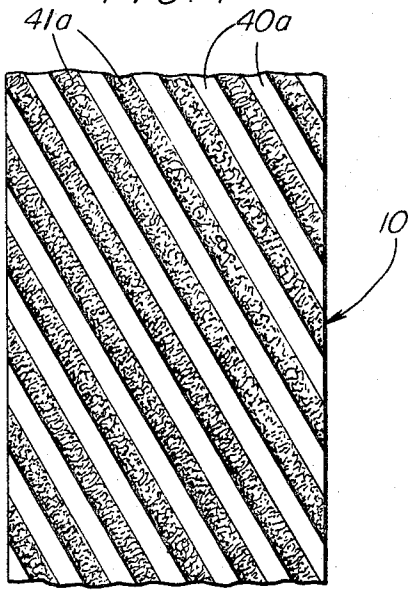


FIG. 4



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TREATMENT OF RECONSTITUTED TOBACCO SHEET

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U.S. Cl. 131—140 6 Claims
Int. Cl. A24b 9/00; A24c 5/06

This invention relates to a method for treating reconstituted tobacco sheet to provide that when the reconstituted tobacco sheet is shredded for use as a cigarette filler, it has a filling capacity greater than that of ordinary untreated reconstituted tobacco sheet.

Various methods are known by means of which tobacco scraps and similar tobacco residue evolved in the processing of tobacco products can be utilized in smoking articles. In general, the scraps and residue are reconstituted into a self-sustaining sheet, the reconstituted sheet thereafter being further processed and used as cigarette filler or cigar wrappers. The presnt invention provides a novel method by means of which reconstituted tobacco sheet is contracted along bands extending longitudinally of the sheet and transversely spaced from each other. This is effected by subjecting the tobacco sheet along said bands to compressive forces applied in directions parallel with the faces of the sheet and imparts non-uniform stress-strain properties thereto which cause the tobacco shreds formed when the sheet is shredded for use as a cigarette filler, to curl and kink thereby increasing the bulk density of the filler.

The treatment of the reconstituted tobacco sheet involves building up therein a pattern of residual differential stresses which cause the sheet and consequently tobacco shreds formed therewith to curl and kink in a fashion akin to that in which natural tobacco leaf becomes curled when it is steam dried in conventional tobacco processing methods. This involves producing an alternating arrangement of compacted and non-compacted bands in the sheet and mechanically inducing therein non-uniform stress-strain characteristics. The reconstituted tobacco sheet may be treated with various forms of apparatus. However, a preferred embodiment of the apparatus comprises a pair of rollers one of which is a heated smooth faced roller, and an endless, thick rubber belt which is provided on one side with an alternating arrangement of ribs and grooves to give it a discontinuous transverse surface. The endless belt is fed into the nip of the two rollers, with the belt traversing a course partly around each. The tobacco sheet also is fed into the roller nip and against the discontinuous surfaced face of the endless belt so that one face thereof engages the said belt face and the other face of the sheet engages with the smooth surface of the heated roller. The arrangement is such that the endless belt traverses a course partly around each roller with the nip therebetween being at a point where the course of the sheet engaging face of the endless belt undergoes a transition from a convex travel on the unheated roller to a concave travel on the other or heated roller. In this manner, the discontinuous sheet engaging face of the endless belt changes from a tensed to a compressed condition. The endless belt material is of such nature as to maintain a strong frictional hold on the tobacco sheet so that the compressed face of the belt applies a compression to the sheet at longitudinally extending, transversely spaced areas of the sheet, the compression being applied to the sheet in the direction of its faces and opposite to its direction of travel. Additionally, a compressive force acting perpendicular to the run of the tobacco sheet is maintained along said areas by the tightened condition of the rubber belt thereby preventing any increase in thickness in the treated longitudinal bands or areas of

the tobacco sheet although the overall natural length of said bands decreases. The action of the rollers and rubber belt on the tobacco sheet thus is to rearrange the relative positionings of and crowd together the tobacco constituents within the longitudinal bands, with the tobacco portions between said bands becoming creped.

Various other objects, features and advantages of the present invention will be made apparent by the description that follows and the illustrative examples depicted in the drawing. The invention accordingly comprises the several steps and the relation of one or more such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangements of parts which are adapted to effect such steps, all as exemplified in the following detailed description and the scope of the invention will be indicated in the claims.

In the accompanying drawings:

FIGURE 1 is a side elevational view of a preferred embodiment of the apparatus with which reconstituted tobacco sheet may be treated according to the principles of the present invention.

FIGURE 2 is a transverse sectional view through the flexible belt used in the apparatus of FIGURE 1.

FIGURE 3 is a partial longitudinal plan view of a reconstituted tobacco sheet treated with the apparatus of FIGURE 1 in accordance with the present invention showing the alternate arrangement of compacted and non-compacted bands therein which produce non-uniform residual stresses and strains in the tobacco sheet to thereby increase its filling capacity when it is used as a cigarette filler.

FIGURE 4 is similar to FIGURE 3 except that the alternate compacted and non-compacted bands in the tobacco sheet are directed angularly of the longitudinal axis of the sheet as occurs when the ribs and grooves on the endless belt are arranged to extend at an angle to the major axis thereof.

FIGURE 5 is a fragmentary plan view on enlarged scale of a section of treated reconstituted tobacco sheet showing the planar contours produced therein by the method of the present invention.

FIGURE 6 is a sectional view as taken along line VI—VI in FIGURE 5.

The present invention is concerned with the treatment of reconstituted tobacco sheet, i.e., one which is made from tobacco stems and other tobacco residue, the sheet being formed by casting it in a Fourdrinier apparatus in the same general manner employed in paper making. The present invention contemplates that the wet sheet of tobacco on leaving the Fourdrinier apparatus, that is, on being removed from the wire forming carrier will be subjected to some drying. This may be carried out by means of suction boxes, Yankee drier unit, or other conventional drying equipment and is intended to reduce the water content of the wet tobacco sheet to a range of between 12% and 25% by weight but preferably about 15%. The tobacco sheet is then directed into the roller apparatus shown in FIGURE 1. The apparatus comprises a pair of driven rollers **11** and **12**, the roller **12** being a heated drum which has a smooth outer surface that will offer low frictional resistance to the movement of the tobacco sheet **10** thereon when the latter is brought into contact with it in the manner to be described later on in the specification. Intermediate the two rollers **11**, **12** there passes a continuous belt member **14**, the outer surface **16** of which is of a contractible character and to that end, the belt member **14** is preferably made of rubber. The apparatus also includes an additional roller **17** around which the belt member **14** passes with the roller **17** being spaced sufficient distance from roller drum **12** to provide a

straight belt run transfer from the roller drum **12** to roller **17**. A guide roller **18** is also provided. The outer surface or face **16** of the belt, i.e., the tobacco sheet engaging face is discontinuous in a transverse direction as shown in FIGURE 2 having extending thereon a plurality of transversely spaced, longitudinally extending ribs **20**, with grooves **21** extending between adjacent ribs. In a preferred form of the belt, the width of the ribs **20** should be in a range between 1/10 of an inch and 1 (one) inch, the preferred width being between 1/4 and 3/8 of an inch. It was found that to achieve an improvement in the filter characteristics of reconstituted tobacco sheet, the application of the compressive forces thereto has to be effected along relatively narrow bands or areas of the sheet. Hence, the use of rib widths in the range above. The grooves **21** should be at least equal to the widths of the ribs although they can be made with a somewhat larger dimension without producing change in the teaching of the invention. The arrangement of the rollers **11** and **12** is such that the face **16** of the belt **14** (which is comprised of the flat surfaces of the respective ribs **20** and which contacts the tobacco sheet) undergoes a transition from a convex run on the drum **11** to a concave run on heated drum **12**, the belt face **16** shortening or contracting as it undergoes this transition. As a consequence, the tobacco sheet **10** feeding intermediate the outer face of the belt **14** and the smooth outer face of heated drum **12** is gripped tightly by the transversely discontinuous belt face and responsive to the contraction of the latter, is subjected to compressive forces exerted parallel to the faces of the tobacco sheet and counter to the direction of the sheet run thereby distorting and flexing the tobacco constituents in the reconstituted sheet along longitudinal directed bands corresponding to the location of the ribs **20** on the belt **14**. It should be understood that the phenomenon of "distorting and flexing" the tobacco constitutents is in effect a rearrangement of the relative positions of the pectins, hemicelluloses, galacturonic acids and other constituents which comprise reconstituted tobaco, the constituents being pushed or crowded together in a direction opposite to the sheet travel with resulting shortening of the natural length of the sheet. It is believed that little or no actual geometric distortion of the tobacco constituents occurs as reconstituted tobacco sheet constituents rarely have length/width ratios greater than 1:1 and as such are not amenable to physical distortion and changes in geometric configuration in the same manner as fibrous materials, as for example, paper fibers having length/width ratios in excess of 5:1.

As seen in FIGURE 3, the treated tobacco sheet has an alternating arrangement of compacted bands **40** and non-compacted bands **41** corresponding respectively to the rib-groove arrangement on the belt member **14**. During the course of treating the tobacco sheet, the primitive lengths of the compacted band portions **40** are progressively shortened without any increase in the thickness thereof, this being prevented by the action of belt **14** in holding the sheet in tight contact with the roller drum **12** and applying a compressive force normal to the direction of travel of the tobacco sheet. The non-compacted bands **41** on the other hand are not subjected to shortening of their primitive lengths. Instead, they assume a randomly patterned creped condition caused by the shortening of the two compacted band portions **40** adjacent each non-compacted band **41**. This condition is shown with greater clarity in FIGURE 5 wherein it will be noted the compacted bands **40***b* are smooth faced at both sides of the sheet and the non-compacted bands **41***b* have an undulating contour **43** characteristic of creped sheet.

The effect of compacting the tobacco sheet only along longitudinally directed, transversely spaced bands is to mechanicaly induce stresses and strains in the sheet and impact varying dimensional characteristics thereto. In other words, the reconstituted sheet on being treated as described assumes a non-uniform modulus of elasticity. This will be apparent by referring to FIGURE 6. The compacted bands **40***b* which have been stressed are of flat section. The non-compacted bands **41***b* however exhibit the randomly arranged undulating segments **46**. Thus when the sheet is shredded along shear planes X–Y for filter purposes, the shred is comprised of a stressed segment **47** represented by the compacted band portion of the shred and a relatively non-stressed segment **46**. The stress differential within the respective segments of each shred causes it to assume a curl or kink. A reconstituted tobacco sheet treated uniformly throughout its width instead of in an alternate banding arrangement will on the other hand, possess a uniform modulus of elasticity and shreds formed therefrom lacking a stress differential will not curl or kink. The difference is of consequence when the respective sheets are used as a cigarette filler as will appear.

When ordinary untreated reconstituted tobacco sheet is shredded for use as a cigarette filler, the shreds produced for the most part lay flat and occupy less space than natural leaf tobacco shreds. Natural tobacco leaf on the other hand, is curly and possesses a stress and strain therein imparted by steam drying during leaf processing so the tobacco shreds kink or twist when the leaf is shredded, thus increasing its bulk density or filling capacity. The reconstituted tobacco sheet treated as described above, i.e., one compacted in alternate bands extending longitudinally of the sheet does not suffer the limitation of laying flat during cutting so that the shreds possess a kink or curl akin to that of natural tobacco leaf giving the filler increased bulk density.

Further understanding of the invention will appear from the following examples.

Example 1

A reconstituted tobacco sheet which was cast in a Fourdrinier apparatus and dried to a water content of about 15% by weight of water was treated as previously described on apparatus as shown in FIGURE 1 and having a rubber belt. The treated sheet was then shredded to serve as cigarette filler.

An untreated reconstituted tobacco sheet also was shredded providing a filler with which cigarettes serving as a control were prepared.

During the shredding, the reconstituted tobacco sheet treated according to the present invention had a non-uniformity of shred (a curl or kink) and the curled and intertwined shreds were easily handled when making cigarettes. The untreated reconstituted tobacco sheet made flat shreds which were more difficult to handle.

Control and experimental cigarettes were then made from the respective treated and untreated tobacco sheet fillers to provide data on the filling power of each. Since filling power is difficult to define and determine, it was necessary to select variables most likely to give a correlation with filling power. Accordingly, the cigarettes were made at a constant resistance-to-draw (RTD expressed in inches of water). The RTD of both the control and the experimental cigarettes was 2.2–2.6 inches of water. The cigarettes were 65 mm. long and had a circumference of 25.2 mm. The weight of the cigarettes made from the treated filler was 0.956 gram/cigt. From four ounces of the treated filler, 119 cigarettes were prepared. From four ounces of the control, 117 cigarettes were prepared.

Since the RTD of the cigarettes remained constant and since more cigarettes were made from the four ounces of the test filler, it was evident that the treatment of the reconstituted tobacco sheet according to the present invention increased the bulk density of the filler and it was concluded that the treated tobacco sheet has a greater filling power than the untreated control sheet.

Example 2

Control and test cigarettes were prepared as described in Example 1 with the RTD kept constant at 2.2–2.6 inches of water. The cigarettes made were 70 mm. long

and had a circumference of 25.2 mm. The test cigarettes were filled with 1.144 grams/cigt. and the control with 1.216 grams/cigt.

From four ounces of the treated filler, 99 cigarettes were made. Ninety-four (94) control cigarettes were made from the four ounces of untreated filler. Thus, approximately 5% more cigarettes were made with the treated filler than with an equal weight of the untreated filler.

Example 3

In a similar experiment to determine the filling power of test and experimental cigarettes, the cigarettes were kept at a constant weight. The cigarettes differed from those described in Examples 1 and 2 as follows: the cigarettes were made to a constant weight of 103–107 cigarettes per 4 ounces of filler; they had a length of 65 mm. and a circumference of 25.2 mm. The control cigarettes were made of a blend of predominantly natural leaf filler and shredded filler from an untreated reconstituted tobacco sheet. Comparisons of the filling power of test cigarettes and the control were made by determining their RTD, a measure of bulk density of the cigarettes. The treated cigarettes had an RTD of 3.0; the control had an RTD of 2.9 showing that the treated cigarettes were more tightly packed than was the control. This indicated an increased filling power.

Example 4

Test cigarette filler was prepared as described in Example 1. The control cigarettes had the same filler as the control in Example 3. Test and control cigarettes were made to a constant RTD of 2.0–2.2 inches of water. The cigarettes made were 65 mm. long and had a circumference of 25.2 mm. From 4 ounces of the treated filler, 119 cigarettes were made. From 4 ounces of the blend used as the control, 115 cigarettes were made. The increase in the number of cigarettes prepared from the treated cigarettes indicated that the filling power of the treated filler was greater than that of the blended filler.

It will be understood from the foregoing description that the present invention requires compacting or contracting a reconstituted tobacco sheet in narrow longitudinally directed, transversely spaced bands to achieve an improvement in the filling properties of the sheet when it is used as a cigarette filler. While the compaction of the sheet is carried out in an effective manner with the apparatus of FIGURE 1, it will be apparent that other devices can be employed to produce the same effect. For example, a roller set having a speed differential therebetween and employing a discontinuous surface on one of the rollers could also be used. Moreover, the construction of belt member **14** can be modified to provide it with ribs extending angularly of the longitudinal axis thereof so as to produce a compacted band **40***a*-non-compacted band **41***a* alternating arrangement pattern such as that shown in FIGURE 4.

The present invention provides an effective manner with which the filling properties of reconstituted tobacco sheet can be improved when it is used as a cigarette filler. It is possible to produce a more dense cigarette from a given weight of treated reconstituted tobacco sheet than is possible when using an equal weight of untreated sheet. Not only is the bulk density of reconstituted tobacco sheet improved when it is treated according to the present invention but better resistance-to-draw qualities, as shown by Example 3, as well as firmer packing of the cigarettes made therewith are achieved.

What is claimed is:

1. A process for treating reconstituted tobacco sheet to increase its filling capacity when it is used as cigarette filler which comprises,

compacting said sheet in transversely spaced flat bands extending longitudinally of said sheet to shorten the natural length of said compacted bands, leaving between succeeding compacted bands uncompacted bands of reconstituted tobacco the natural lengths of which are substantially unchanged,

the compacting of said sheet being effected by subjecting it while it is advancing in a longitudinal course, to compressive forces applied parallel to the sheet faces and counter to the advance thereof so as to rearrange the relative positioning of the reconstituted tobacco constituents within said compacted bands and therewith establish residual differential stresses between the renconstituted tobacco in each compacted band and reconstituted tobacco in the uncompacted bands adjacent thereto,

while simultaneously applying compressive force to said compacted bands in a direction normal to the faces thereof to prevent an increase in the thickness of said compacted bands as the natural lengths thereof are shortened, and

thereafter shredding said sheet into shreds each comprised of at least a segment from one of said compacted bands and a segment from an uncompacted band so that the stress differential existing between the compacted band segment and uncompacted band segment cause said shred to curl and kink.

2. The process of claim **1** wherein the sheet of reconstituted tobacco is subjected to the application of said compressive forces and counter to the advance thereof normal to the faces of said compacted bands while it is in a wet state containing water in a range of between 12% to 25% by weight of the sheet.

3. The process of claim **2** wherein the sheet is subjected to the application of said compressive forces while it is in a wet state containing substantially 14% by weight of water.

4. The process of claim **1** wherein the width of the transversely spaced bands at which said compressive forces are applied is in a range between $\frac{1}{10}$ inch to 1 (one) inch, and the spacing between succeeding bands is at least equal to the width of said bands.

5. The process of claim **4** wherein the width of the transversely spaced bands at which said compressive forces are applied is in a range between ¼ inch to ⅜ inch.

6. The process of claim **1** wherein the reconstituted tobacco sheet is compacted by advancing it in a wet state in a longitudinal direction and between and in contact with the juxtaposed surfaces of two moving bodies, one of which is heated, the surface of the other of said bodies being discontinuous in a direction lateral to the advance of the sheet and being smooth and contractible and offering greater frictional resistance to the movement of the sheet thereon than that offered by the surface of said heated body, the discontinuous surface of said other body being contracted in a direction counter to the advance of said sheet to apply compressive forces parallel to the faces of said sheet for shortening the natural length of the reconstituted tobacco sheet contacted by said continuous surface, the compressive force applied normal to the faces of the sheet being applied by maintaining a fixed spacing of the juxtaposed surfaces of said two moving bodies.

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MELVIN D. REIN, *Primary Examiner.*

U.S. Cl. X.R.

131—20, 145, 147

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,431,915 March 11, 1969

Osvalds F. Licis

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 14, "arrangements" should read -- arrangement --. Column 3, line 73, "impact" should read -- impart --. Column 6, line 35, "14%" should read -- 15% --.

Signed and sealed this 31st day of March 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents