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PATENT SPECIFICATION

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DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements relating to Cigarettes

We, THE IMPERIAL TOBACCO COMPANY (of Great Britain and Ireland), Limited, a British Company, of East Street, Bedminster, in the City and County of Bristol, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to cigarettes and in the case of all-tobacco cigarettes it particularly concerns the fibrous sleeve that is shaped to surround the tobacco filling.

Mouthpiece cigarettes, i.e. cigarettes having a stub, as hereinafter defined, at the mouth end are at present made on three general principles.

According to one principle an all-tobacco cigarette is joined to a stub by folding or wrapping a band of paper, or other suitable material, so that said band encircles the stub and a short length of the all-tobacco cigarette, and so far as this principle is concerned the present invention relates to the fibrous sleeve that surrounds the tobacco filling of the all-tobacco cigarette portion and it may relate to the band that encircles the stub and cigarette.

According to the second principle, mouthpiece cigarettes are manufactured as a continuous rod. For example, a filling of tobacco and stubs at suitable spaced intervals is fed to a cigarette paper web, and the web is folded or wrapped around the filling and stubs to provide the continuous rod, whereupon the rod is cut to provide individual cigarettes with stubs at one end. In this case the present invention relates to the fibrous sleeve that constitutes the cigarette paper web.

According to the third principle, a stub is inserted in a preformed cigarette paper tube and in this case the present invention relates to the fibrous sleeve that constitutes the cigarette paper tube.

In all three principles, the stub before being joined, fed or inserted as the case may be, may itself be encircled in a paper or like sleeve, and the present invention may also concern such an encircling sleeve.

The present invention may also relate to a cork, or other band, that is sometimes provided at the mouthpiece end of an all-tobacco cigarette.

The word "stub" is used to signify a portion of a cigarette that differs from the remainder thereof, frequently referred to as a filter, for instance rolled or crumpled paper or other material, or it may be merely a hollow cylinder.

In the case of a stub that comprises a hollow cylinder, which may comprise a spiral of paper or similar material, so far as the present invention relates thereto, the fibrous sleeve concerned is the material which is shaped to form the mouthpiece.

Recently a considerable amount of research has been carried out in connection with the manufacture of tobacco webs, that is to say a paper made from tobacco fibres, with or without additives, e.g. glycerine. The manufacture of such tobacco paper has now become an economic commercial proposition and it may be used as a substitute for normal paper in any of the hereinbefore described cigarettes and/or stubs and for covering cigars and cigarillos.

In view of the above it is to be understood that where hereinafter the expression "cigarette paper web" is used and the context so permits, it is intended to refer to the sleeve that is shaped to surround the tobacco filling, or to surround the tobacco filler and the stub, or the stub itself, or to encircle an all-tobacco cigarette and stub to join them together, or a cork or similar tip, or in the case of a hollow cylinder stub, the material that is shaped to form the cylinder, and the invention also relates to any suitable combination thereof. It also refers to a tobacco paper used for any of these purposes.

[*Price 4s. 6d.*]

The purpose of the present invention is to provide an improved form of sleeve for an all-tobacco or mouthpiece cigarette and methods of and apparatus for making such sleeves and cigarettes.

In accordance with a feature of the present invention, flutes are impressed in a cigarette paper web by passing the web between rollers, the surfaces of which comprise a plurality of co-operating flutes and ribs such as to stretch the web laterally and impress corresponding longitudinally extending flutes and ribs in the paper, the pattern of the rollers being such that some compression of the paper takes place at least at the flanks of the flutes so as to offset any additional air permeability that results from the stretching, and wherein the flutes of one roller are centrally disposed with respect to the corresponding ribs of the other roller so as to render said compression uniform.

The pattern of the rollers may be such that the paper is compressed on the flanks of the flutes and at the top of successive ribs of one roller.

The flutes may extend continuously along the cigarette paper web, or alternatively they may be interrupted to provide patterns of flute-free areas on the web.

The flutes may be arranged parallel to the edges of the cigarette paper web or at an angle thereto so that in the latter case they appear spirally on a finished cigarette.

The present invention also consists in an all-tobacco cigarette or a mouthpiece cigarette of which the paper web that provides the fibrous sleeve is fluted by any of the above defined methods.

The present invention further consists in apparatus for impressing flutes in cigarette paper comprising a metal roller having flutes extending around its periphery, an impression roller having co-operating ribs around its periphery, means for rotating each roller in axial alignment with the other; means for aligning the flutes of one roller centrally disposed with respect to the corresponding ribs of the other roller, and means for feeding a cigarette paper web to the nip between the two rollers and for receiving the fluted paper after it has passed between the two rollers.

The impression roller may also be made from metal.

The ribs in the impression roller may be shallower than those on the metal roller so that no compression of the paper takes place at said shallower ribs.

Forms of cigarettes, of the web from which the sleeve is made, and of co-operating flute forming rollers, in accordance with the present invention are diagrammatically indicated in the drawings accompanying the Provisional Specification, in which:—

Fig. 1 shows an all-tobacco cigarette having a spirally fluted fibrous sleeve.

Fig. 2 is an end view of the cigarette in Fig. 1.

Fig. 3 is a plan view of a strip of material suitable for the cigarette in Fig. 1.

Fig. 4 is a cross section on the line 3—3 of Fig. 3 but drawn to a larger scale.

Fig. 5, drawn to the same scale as Fig. 4, is a view of some of the flutes and ribs of the co-operating rollers, the intermeshing impression roller being the one shown sectioned.

Fig. 6 shows a mouthpiece cigarette made by joining an all-tobacco cigarette to a stub with an encircling band.

Fig. 7 is a view on the line x—x of Fig. 6.

Fig. 8 shows a mouthpiece cigarette made on the continuous rod principle.

Fig. 9 is a view from the left-hand end of Fig. 8.

Fig. 10 is a simplified illustration showing the metal fluting roller and how the cigarette paper web is impressed with flutes and is subsequently formed into a cigarette rod.

Figs. 1 to 3 and 6 to 10 are all drawn to a larger scale than a normal cigarette and are not drawn to represent the number and size of flutes which are preferred. Thus in practice the flutes are preferably only of the order of 1.0 m.m. pitch and 0.20 m.m. depth.

Referring to Fig. 5 — 1 represents a metal roller and 2 a roller made from thermoplasitc material — a suitable material being that sold under the Registered Trade mark "Perspex." The "Perspex" roller is hereinafter referred to as the impression roller.

The metal roller 1 is cut accurately by conventional methods so that its periphery comprises a number of flutes 5 parallel to each other with between them ribs 3 of truncated triangular cross-section. The arrangement of the flutes is best appreciated by referring to Fig. 5.

A conventional method of producing a pattern on the initially plain surfaced thermoplastic impression roller 2, corresponding to the pattern of the fluted metal roller 1, is for the two rollers, which must be truly cylindrical, to be run together, with their axes parallel to each other, under pressure with heat applied to the metal roller 1 and for as long as is required to produce flutes in the impression roller separated by ribs 4 of the requisite height.

In the embodiment illustrated, contact between the two rollers is not continued so that the ribs 4 of the impression roller 2 conform to the whole depth of the flutes 5 in the metal roller 1, but so as to leave a clearance 6. (This clearance 6, however, is not essential).

The clearance 6 is left to preserve the opacity of the paper as far as possible as is hereinafter explained.

In the manufacture of cigarette paper great care is exercised to achieve a high quality product having uniform characteristics,

as to substance (weight in grammes per square metre), thickness, stretchability, air permeability, opacity and combustibility; except for opacity, these control the burning characteristics of the paper, and thus to some extent the burning characteristics of the cigarettes.

It will be appreciated that when paper is passed between flute forming rollers, such as above described, stretching of the paper occurs and thus any defects present in the paper tend to be exaggerated. For example, if originally there is a pinhole in the paper, stretching may result in rupture at that point. It is desirable to permit stretching to take place over the entire width of the web.

Stretching begins as soon as the initially flat web begins to be deformed by the rollers 1 and 2 (Figs. 4 and 5), continuing until flute formation is completed when the rollers intermesh to the fullest desired extent.

Referring to both Figs. 4 and 5, in which for clarity relevant numerals correspond, it will be evident that stretching occurs between points 10—11 and 12—13 (the flanks of the ribs); between 11—12 (the peripheral width of a rib 4 of roller 2) and 31—10 (the peripheral width of a rib 3 of roller 1). When the rollers intermesh to the fullest desired extent, except between points 11 and 12, the web of paper is compressed between the roller surfaces, viz. at 8, 7 and 9. The compression results in reduction of opacity but not to an unacceptable degree. Almost the full degree of opacity is preserved between points 11 and 12 by virtue of the clearance 6 previously mentioned, which is in excess of the paper thickness. It will be appreciated that the widths of the paper between the points 11 and 12 exceed the widths between 31 and 10 as a consequence of the said clearance 6.

Preferably, the cigarettes are manufactured so that the comparatively wide uncompressed rib surfaces 32 (Fig. 4) of the paper web are located externally on the cigarettes. By virtue of the consequent marked contrast between these areas of unimpaired high opacity and the intervening flutes, the appearance of the cigarettes is enhanced.

Typical dimensions for the flutes and ribs of roller 1 in Fig. 5 are as follows:—

Distances between points 31—10, 10—14, 14—15, and 15—13, all 0.293 m.m.; pitch of flutes, normal to their helix angle, 1.0 m.m.; depth of flutes of roller 1, 0.207 m.m.; the included angle between flanks of flutes is 90°.

It is desirable to set the intermeshing relationship of the rollers 1 and 2, so that the paper is gripped to the same degree between the points 10—11, as between the points 12—13, and to achieve this it is necessary for the axes of the rollers to be parallel to each other, and for the fluted surfaces to run true. It is also necessary for the ribs of the impression roller 2 to be located centrally in the flutes of roller 1. Endwise movement of both rollers and angular backlash between them must be eliminated.

In order to achieve the above-mentioned requirements, a positive gear drive is provided between the two rollers 1 and 2 and provision made to eliminate backlash between these gears.

A convenient way to eliminate backlash is to provide a split gear on one of the two rollers. The split gear comprises two gears of half the normal thickness, each with identical gear teeth. These gears are secured to a boss on the roller shaft by means of three bolts securing the two half gears together and to the boss. The bolts pass through similar arcuate slots around the centres of the two half gears so that one half gear may be turned clockwise to take up any slack, and the other half gear may be turned counter-clockwise to take up any slack in the opposite direction, then the bolts are tightened. This of course has the effect of increasing the pitch line width of the teeth.

To apply the above to the fluted rollers hereinbefore referred to, the two rollers are set up with flutes and ribs engaging, and free from end play, then with the split gear loose on its boss, a strip of cigarette paper web is turned by hand into the nip between the rollers to centralize the flutes and ribs. Then the gears are turned clockwise and counter-clockwise as above explained to take up any slack in the gear teeth and the bolts are tightened.

Means are preferably provided for enabling the distance between the centres of the axes of rollers 1 and 2, to be capable of increasing, so that in the event of the paper breaking and rolling onto one or other of the rollers, the said axes may move apart. Thus the axes of the rollers 1, 2 may be spring urged together against limiting stops. By this arrangement the degree of intermeshing of the rollers may be controlled before adjusting the angular relationship of the two part gears to eliminate backlash, and the rollers may be resiliently moved apart as above described.

Most cigarette papers are about .0015" thick (0.0381 m.m.) and it is considered advisable to set the rollers so as to compress the paper to about two-thirds of its original thickness at the surfaces 9. When the rollers are thus set 0.0254 m.m. apart at the surfaces 9 and, as previously mentioned, the included angle between the flanks of the flutes is 90°, the distance between the ribs at the surfaces 7 and 8 will be 0.0254 Sin 45°. Therefore the grip and hence compression of the paper is tighter between the latter surfaces than between the former. This has been found quite satisfactory.

If, however, it is desired to grip the paper

evenly at the surfaces 7, 8, 9, the impression roller pattern may be cut by conventional methods to such dimensions as to produce equal clearances between these surfaces when the rollers 1 and 2 are intermeshing to the fullest desirable extent. The clearance 6 would still be maintained if desired.

Consider now what happens when a paper web of thickness say .038 m.m. is passed through flute forming rollers adjusted in relationship to each other so that the distance between the surfaces at 9 is 0.0254 m.m. Stretching occurs over the whole width of the paper web and there is a consequent tendency for the air permeability of the paper to increase, particularly if there are any imperfections (e.g. pinholes) in the paper as manufactured. Compression however occurs where the paper is gripped at surfaces 7, 8 and 9 and, since compression reduces the air permeability of the paper and the compression occurs over a greater effective width of the web than the uncompressed width, any increase in air permeability at the latter width (between the points 11—12) is offset by the reduction in air permeability in the compressed width.

The explanation of the compression of paper is believed to be as follows:—

Cigarette paper is a heterogeneous structure on a microscale consisting of short cellulose fibres and filler (chiefly calcium-carbonate) held together by the clinging together of the fibres and the packing of the particles of the filler, and the structure as such contains a large proportion (up to 60%) of air.

When this structure is compressed as hereinbefore mentioned, the fibres and filler particles are packed more tightly together, thus reducing the air spaces so that air can no longer pass through, or at any rate pass through less freely, and consequently the paper becomes less air permeable where compression occurs. Thus, to explain the position according to the present invention simply, a slight increase in permeability may remain in the widths between points 11—12 (rib surfaces 32) but this increase is more than offset by the considerable reduction due to compression over the remainder of the width of the paper, so that a paper web fluted in accordance with the present invention is less air permeable than as manufactured.

Paper fluted as hereinbefore described is stiffer than as manufactured in that it has an increased resistance to bending about a line at right-angles to the flutes. Consequently, a cigarette made from such paper, especially from spirally fluted paper having an angle of the order indicated in Figs. 1, 3, 6 and 8, is stiffer than a corresponding cigarette made from the same paper before being fluted. Also, it is found in practice that there is an effective increase in width of the web, thus on one example a paper web 27.5 m.m. as manufactured increased in effective width by from 0.25 m.m. to 0.5 m.m. when fluted thus making possible a saving in the consumption of paper.

The increase in effective width may result from the residual resiliency of the paper after fluting is complete causing an increase in width as the flutes tend to flatten out when the paper is released from the rollers.

Although the above discussion with respect to Fig. 5 described typical measurements and a typical degree of stretching, it is to be understood that the invention is not to be limited thereto, since different pitches and sizes of flutes may be used, and different papers react in different manners.

In practice a decision is first made as to the desired depth and pitch of the paper flutes, this being dependent to an extent on the stretchability and other characteristics of the paper web as manufactured, and then the depth of the roller flutes is determined accordingly.

The hereinbefore described fluted paper may conveniently be formed when the cigarette paper web is passing towards the rod forming mechanism in a cigarette making machine of the continuous rod type.

Before reaching the forming mechanism it is customary to pass the paper through a printing unit and co-operating fluted rollers in accordance with the present invention may conveniently be located, say, just prior to said printing unit.

The cigarette rod (i.e. tobacco with ensleeving web) is formed with one edge of the paper overlapping the other with an adhesive in between, the overlap being uppermost. This overlap then passes beneath a heater bar to dry the adhesive and seal the joint.

It is desirable that the flutes at the edge of the overlap shall pass beneath the heater bar in a trailing direction, so that the ribs are not rubbed up by friction against the heater bar.

The arrows A in Figs. 1, 6 and 8 indicate the direction of travel of the cigarette rod beneath the heater bar so as to fulfil the desired trailing direction referred to. The fluting rollers should be designed accordingly.

Figs. 6 to 9 require little explanation since they illustrate only different types of mouthpiece cigarettes and differences in the flutes.

Thus, referring to Figs. 6 and 7. These illustrate a mouthpiece cigarette made by joining a stub 16 to an all-tobacco cigarette by means of an encircling band of plain paper 17. The helix angle of the flutes shown in Fig. 6 is less than those previously described with the result that no flute will extend for the entire length of the all-tobacco cigarette portion.

Fig. 8 and 9 show a mouthpiece cigarette

made on the continuous rod principle, in which the stub 16 is butted against the tobacco portion and the whole is ensleeved with a fluted paper web.

It should be appreciated that neither the helix angle of the flutes on the cigarette nor the pitch between them can be chosen indiscriminately. These two factors are interdependent, and are governed by a third factor, the diameter of the roller 1, which dimension itself is governed largely by the limitations of the gearing employed to drive the roller on the cigarette machine.

The following explains how a suitable fluted roller is designed, and Fig. 10 is drawn to illustrate the interdependence of various factors that must be considered when constructing a roller. Thus the helix angle of the flutes on the roller and the number and pitch of flutes thereon determine the diameter for the roller. In this drawing the impression roller 2 has been omitted. Thus in that figure, 1 is a fluted metal roller, 18 is a cigarette paper web, 19 is a formed cigarette rod having a steam comprising an inner lap 20 and an outer lap 21. The arrow B shows the direction of movement of the cigarette paper web and the arrow C the direction of rotation of the metal roller 1.

A right angled triangle PQR has been superimposed on the roller 1 and it will be appreciated that the side PQ equals the pitch of the flutes or ribs on the paper and the roller, PR equals the circumferential pitch of the flutes or ribs on the roller, the angle R is the helix angle of the flutes or ribs on the roller and is also the angle subtended between the flutes or ribs on the cigarette paper, in its flat condition, and its edge. When however the paper web is formed into a cylinder, as at 19, the helix angle of the flutes along the cylindrical surface (with respect to a circumference thereof) will be the complement of the angle R, in other words it is equal to the angle P.

Having decided on the pitch PQ of flutes or ribs it is desired to produce on the cigarettes 19, the helix angle R possible for the flutes on the roller 1 will be limited to such an angle or angles as will produce exact numbers of circumferential pitches PR between flutes on the roller.

Alternatively, if a desired helix angle P for the flutes or ribs on the cigarette 19 has been chosen, then the pitch PQ of such flutes will be limited to a dimension that will likewise produce an exact number of circumferential pitches PR between the flutes on the roller.

It follows from the above that when the helix angle of the flutes on the roller is R, that of the flutes on the cigarettes (P) is $90° - R$; conversely, when the helix angle of the flutes on the cigarette is P, that of the flutes on the roller R is $90° - P$.

The following equation indicates the relationship between various measurements that govern the formation of the flutes; using the data given above.

$$\frac{PQ}{PR} = \text{Sin } R$$

$$PR = \frac{PQ}{\text{Sin } R}$$

$$PR = \frac{PQ}{\text{Sin } 90° = P}$$

and PR must be a dimension divisible into the circumference of the roller on exact number of times.

It will be appreciated that the passage of the cigarette paper web through the co-operating rollers as above described may result in lengthwise variations in the web. Consequently provision is preferably made to compensate for such variations by conventional means. For example the co-operating rollers may be driven through a variable speed mechanism such that if the paper tends to lengthen, the speed of the drive is automatically decreased and vice versa.

Conventional means for varying the speed involves a loop in the cigarette paper web after fluting, and a sensing device operable by the changing length of the loop to increase or decrease the speed of the co-operating rollers.

In the invention as hereinbefore described, the impression roller was produced by running a metal roller in contact with a roller of thermoplastic material. Clearly, however, both rollers may be of metal produced by precision engineering methods.

The apparatus described and claimed refers to the use of metal rollers and these conveniently may be manufactured from hardened cast steel. It is to be understood however that any other suitable metal may be used provided it is sufficiently hard, for example glass or ceramic material.

WHAT WE CLAIM IS:—

1. A method of impressing flutes in a cigarette paper web wherein the web is passed between rollers, the surfaces of which comprise a plurality of co-operating flutes and ribs such as to stretch the web laterally and impress corresponding longitudinally extending flutes and ribs in the paper, the pattern of the rollers being such that some compression of the paper takes place at least at the flanks of the flutes so as to offset any additional air permeability that results from the stretching, and wherein the flutes of one roller are centrally disposed with respect to

the corresponding ribs of the other roller so as to render said compression uniform.

2. A method as claimed in claim 1 wherein the pattern of the rollers is such that the paper is compressed on the flanks of the flutes and at the top of successive ribs of one roller.

3. A method as claimed in claim 1 or claim 2 in which the flutes are impressed so as to extend continuously along the cigarette paper web without interruption.

4. A method as claimed in claim 1 or claim 2 in which the flutes are interrupted so as to impress patterns of flute-free areas on the cigarette paper web.

5. A method as claimed in any one of claims 1 to 4 in which the flutes are impressed parallel to the edges of the cigarette paper web.

6. A method as claimed in any one of claims 1 to 4 in which the flutes are impressed so that they are at an angle to the edges of the cigarette paper web and so appear spirally on a finished cigarette.

7. An all-tobacco cigarette or a mouthpiece cigarette of which the paper web that provides the fibrous sleeve is fluted by the method claimed in any one of claims 1 to 6.

8. Apparatus for impressing flutes in a cigarette paper web comprising a metal roller having flutes extending around its periphery, an impression roller having co-operating ribs around its periphery, means for rotating each roller in axial alignment with the other, means for aligning the flutes of one roller centrally disposed with respect to the corresponding ribs of the other roller, and means for feeding a cigarette paper web to the nip between the two rollers and for receiving the fluted paper after it has passed between the two rollers.

9. Apparatus as claimed in claim 8 comprising a plain surfaced thermoplastic impression roller run under pressure and in contact with a fluted metal roller, while the latter is heated, for a sufficient length of time to produce corresponding flutes on the impression roller but such as not to conform to the whole depth of the metal roller flutes, thereby leaving a clearance between the ribs of the impression roller and the flutes of the metal roller.

10. Apparatus as claimed in claim 8, comprising a plain surfaced thermoplastic impression roller run under pressure and in contact with a fluted metal roller while the latter is heated for a sufficient length of time to produce corresponding flutes on the impression roller that conform to the whole depth of the ribs of said metal roller, thereby leaving no clearance between the ribs and flutes of the rollers.

11. Apparatus as claimed in Claim 8 comprising an impression roller having co-operating ribs around its periphery made from metal.

12. Apparatus as claimed in claim 11 in which the ribs of one roller do not conform to the whole depth of the flutes on the other roller thereby leaving a clearance between the ribs of one roller and the flutes of the other.

13. Apparatus as claimed in claim 11 in which the ribs of one roller conform to the whole depth of the flutes on the other roller thereby leaving no clearance between the ribs and flutes of the two rollers.

14. Apparatus as claimed in any one of claims 8 to 13 in which the means for aligning the flutes of one roller centrally disposed with respect to the corresponding ribs of the other roller comprises a gear on one roller axle intermeshing with a split gear mounted on the other roller axle, whereby said split gears may be turned clockwise and counterclockwise respectively to take up slack in both directions before being locked to said axle.

15. Apparatus for impressing flutes in a cigarette paper web as claimed in any one of claims 8 to 14 mounted in a cigarette making machine of the continuous rod type in such a manner that the paper web is impressed with flutes during its passage through the machine towards the forming mechanism.

16. Apparatus for impressing flutes in a cigarette paper web as claimed in claim 15 mounted in association with the printing mechanism whereby the paper is printed after being impressed.

17. The method of impressing flutes in a cigarette paper web substantially as hereinbefore described with reference to Fig. 4, 5 and 10 of the drawings.

18. Apparatus for impressing flutes in a cigarette paper web constructed and operating substantially as hereinbefore described with reference to Figs. 5 and 10 of the drawings.

19. Cigarettes ensleeved in fluted cigarette paper substantially as hereinbefore described with reference to Figs. 1 and 2 or 3 and 4 or 6 and 7 or 8 and 9 of the drawings.

For the Imperial Tobacco Company (of Great Britain and Ireland), Limited.
H. S. HURST.

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