A method and apparatus for manufacturing a filter for a smoking article. Embodiments of the invention relate to a method and an apparatus for manufacturing a filter for a smoking article, and a smoking article produced by the method. The method can include forming a filter section having a surface relief pattern with a filter forming device, transferring the filter section to a filter wrapping device with a filter transfer device and wrapping a sheet material around the filter section with the filter wrapping device.
A method and an apparatus for manufacturing a filter for a smoking article

Technical Field

Embodiments of the invention relate to a method and an apparatus for manufacturing a filter for a smoking article, and a smoking article produced by the method.

Background

Filters for cigarettes can be compressed to give a shape to the outer surface. A filter may be compressed to form grooves in the outer surface thereof. In some examples, a grooved filter may provide a flow of ventilated air. In other examples, a grooved filter may provide an enhanced tactile experience.

Summary

According to embodiments of the invention, there is provided, in a first aspect, a method of manufacturing a filter for a smoking article, comprising forming a filter section having a surface relief pattern with a filter forming device, transferring the filter section having the surface relief pattern to a filter wrapping device, using a filter transfer device, and wrapping a sheet material around the filter section having the surface relief pattern with the filter wrapping device.

The filter section can be transferred automatically from the filter forming device to the filter wrapping device by the filter transfer device, in a continuous assembly process.

Wrapping the sheet material around the filter section having the surface relief pattern can take place before the surface relief pattern is substantially lost by elastic expansion of the filter section. The time between forming the filter section having a surface relief pattern and wrapping the sheet material around the filter section can be less than 2 minutes, less than 1 minute, less than 30 seconds, less than 20 seconds, less than 10 seconds, less than 2 seconds or less than 1 second.

Forming the filter section can comprise forming a cylinder of filtration material having the surface relief pattern and dividing the cylinder of filtration material to form a plurality of filter sections.
Forming the filter section can comprise forming a cylinder of filtration material and shaping the cylinder of filtration material to have the surface relief pattern.

Forming the cylinder of filtration material can comprise passing filtration material through at least one tapering guide.

Shaping the cylinder of filtration material can comprise passing the cylinder of filtration material through at least one shaping device.

The cylinder of filtration material can be shaped by wrapping with a plug wrap having one or more weakened sections.

The surface relief pattern can comprises a plurality of grooves extending in a longitudinal direction along said filter section.

Wrapping a sheet material around the filter section can comprise affixing a blank of sheet material to the filter section and rolling the filter section such that the blank is wrapped around the filter section.

The method can further comprise attaching the blank to a plurality filter sections.

The method can further comprise attaching the blank to at least one tobacco rod.

Transferring the filter section can comprise translating linear movement of the filter section into rotational movement. Transferring the filter section can comprise translating linear movement of the filter section in the direction of a first axis into rotational movement about a second axis parallel to the first axis. The filter section can be held parallel to the first axis by the filter transfer device.

According to embodiments of the invention, there is provided, in a second aspect, an apparatus for manufacturing a filter for a smoking article, comprising a filter forming device for forming a filter section having a surface relief pattern, a filter wrapping device for wrapping a sheet material around the filter section having the surface relief pattern, and a filter transfer device arranged to transfer the filter section having the surface relief pattern from the filter forming device to the filter wrapping device.
The filter transfer device can be arranged to transfer the filter section automatically from the filter forming device to the filter wrapping device in a continuous assembly process.

The apparatus can be configured to operate such that wrapping the sheet material around the filter section having the surface relief pattern takes place before the surface relief pattern is substantially lost by elastic expansion of the filter section.

The apparatus can be configured to operate such that the time between forming the filter section having a surface relief pattern and wrapping the sheet material around the filter section is less than 2 minutes, less than 1 minute, less than 30 seconds, less than 20 seconds, less than 10 seconds, less than 2 seconds or less than 1 second.

The filter forming device can comprise a garniture for forming a cylinder of the filtration material.

The apparatus can further comprise a shaping device for shaping the cylinder of filtration material to have the surface relief pattern.

The filter forming device can comprise a garniture for forming a cylinder of the filtration material and the garniture can comprise a shaping garniture configured to impress the surface relief pattern onto a cylinder of filtration material passed through the garniture.

The shaping device can comprise a shaping plate configured to impress the surface relief pattern onto a cylinder of filtration material rolled over the plate.

The filter forming device can be configured to wrap a plug wrap having one or more weakened areas around the filter section.

The surface relief pattern can comprise a plurality of grooves extending in a longitudinal direction along said filter section.

The filter wrapping device can comprise a wrapping drum comprising at least one recess for holding the filter section, a feeder drum arranged to affix a blank of sheet
material to the filter section, and a rolling element arranged to roll the filter section such that the blank is wrapped around the filter section.

The filter wrapping device can comprise a filter combining machine, wherein the recess of the wrapping drum is arranged to hold a plurality of filter sections, and the feeder drum is arranged to affix the blank of sheet material to the plurality of filter sections.

The filter wrapping device can comprise a cigarette making machine wherein the recess of the wrapping drum is arranged to hold one or more tobacco rods and the feeder drum is arranged to affix the blank of sheet material to the one or more filter sections and the one or more tobacco sections held by the recess.

The filter transfer device can be arranged to translate linear movement of the filter section into rotational movement. For instance, the filter transfer device can be arranged to translate linear movement of the filter section in the direction of a first axis into rotational movement about a second axis parallel to the first axis.

The filter transfer device can comprise a plurality of receptacles arranged to receive one or more filter sections, wherein the receptacles hold the one or more filter sections parallel to the first axis.

According to embodiments of the invention, there is provided, in a third aspect, a smoking article filter produced by the method set out above.

According to embodiments of the invention, there is provided, in a fourth aspect, a smoking article including a smoking article filter as set out above.

**Brief Description of the Drawings**

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a smoking article having filter with a surface relief pattern of grooves channelling a flow of ventilating air;

Figure 2 is a schematic illustration of an apparatus for manufacturing a smoking article, the apparatus including a filter forming device, a filter transfer device and a filter wrapping device;

Figure 3 is a schematic illustration of the filter forming device of Figure 2;
Figure 4 is a perspective illustration of inner wrapping material for use by the filter forming device of Figure 3; Figure 5 is a perspective view of the filter transfer device of Figure 2; Figure 6 is flow diagram illustrating a method of manufacturing a smoking article; and Figure 7 is a perspective illustration of a smoking article having an indexing mechanism formed by ridges in a filter section.

**Detailed Description**

As used herein, the term "smoking article" includes smokeable products such as cigarettes, cigars and cigarillos whether based on tobacco, tobacco derivatives, expanded tobacco, reconstituted tobacco or tobacco substitutes, also heat-not-burn products and nicotine delivery devices such as electronic cigarettes. The smoking article may be provided with a filter for the gaseous flow drawn by the smoker.

A smoking article formed by the apparatus or method described herein can comprise an elongate source of smokable material. In particular, the smokable material can be tobacco arranged in a cylindrical tobacco rod. One or more filters or filter sections can be attached to the tobacco rod. The filter or filter sections define a longitudinal axis, which is common to a longitudinal axis of the tobacco rod.

Figure 1 illustrates a first exemplary smoking article 10, which may be manufactured using the apparatus or method described herein. The smoking article has a filter with a surface relief pattern of grooves channelling a flow of ventilating air. This smoking article 10 is illustrated by example only, and the apparatus and method may be used in the manufacture of different types of smoking article.

The smoking article 10 comprises a first part comprising a source of smokable material. In this example, the smokable material is tobacco, in the form of a tobacco rod 20. The smoking article further comprises a filter section 30 attached to the source of smokable material. The tobacco rod 20 and filter section 30 may be connected with a covering layer 40 to affix the filter section 30 to the tobacco rod 20, for example formed of a sheet material, e.g. tipping paper.

The filter section 30 has a plurality of depressions 32 which form a surface relief pattern on an outer surface thereof. In particular, the filter section 30 has an outer surface which is not smooth, comprising a plurality of elongate grooves 32, separated
by ridges 33, which extend, in the present example, substantially longitudinally along the length of the filter section 30. The plurality of ridges 33 and grooves 32 may define a sinuous outer surface, which smoothly oscillates in radius. The ridge 33 between adjacent depressions 32 may have a curved profile with a substantially uniform radius of curvature. Alternatively, the grooves 32 may be formed as flutes, having a concave profile. The ridge 33 between adjacent depressions 32 may have a pointed, creased, or tapering profile, having a substantially sharp point of maximum radius.

The filter section 30 may be made of filtration material(s) 34, including but not limited to cellulose acetate tow. The filter section 30 further comprises one or more sheets of inner wrapping material 35, for example paper, e.g. plugwrap, which is wrapped around the filtration material 34. The paper 35 extends around the curved sides of the filter section 30. The paper 35 forms, or supports, a continuous outer surface defining the grooves 32 and ridges 33 of the filter section 30. The paper 35 is deformed to form the grooves 32 and ridges 33, as will be described in greater detail below.

The filter section 30 is wrapped with a sheet of outer wrapping material 40, e.g. tipping paper. The outer wrapping material 40 may be affixed to the filter section 30 by an area of adhesive on an inner surface thereof. The outer wrapping material 40 is wrapped around the circumference of the filter section 30 and adhered at a region where parts of the material 40 overlap, forming a cylinder of material 40 substantially covering the filter section 30.

The outer wrapping material 40 comprises one or more ventilation areas 41, which may include ventilation apertures and/or air permeable material. The grooves 32 of the filter section 30 form a plurality of ventilation pathways, which connect the ventilation areas 41 to a mouth end of the smoking article 10. Ventilating air can pass through the ventilating areas 41, into the ventilation pathways formed by the grooves 32, and to the mouth end of the smoking article 10.

An apparatus and a method in accordance with embodiments of the invention for producing a filter having a relief pattern on an outer surface thereof, will be described with reference to Figures 2 to 6.

Referring to Figure 2, an apparatus for manufacturing a filter for a smoking article includes a filter forming device 100 arranged to form a filter section having a surface
relief pattern, a filter wrapping device 300 for wrapping a sheet material around the
filter section and a filter transfer device 200 arranged to transfer the filter section from
the filter forming device 100 to the filter wrapping device 300.
A continuous filter assembly line is provided in the illustrated example. Filter sections
are accordingly transferred mechanically from the filter forming device 100 to the filter
transfer device 200 and from the filter transfer device 200 to the filter wrapping device
300. According to the illustrated example, the continuous filter assembly line does not
require a hopper to hold a plurality of filter sections for collection by the filter wrapping
device 300. For instance, neither the filter forming device 100, filter transfer device
200 nor the filter wrapping device 300 requires a hopper.

Referring to Figure 3, the filter forming device 100 comprises a garniture 110 and a
guide funnel 120, which can comprise a stuffer jet. The garniture 110 is a passage in the
form of a duct of tube, having a wide entrance opening 111 and a narrow exit opening
114. The garniture narrows in a first 'tow guide' or 'garniture tongue' portion 112,
extending from the wide entrance opening 111. A second section 113 of the garniture,
extending between the tow guide portion 112 and the narrow exit opening 114, is
substantially constant in cross-section along its length. Alternatively, the second section
113 may continue to taper but more gently than the tow guide portion 112.

The garniture 110 is generally circular in cross-section. A continuous garniture belt 130
extends through the garniture 110 and over a plurality of guide rollers 131 and is driven
to be conveyed around the rollers 131 in the direction shown by the arrows A. Loose
filter tow material, such as loose cellulose acetate fibre, is fed into the funnel 120 and is
guided into the tow guide portion 112 of the garniture 110. The filter tow material is
conveyed through the tapering tow guide portion 112 on the plug wrap so that the loose
filter tow material is formed into a more compacted rod as it emerges from the narrow
end of the garniture 114.

The length of the garniture 110 defines a first longitudinal axis of the filter forming
device 100, along which the filter tow material is conveyed by the garniture belt 130.
The compacted filter rod extends along the first longitudinal axis of the filter forming
device 100, and exits the filter forming device 100 moving in a linear fashion along the
first longitudinal axis.
In some embodiments, a plug wrap is fed from a spool 140 onto the upper surface of the garniture belt 130 and is conveyed through the garniture 110 by the moving garniture belt 130. As the plug wrap travels through the garniture 110 the shape of the tapered tow guide 112 deforms the garniture belt 130 and plug wrap thereon such that, in cross-section, the plug wrap goes from being flat (as it is on the spool 140) when it enters the wide entrance opening 111 of the garniture 110, to a closed circle as it leaves the narrow exit opening 114 of the garniture 110, completely surrounding the formed filter rod.

As the plug wrap is wrapped around the filtration material, the edges meet to form a seam at an upper portion of the garniture 110. This seam may then be glued or, alternatively, the plug wrap may be pre-glued where the seam is to be formed. A section of the upper portion of the garniture 110 may comprise a heating bar to heat and activate the glue at the seam of the plugwrap to adhere the plugwrap in place around the filtration material. Alternatively, hot melt glue is applied to the plug wrap and a cooling bar may be present in place of a heating bar.

As the filter tow material travels through the garniture 110 and is compressed, the plug wrap is folded around the outside of the compressed cylinder of filter tow material and glue is applied to the over-lapping seam and heated to activate the glue, such that when the filter tow material exits through the narrow exit opening 114 of the garniture 110, the filter tow material is formed into a compressed cylindrical filter rod enveloped by an outer plug wrap.

In an alternative embodiment, the filter rod may be formed in the garniture 110 without a plug wrap, and the plug wrap may be subsequently wrapped around the formed filter rod once it has exited the garniture 110, or the filter rod may be provided as a non-wrapped acetate (NWA) rod.

A shaping device (not shown) associated with the filter forming device 100 is used to form a filter rod having a surface relief pattern. In some embodiments, the shaping device is formed as an integral part of the first garniture 110 or, alternatively, may comprise a second shaping garniture in series with the first garniture 110. The inner wall of the garniture may be provided with a plurality of ribs projecting inwardly and extending longitudinally towards the narrow exit opening of the garniture. As the filter tow material travels through the garniture, the ribs on the inner surface of the garniture wall, which may be heated, impress a grooved pattern on the outer surface of the filter rod.
rod so that when the filter rod exits through the narrow exit opening of the garniture, it has a series of longitudinal grooves formed around its outer surface. It will be appreciated that in this embodiment, the garniture belt is sufficiently thin and flexible that the grooved shape can be effectively imparted onto the filter rod by the ribs through the thickness of the garniture belt.

In another example of the shaping device the garniture belt may comprise one or more protrusions, for instance integrally formed with the garniture belt or provided as a coating or material, formed on one side which is set thereon with the desired surface relief pattern. The protrusions are sufficiently flexible to enable the garniture belt to deform into a rolled up state and may have heat applied thereto to impress the surface relief pattern on the filter rod. Alternatively, the garniture belt may comprise a plurality of linked plates configured to deform from a flat state to a rolled up state in which they are rolled up about their longitudinal axis. As the garniture belt enters and is conveyed through the tow guide portion, the garniture belt is deformed from its flat state to its rolled up state. As the garniture belt reaches the narrow end of the garniture, the garniture belt forms a closed circle in cross-section and the loose filter tow material is formed in a compact rod circumscribed by the garniture belt.

In some examples, the shaping device is arranged to receive the compressed filter rod from the garniture no. The shaping device may comprise a plate provided with a plurality of projections for forming the desired surface relief pattern. The plate may comprise a plurality of longitudinally extending projections for forming grooves on an outer surface of the filter rod. The filter rod is rolled laterally across the plate such that a grooved pattern is impressed on the outer surface by the plurality of projections. The filter rod may be divided into a plurality of filter sections which are rolled across the plate of the shaping device. A second plate moves laterally across the plate, in a direction perpendicular to the longitudinal axis of the filter forming device loo. The filter sections are placed between the plates and rolled laterally over the plurality of projections to form the desired surface relief pattern. Reference is directed to WO 2010/115675, the content of which is hereby expressly incorporated by reference herein in its entirety, for further details of a suitable shaping device.

As the filter tow material travels through the shaping device, the desired surface relief pattern is impressed on the outer surface of the filter rod so that when the filter rod exits the shaping device, it has the desired surface relief pattern, e.g. in the present
examples a series of longitudinal grooves, formed around the entire perimeter of its outer surface.

In some embodiments, the shaping device is a garniture which forms the desired surface relief pattern by wrapping the compressed filtration material with a plug wrap. The surface relief pattern is, for instance, formed by embossing, crimping or otherwise weakening the plug wrap prior to wrapping around the filter rod. Compression of the filtration material can lead to recovery expansion upon exiting the garniture. The weakened areas of the plug wrap allow for a faster rate of expansion, such that a surface relief pattern is formed. Figure 4 illustrates a spool 140 supplying an exemplary plug wrap 150 having a plurality of weakened areas 151, formed in this examples as embossed sections. In some embodiments, the plug wrap 150 may be embossed with a plurality of parallel lines extending longitudinally. When wrapped around the compressed filtration rod, the embossed lines allow a faster rate of expansion and form a plurality of ridges on the outer surface of the filter rod, similar to the ridges illustrated in Figure 1.

In order for the surface relief pattern to remain set in the filter rod, a plasticiser can be mixed with the cellulose acetate fibres to set the fibres in the shape formed by the shaping device.

In some embodiments, as briefly described above, the shaping device may include a heating means which accelerates the reaction of the plasticiser. The heating means may, for instance, comprise inlet ducts along the length of the garniture through which steam can be injected. In order that the heat of the steam can be most efficiently applied to the cellulose acetate and plasticiser mix, the garniture belt may be porous to allow steam therethrough. Alternatively, the garniture may comprise one or more heating elements along its length, such that the heat required to activate and accelerate the reaction of the plasticiser and the cellulose acetate of the filtration material is provided directly by conduction from the heating element through the wall of the garniture.

The filter forming device 100 further comprises a cutting tool (not shown) which divides the continuous filter rod into a plurality of filter sections. The cutting tool comprises one or more blades located on the outer surface of a rotating cutting drum. The cutting drum rotates such that the blade passes through the continuous filter rod as
it moves past the cutting drum, and separates the filter rod into filter sections. Alternatively, the blade is located on a cutting bar lying perpendicular to the continuous filter rod, and is passed through the filter rod by reciprocal linear motion of the cutting bar. In some embodiments, the cutting tool may be positioned between the garniture and the shaping tool of the filter forming device 100.

The filter wrapping device 300, in the present example, is a cigarette maker comprising a wrapping drum configured to wrap a layer of sheet material, such as the outer wrapping material 40, around the filter section. The outer wrapping material 40 is also wrapped around a portion of a tobacco rod to connect the tobacco rod to the filter section. The wrapping drum comprises a plurality of recesses on an outer surface thereof each of which is arranged to receive at least one filter section, in alignment with a tobacco rod. A blank for forming the layer of tipping paper or other outer wrapping material is affixed to the filter section and tobacco rod whilst the one or more filter sections are held by the recesses of the wrapping drum. The blank is affixed to the filter section and tobacco rod at a first end of the blank such that the blank extends away from the filter section and tobacco rod when attached only at the first end of the blank.

A sheet material supply provides the outer wrapping material for the blank in a continuous length of material to a feeder drum, which holds the sheet material to an outer surface thereof by suction means. The feeder drum is rotated in an opposite sense to a sheet material cutter, comprising a plurality of blades spaced circumferentially around a rotational axis. The outer wrapping material is rotated such that it passes between the feeder drum and the sheet material cutter. The blades of the cutter are positioned to divide the outer wrapping material into a plurality of blanks for wrapping around a filter section.

Adhesive is applied to the outward facing surface of the blanks whilst they are held on the outer surface of the feeder drum. Alternatively, adhesive is pre-applied to the continuous supply of sheet material provided to the feeder drum. The feeder drum presents the blanks with adhesive applied to the plurality of filter sections at an interface between the feeder drum and the wrapping drum. The first end of the blank is aligned with at least one of the filter sections and pressure is applied between the feeder drum and the wrapping drum to activate the adhesive on the surface of the blank. The blank is affixed to at least one filter section and the combined filter section and blank continues to rotate on the outer surface of the wrapping drum.
The blank is wrapped around the section by rolling the filter section around the outer surface of the wrapping drum. A stationary rolling element is configured to cooperate with the wrapping drum to apply pressure to the filter section, thereby rolling the filter section between the wrapping drum and rolling element. In some embodiments, the rolling element may comprise a rolling drum rotating in an opposite sense to the wrapping drum. The differential in linear speed at the interface between the wrapping drum and the rolling drum causes rotation of the filter section and wraps the tipping paper to form a cylinder around the filter section.

The filter wrapping device may alternatively be a filter combining machine configured to wrap a blank around a plurality of filter sections. Two or more filter sections are held by each recess of a wrapping drum and a blank is affixed to the plurality of filter sections. Alternatively, the filter wrapping device may be configured to wrap a blank around individual filter sections.

The apparatus comprises a transfer device 200 which receives the plurality of filter sections from the filter forming device 100 and provides the plurality of filter sections to the filter wrapping device 300. The transfer device 200 translates linear movement of the filter sections into a rotational movement. The filter sections exit the filter forming device 100 in a direction parallel to the first longitudinal axis of the filter forming device 100, which defines the longitudinal axis along which the compressed filter rod extends. In some embodiments, the transfer device 200 translates linear movement of the filter sections along the first longitudinal axis of the filter forming device 100, into rotational movement around a second longitudinal axis substantially parallel to the first longitudinal axis, for supply to the filter wrapping device 300. The orientation of the filter sections is substantially unchanged by the transfer device 200, such that the longitudinal axis of each filter section remains substantially parallel to the first and second axes.

The transfer device 200 is arranged to receive the plurality of filter sections directly from the filter forming device 100. Filter sections are in this way transferred automatically from the filter forming device 100 to the transfer device 200. Similarly, the filter wrapping device 300 200 is arranged to receive the plurality of filter sections directly from the transfer device 200. Filter sections are in this way transferred automatically from the transfer device 200 to the filter wrapping device 300. As such,
the apparatus provides a continuous assembly line. Filter sections are transferred automatically and, according to examples described herein, mechanically, from the filter forming device 100 to the filter wrapping device 300. The apparatus does not require a hopper positioned between the filter forming device and the filter wrapping device in order to accumulate a plurality of filter sections for collection by the filter wrapping device.

Referring to Figure 5, the transfer device 200 comprises a plurality of receptacles 210 each configured to receive one or more filter sections in a linear direction and to provide rotational movement to the one or more filter sections. In some embodiments, each receptacle 210 receives one filter section. Alternatively, each receptacle 210 may receive two or more filter sections. The receptacles 210 are formed on a plurality of carrier arms 220, which are pivotably mounted on a rotating transfer support 230. The transfer support 230 rotates about an axis which is substantially perpendicular to the first longitudinal axis. The axis of rotation of the transfer support 230 is inclined with respect to the horizontal. Alternatively, the axis of rotation is substantially horizontal and the transfer support 230 rotates in a vertical plane.

The receptacle 210 holds the filter section by means of suction, which can be turned off such that the filter section is deposited. Alternatively, the filter section is held by means of a releasable clamp, or a trough which is tilted or overturned to deposit the filter section. The carrier arms 220 are pivotably mounted such that the filter sections carried by the plurality of receptacles 210 are held substantially parallel to the first longitudinal axis throughout the transfer motion.

In an alternative embodiment, the plurality of receptacles, rather than being formed on a plurality of carrier arms 220, are formed on an outer surface of a rotating collection drum. The collection drum rotates about a second axis parallel to the first longitudinal axis of the filter forming device 200. The receptacles are arranged to receive one or more filter sections moving longitudinally from the filter forming device 200. The receptacles are formed by a plurality of recesses on the outer surface of the collection drum. The recesses forming the receptacles may have a fluted profile, being wider at an end proximate to the filter forming device 200.

The collection drum, or other filter transfer devices described herein, may be formed as part of the filter forming device 100 or as part of the filter wrapping device 300.
some examples, the collection drum is arranged to receive the plurality of filter sections moving longitudinally from the garniture of the shaping device.

In some embodiments, the transfer device 200 further comprises a transfer drum 240 which rotates about a third axis parallel to the first longitudinal axis of the filter forming device 200. The transfer drum 240 comprises a plurality of recesses 241 formed in an outer surface thereof. The plurality of receptacles 210 deposit the filter sections into the recesses 241 of the transfer drum 240, wherein the filter sections are conveyed by rotational movement around the third axis of the transfer drum 240. The filter sections are held in the recesses 241 of the transfer drum 240 by suction means. Alternatively, the filter sections are held on the outer surface of the transfer drum 240 by an arrangement of pins.

The plurality of filter sections are passed from the transfer drum 240 to the wrapping drum of the filter wrapping device, wherein the plurality of tipping paper or other material blanks are affixed and rolled around the filter sections. In some embodiments, the blanks are affixed to the filter sections whilst they are held in the recesses 241 of the transfer drum 240, and the filter sections with blanks attached are passed to the wrapping drum, wherein the blanks are rolled around the filter sections by the rolling element. Alternatively, the blanks are affixed to the filter sections whilst they are held in the recesses 241 of the transfer drum 240, and the blanks are rolled around the filter sections by exerting pressure between the transfer drum 240 and the rolling element.

The transfer device 200 is configured to translate linear movement to rotational movement, such that the plurality of filter sections can be transferred directly from the filter forming device 100 to the filter wrapping device 300.

The outer wrapping material 40, e.g. tipping paper, wrapped around the filter section is suitable for holding the filtration material in a compressed form. The filtration material can, for instance, recover from the compression applied by the filter forming device to impress the surface relief pattern into the filter section, after the filter section exits the filter forming device 100. Heating means applied to the plasticiser and cellulose acetate may be insufficient to cause the filtration material to harden fast enough to stop recovery expansion of the filtration material. The plug wrap, if present, may have insufficient tensile strength to resist the recovery expansion of the filtration material.
The compression applied by the garniture no can lead to recovery expansion of the filtration material upon exiting the filter forming device 100. In addition, the further compression applied by shaping device can lead to recovery expansion of the filtration material upon exiting the filter forming device 100. In particular, the expansion of the filtration material may affect the surface relief applied to the outer surface of the filter section. The pattern, e.g. longitudinally extending grooves, applied to the outer surface of the filter section may be reduced in depth or removed completely by expansion of the filtration material.

The covering layer of sheet material applied to the compressed filter section can at least partially alleviate the problem recovery expansion of the filtration material, for instance substantially maintaining the filter section in a compressed form. By directly and automatically transferring the plurality of filter sections from the filter forming device to the filter wrapping device using the filter transfer device, the invention provides a method in which the filter section can be wrapped before recovery expansion of the filtration material can take place. For instance, wrapping the sheet material around the filter section having the surface relief pattern can take place before the surface relief pattern is substantially lost by elastic expansion of the filter section.

The compressed filter section has a first outer circumference upon exiting the filter forming device 100, defined by the largest features, e.g. the ridges, on the outer surface thereof. The first outer circumference of the filter section is equivalent to the circumference of the smallest circle which can be drawn around the filter cross-section. The filter wrapping device is configured to wrap the covering layer of tipping paper tightly around the filter section, and forms a cylinder with a circumference substantially the same as the first outer circumference. The tensile strength of the tipping paper restricts the filter section from expanding to have a circumference which is larger than the first outer circumference.

The compressed filter section has a first cross sectional area upon exiting the filter forming device 100. The tensile strength of the tipping paper restricts the filter section from expanding to have a cross sectional area which is larger or at least substantially larger than the first cross sectional area.

The process of elastic recovery of the filtration material is not instantaneous and happens gradually upon exit of the filter section from the filter forming device 100. The
The invention provides a method and apparatus for transferring the filter section from the filter forming device 100 to the filter wrapping device 300, such that the time for elastic recovery to occur is reduced and the extent of expansion of the filtration material is reduced. The time between forming a filter section having a surface relief pattern with the filter forming device and wrapping a sheet material around the filter section having the surface relief pattern with the filter wrapping device can be substantially minimised by the present invention. The time can, for instance, less than 2 minutes, 1 minute, 30 seconds, 20 seconds, 10 seconds, 2 seconds or 1 second.

The present invention therefore provides for an expedient transfer between the filter forming device 100 and the filter wrapping device 300 such that a covering layer of sheet material, e.g. tipping paper, can be wrapped around the filter section before elastic recovery of the filtration material takes place. An amount of time between compression of the filter section by the filter forming device and wrapping of the filter section with tipping paper by the filter wrapping device can be reduced and/or minimised. The invention therefore reduces and/or minimises the extent of recovery expansion of the filtration material which can occur in the plurality of filter sections.

Figure 6 is a schematic flow diagram showing an exemplary method of manufacture. At step S100 a filter section is formed with a filter forming device. The filter section is formed with a surface relief pattern on an outer surface. The filter section may be formed by forming a cylinder of filtration material, which may be shaped by a shaping device to have the surface relief pattern, and dividing the cylinder of filtration material to form a plurality of filter sections. Alternatively, the cylinder of filtration material may be divided into a plurality of filter sections, which are shaped by the shaping device.

The cylinder of filtration material is formed by passing filtration material through at least one garniture. The shaping device provides the surface relief pattern by passing the cylinder of filtration material through at least one garniture. Alternatively, the cylinder of filtration material may be wrapped with a plug wrap having one or more weakened areas. The weakened areas are formed by embossing, crimping or otherwise weakening the plug wrap prior to wrapping around the filter rod. The weakened areas of the plug wrap allow for a faster rate of expansion, such that the surface relief pattern is formed.
The surface relief pattern may comprise a plurality of longitudinally extending grooves.

At step S200 the filter section is transferred from the filter forming device to a filter wrapping device. The filter section is transferred using a filter transfer device. The filter transfer device, in one example, receives the filter section moving linearly along a longitudinal axis of the filter forming device. Transferring the filter section to the filter wrapping device comprises translating linear movement of the filter section into rotational movement. The transfer device is arranged to translate linear movement of the filter section along the longitudinal axis of the filter forming device into rotational movement about a second axis parallel to the longitudinal axis. The filter section is provided to the filter wrapping device moving rotationally about the second axis. The filter section is held parallel to the longitudinal axis of the filter forming device by the filter transfer device.

At step S300 the filter section is wrapped with a sheet material. The sheet material is wrapped around the filter section with the filter wrapping device. A blank of the sheet material is affixed to the filter section by the filter wrapping device. The blank may be attached to a plurality of filter sections. The blank may also be attached to one or more tobacco rods. The blank is wrapped around the filter section by rolling the filter section with the blank of sheet material attached.

Figure 7 shows a second exemplary smoking article 50, which may be manufactured using the apparatus or method described herein. The smoking article has an indexing mechanism formed by ridges in a filter section 30. This smoking article 50 is illustrated by example only, and the apparatus and method may be used in the manufacture of different types of smoking article.

Features other than those described hereinbelow are the same as those described with respect to Figure 1 and like numerals refer to like parts.

The smoking article 50 includes an outer wrapping material 40 at least a part of which is configured to be movable relative to the filter section 30. The filter section 30 is located adjacent to the tobacco rod 20, and the smoking article 50 also comprises a mouth end filter section 51 affixed to the outer wrapping material 40. In another embodiment, part of the outer wrapping material 40 affixed to the filter section 30 and
a part movable relative to the filter section 30 may be separably connected, e.g. by a perforated region of the sheet material 40.

The relative rotation between the outer wrapping material 40 and the filter section 30 can control a property of the smoking article 10, e.g. ventilation. The smoking article 50 comprises a control mechanism in the form of an indexing mechanism 52, configured to control rotation between the filter section 30 and outer wrapping material 40. The indexing mechanism 52 comprises an indexing feature 53 on the filter section which can be engaged by an engaging feature 54 on the outer wrapping material 40. The outer wrapping material 40 is rotatable relative to the filter section 30 into a plurality of pre-determined indexed rotational positions. The indexed positions are narrowly spaced, providing for incremental step-wise movement.

The indexing feature 53 is formed by the plurality of depressions forming a surface relief pattern on the outer surface of the filter section 30. In particular, the indexing feature 53 comprises a plurality of elongate grooves, separated by ridges, which extend substantially longitudinally. The ridge between adjacent depressions defines a point of maximum resistance to movement of the engaging feature 54 between the adjacent depressions. The ridge profile is configured to provide for a sound when the filter section 30 and covering layer 40 are rotated relative to each other, providing clear audible feedback.

The indexing grooves and ridges preferably extend around the whole circumference of the filter section 30, or alternatively, extend around only a part of the circumference of the filter section 30. The indexing grooves and ridges may extend over the whole length or only a part of the length of the filter section 30, and in the present example are illustrated as only extending over part of the length of the filter section 30.

The engaging feature 54 comprises one or more protrusions extending radially inwardly from the inner surface of the outer wrapping material 40. The protrusion is configured to engage in the grooves of the indexing feature 53 to control relative rotation of the outer wrapping material 40 and filter section 30. The protrusion is formed by a folded paper pawl affixed to the inner surface of the outer wrapping material 40. Alternatively, the protrusion may be formed by a dot of raised ink, dot of glue, by an indent, by an embossing, or by any other suitable means to engage with the indexing feature. The indexing feature 53 is resiliently deformable to allow the protruding feature 54 to
releasable engage therewith. Application of a rotational force above a threshold level causes resilient deformation of the indexing feature 53, providing for rotation to the next indexed position where the protruding feature 54 engages.

The continuous length of outer wrapping material provided by the sheet material supply may have a plurality of paper pawls affixed to an outward facing surface, which are arranged to form the engaging feature of the indexing mechanism 52. Alternatively, the outward facing surface of the outer wrapping material may comprise one or more protrusions formed by a dot of raised ink, dot of glue, by an indent, by an embossing, or by any other suitable means to engage with the indexing feature. The continuous length of outer wrapping material may further be provided with a pattern of perforations, forming a plurality of separably connected areas of outer wrapping material.

Rotation of the outer wrapping material 40 may be accompanied with an audible sound, e.g. a click, at each pre-determined position. The indexing mechanism 52 functions to resist rotation between the filter section 30 and the outer wrapping material 40, unless sufficient force is applied and the parts rotate to the next indexed position. The indexing mechanism 52 provides feedback to a user that the parts have been rotated, preferably in the form of touch in the indexing movement and/or sound as each indexing position is engaged.

An exemplary smoking article which may be manufactured by the method of the present invention can be found in WO 2012/123723 or WO 2013/024623, the contents of which are hereby expressly incorporated by reference herein in their entirety.

Filter section 30 is provided with improved surface relief on an outer surface thereof.

Any feature of any embodiment described herein can be used in combination with any other feature of any other embodiment described herein.

In order to address various issues and advance the art, the entirety of this disclosure shows by way of illustration various embodiments in which the claimed invention(s) may be practiced and provide for a superior method and apparatus for manufacturing a filter for a smoking article. The advantages and features of the disclosure are of a representative sample of embodiments only, and are not exhaustive and/or exclusive. They are presented only to assist in understanding and teach the claimed features. It is
to be understood that advantages, embodiments, examples, functions, features, structures, and/or other aspects of the disclosure are not to be considered limitations on the disclosure as defined by the claims or limitations on equivalents to the claims, and that other embodiments may be utilised and modifications may be made without departing from the scope and/or spirit of the disclosure. Various embodiments may suitably comprise, consist of, or consist essentially of, various combinations of the disclosed elements, components, features, parts, steps, means, etc. In addition, the disclosure includes other inventions not presently claimed, but which may be claimed in future.
Claims

1. A method of manufacturing a filter for a smoking article, comprising:
   forming a filter section having a surface relief pattern with a filter forming device;
   transferring the filter section having the surface relief pattern to a filter wrapping device, using a filter transfer device; and
   wrapping a sheet material around the filter section having the surface relief pattern with the filter wrapping device.

2. A method according to claim 1, wherein the filter section is transferred automatically from the filter forming device to the filter wrapping device by the filter transfer device, in a continuous assembly process.

3. A method according to claim 1 or 2, wherein wrapping the sheet material around the filter section having the surface relief pattern takes place before the surface relief pattern is substantially lost by elastic expansion of the filter section.

4. A method according to any preceding claim, wherein the time between forming the filter section having a surface relief pattern and wrapping the sheet material around the filter section is less than 2 minutes, less than 1 minute, less than 30 seconds, less than 20 seconds, less than 10 seconds, less than 2 seconds or less than 1 second.

5. A method according to claim 1, wherein forming the filter section comprises:
   forming a cylinder of filtration material; and
   shaping the cylinder of filtration material to have the surface relief pattern.

6. A method according to claim 5, wherein shaping the cylinder of filtration material comprises passing the cylinder of filtration material through at least one shaping device.

7. A method according to claim 5, wherein the cylinder of filtration material is shaped by wrapping with a plug wrap having one or more weakened sections.
8. A method according to any preceding claim, wherein the surface relief pattern comprises a plurality of grooves extending in a longitudinal direction along said filter section.

9. A method according to any preceding claim, wherein transferring the filter section comprises translating linear movement of the filter section into rotational movement.

10. An apparatus for manufacturing a filter for a smoking article, comprising:
    a filter forming device for forming a filter section having a surface relief pattern;
    a filter wrapping device for wrapping a sheet material around the filter section having the surface relief pattern; and
    a filter transfer device arranged to transfer the filter section having the surface relief pattern from the filter forming device to the filter wrapping device.

11. Apparatus according to claim 10, wherein the filter transfer device is arranged to transfer the filter section automatically from the filter forming device to the filter wrapping device in a continuous assembly process.

12. Apparatus according to claim 10 or 11, wherein the apparatus is configured to operate such that wrapping the sheet material around the filter section having the surface relief pattern takes place before the surface relief pattern is substantially lost by elastic expansion of the filter section.

13. Apparatus according to claim 10, 11 or 12, wherein the apparatus is configured to operate such that the time between forming the filter section having a surface relief pattern and wrapping the sheet material around the filter section is less than 2 minutes, less than 1 minute, less than 30 seconds, less than 20 seconds, less than 10 seconds, less than 2 seconds or less than 1 second.

14. Apparatus according to any one of claims 10 to 13, further comprising a shaping device for shaping the cylinder of filtration material to have the surface relief pattern.

15. Apparatus according to claim 14, wherein the filter forming device comprises a garniture for forming a cylinder of the filtration material and the garniture comprises a
shaping garniture configured to impress the surface relief pattern onto a cylinder of filtration material passed through the garniture.

16. Apparatus according to any one of claims 10 to 13, wherein the filter forming device is configured to wrap a plug wrap having one or more weakened areas around the filter section.

17. Apparatus according to any one of claims 10 to 16, wherein the surface relief pattern comprises a plurality of grooves extending in a longitudinal direction along said filter section.

18. Apparatus according to any one of claims 10 to 17, wherein the filter transfer device is arranged to translate linear movement of the filter section into rotational movement.

19. A smoking article filter produced by the method of any one of claims 1 to 9.

20. A smoking article including a smoking article filter according to claim 19.
FIG. 1

FIG. 2

Filter Forming Device

Filter Transfer Device

Filter Wrapping Device
Start

Form a filter section with a filter forming device

Transfer to a filter wrapping device with a filter transfer device

Wrap a sheet material around the filter section with the filter wrapping device

Finish

FIG. 7

FIG. 8
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. A24D3/Q2
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A24D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>X</td>
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<td></td>
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<tr>
<td>X</td>
<td>EP 0 476 969 AI (PHILIP MORRIS [US]) 25 March 1992 (1992-03-25)</td>
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</tr>
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<td>the whole document</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>EP 0 151 732 AI (REEMTSMA H F &amp; PH [DE]) 21 August 1985 (1985-08-21)</td>
<td>1, 2, 5, 6, 8, 10, 11, 14, 17, 19, 20</td>
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<tr>
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<td>the whole document</td>
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:

"" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search: 12 November 2014

Date of mailing of the international search report: 20/11/2014

Name and mailing address of the ISA/Authorized officer:

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Tel.: (+31-70) 340-2040,
Fax: (+31-70) 340-3016

MacCormick, Duncan
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<tr>
<td>X</td>
<td>GB 2 102 271 A (Fi LTRONA LTD [GB]) 2 February 1983 (1983-02-02)</td>
<td>1, 2, 5, 6, 8, 10, 11, 14, 17, 19, 20</td>
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<tr>
<td>X</td>
<td>US 4 488 563 A (MORI FUJI KAZUHI KO [JP] ET AL) 18 December 1984 (1984-12-18)</td>
<td>1, 2, 5, 6, 8, 10, 11, 14, 17, 19, 20</td>
</tr>
<tr>
<td>X</td>
<td>WO 2007/135414 A1 (Fi LTRONA INT LTD [GB] ; CLARKE PAUL [GB] ; STEVENSON BARRY [GB]) 29 November 2007 (2007-11-29)</td>
<td>1, 2, 5, 6, 8, 10, 11, 14, 17, 19, 20</td>
</tr>
<tr>
<td>X</td>
<td>WO 01/30183 A1 (MITSUBISHI RAYON CO [JP] ; JAPAN FILTER TECHNOLOGY LTD [JP] ; SATO NOBUO) 3 May 2001 (2001-05-03)</td>
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<td>GB 2102271 A</td>
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<td>US 4488563 A</td>
<td>18-12-1984</td>
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<td>TW 200806205 A</td>
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<td>WO 2007135414 Al</td>
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<td>WO 0130183 Al</td>
<td>03-05-2001</td>
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<td>JP 2001120249 A</td>
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<td>WO 9524520 A1</td>
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