

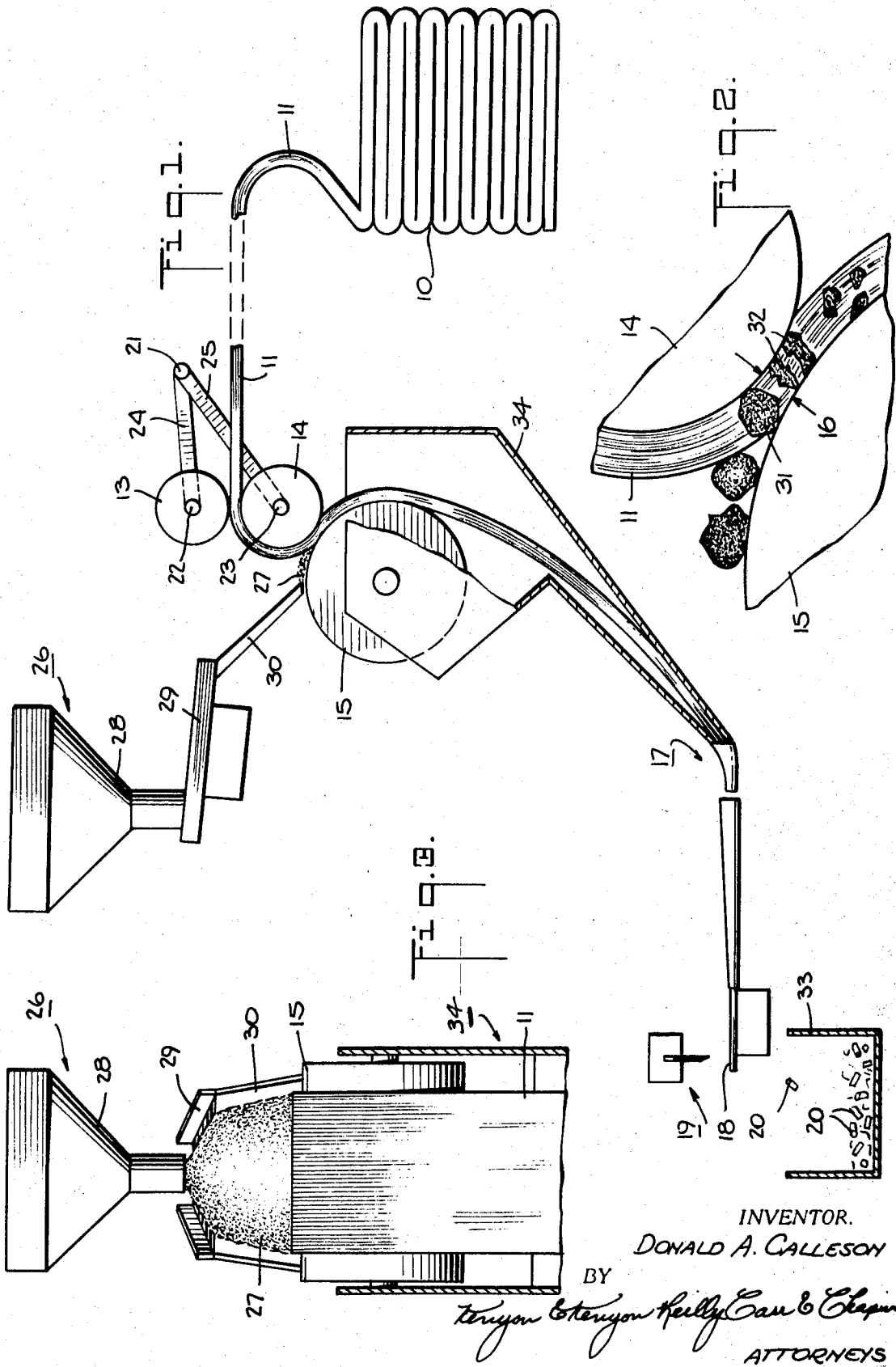
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METHOD AND APPARATUS FOR IMPREGNATING FIBROUS FILTER MATERIAL

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METHOD AND APPARATUS FOR IMPREGNATING FIBROUS FILTER MATERIAL

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ABSTRACT OF THE DISCLOSURE

The filter material is deposited onto the rotating delivery roller prior to entry of the travelling web of tow between the nip of the driven roller and idler roller so that the filter material is forced into the web upon passing through the nip. The embedding of the filter material into the web in the nip serves to distribute the material more uniformly through the cross-section of the tow before the tow is gathered together and formed into a rod.

This invention relates to an apparatus and method for impregnating a web of fibrous filter material. More particularly, this invention relates to an apparatus and method for impregnating granulated filter material into a travelling web of fibrous filter material.

Heretofore, it has been known to impregnate travelling webs of fibrous filter materials such as tow with various fluids and solids in order to improve the filtering qualities of the tow when subsequently formed into a rod for cigarette filters and applied to cigarettes. In some cases, the travelling length of tow has been coated with resin while, in other cases, charges of granulated material have been deposited on the tow prior to the formation of the web of tow into a rod. For example, it has been known to deposit spaced apart charges of granulated material onto the top surface of a travelling web of tow and to thereafter gather the web into a rod. However, the granulated materials which have been incorporated into the tow in this manner have not been uniformly dispersed throughout the tow such that the subsequently formed rod sections have varying concentrations of the granulated material throughout. Also, in those instances where the granulated material has been applied as a uniform layer on a travelling web of tow, the subsequent gathering and forming of the web into a rod causes the layer of granulated material to be concentrated either in the form of a core cylinder in the rod or in the form of a layer with a wound cross-section. Because of these variances in the distribution of the granulated materials in the formed rods, the filters made from the rods have had sections in which only the fibrous filter material is available to filter the smoke and gases generated during smoking of a cigarette. As a result, the efficiency of the filter has been reduced.

Accordingly, it is an object of this invention to provide an improved impregnated filter for cigarettes.

It is another object the invention to uniformly disperse an adsorption type filter material throughout a fibrous filter plug.

It is another object of the invention to provide an apparatus for introducing filter material into a travelling web of fibrous filter material for uniform dispersal throughout the travelling web.

Briefly, the invention provides a method of impregnating a travelling web of fibrous filter material in which a layer of granular filter material is placed in adjacent relation to at least one side of the travelling web and both the web and granular layer are passed through a restricted passageway in which the granular filter material is forced into and dispersed throughout the cross-

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section of the web. In order to have the granular particles embedded into the web during travel through the restricted passageway, the combined thickness of the filter material and web is of a greater dimension than the height of the restricted passage. After passage through the restricted passage, the impregnated web is gathered together and formed into a rod which is subsequently severed into a series of impregnated fibrous filter material plugs. As the layering of the granular material on the web is carried out in a uniform and continuous fashion, the subsequently formed rod has a uniform dispersal of filter material throughout the length thereof.

The apparatus of the invention includes a means for driving a web of fibrous filter material, such as tow through a restricted passageway and means for placing the layer of granular filter material in adjacent relation to at least one side of the web upstream of the restricted passageway so that the granular material and the web can be directed through the restricted passageway simultaneously. In addition, the apparatus includes a means for adjusting the height of the restricted passageway to the size of the granular filter material particles and web so that the individual particles will be embedded into the web upon passing through the restricted passageway.

In one embodiment, a pair of rotatable rolls are used to drive the web and to form a nip which serves as the restricted passage. The nip is sized so that particles of granular filter material will be embedded in the web during passage through the nip. In this embodiment, the granular filter material is deposited onto the surface of the lower of the two rollers while the travelling web is delivered onto the surface of the roller at a point slightly downstream from the point in which the granular filter material is deposited. In this way, the filter material is disposed on the underside of the web prior to passage of the web and granular filter material through the nip formed between the two rollers. As the granular filter material and web pass through the nip formed by the two rollers, the filter particles are forced into the web by a pressing action of the rollers and become dispersed throughout the cross-section of the web.

In order to feed the granular filter material to the travelling web in a uniform manner, the apparatus includes a suitable means, for example, a vibratory feed, in which a supply of filter material is fed from a hopper onto a reciprocating or vibrating tray and from the tray onto a slide which delivers the material directly onto the roller. The slide is inclined in a downward direction and is flared in width at the end so as to uniformly distribute the filter material across the width of the roller, for example, the width of the slide is substantially the width of the web of fibrous filter material.

The filter material which is used can be of any suitable particle size. In addition, where the particle size of the filter material is of a size larger than the restricted passageway or nip, these larger particles are crushed in passing through the restricted passageway or nip. This crushing serves to reduce the particles to a smaller particle size.

After passing through the nip of the rollers the impregnated web is subsequently delivered to a rod forming means in which the impregnated web is formed into a rod. This rod is subsequently severed into suitable lengths of impregnated filter plugs. During gathering of the web into the rod, the granular filter material is maintained in the uniform dispersed state so that the subsequently formed rod and plugs have a uniform dispersal of the granular filter material through the cross-section and throughout the length of the rods and plugs.

These and other objects and advantages of the invention will become more apparent from the following de-

tailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a side view of an apparatus according to the invention;

FIG. 2 illustrates an enlarged view of a pair of rollers used to form the nip in which the filter material particles are forced into a travelling web; and

FIG. 3 illustrates a view of the feed apparatus for the filter materials.

Referring to the figures, the apparatus includes a supply bale 10 for a web 11 of fibrous filter material, for example of cellulose acetate tow and a drive means such as feed rolls (not shown) for pulling the web 11 from the supply roll 10. In addition, an upper driven roller 13 and an idler roller 14 form a nip through which the web 11 is pulled through a plasticizer applicator (not shown) as is known and delivered to a rod forming section 17. Pressure is maintained between the rollers 13, 14 by the weight of the upper roller 13 on the idler roller 14. A roller 15 is spaced below the roller 14 to define a nip 16 of predetermined size. In addition, a rod forming section 17 in which the web is gathered together as is known and formed into a rod 18 is located downstream of the rollers 13, 14, 15 while a suitable severing means 19 is positioned at the end of the rod forming section 17 to sever the rod 18 into a series of filter plugs 20.

The rollers 13, 14 are each pivotally mounted to pivot separately about the same pivot shaft 21 so as to facilitate threading of the apparatus 10 and to permit roller 14 to be adjusted with relation to roller 15 so as to control the nip 16 therebetween. The movement of the roller 14 automatically moves the roller 13 as the roller 13 rests on the roller 14. The roller 15 is mounted on a fixed axis and is chain driven by a separate chain (not shown) from a chain (not shown) which drives roll 13. The ratio of the diameters of rollers 13, 15 are equal to the ratio of the diameters of their respective drive sprockets to insure equal surface speeds of the three rollers 13, 14, 15. Further, the shafts 22, 23 of the rollers 13, 14 are each mounted on suitable box frames 24, 25 to assure that all rolls are mounted parallel to each other. The frames 24, 25 are, in turn, pivotally mounted on the pivot shaft 21.

In order to vary the size of the nip 16, the roller 14 is pivoted relative to the roller 15 and secured in place in a suitable manner upon achieving the required spacing. For example, a suitable screw adjustment can be used to allow precise setting of the pivot angle of the roller 14.

The apparatus further includes a means 26 for feeding granular filter material 27 such as a granulated material, e.g. charcoal, or a material such as diatomaceous earth to the roller 15 upstream of the nip 16 and upstream of the point where the web 11 contacts the roller 15. In this way, the filter material 27 is disposed on the side of the travelling web 11 facing the roller 15. This feeding means 26 is in the form of a vibratory feed system, as is known, which includes a hopper 28 for supplying material such as charcoal, diatomaceous earth, or any other suitable filter material, a tray 29 which is mounted in a vibratory manner below the hopper 28 to receive the filter material 27 and which, in turn, communicates with a depending slide 30 which is directed towards the lower roller 15. The slide 30 increases in width from the tray 29 so that the material 27 which slides down the slide 30 is dispersed in a substantially uniform manner across the width of the roller 15. For example, the width of the slide 30 at the lower end is substantially the width of the web 11 of tow supplied from the supply bale 10.

In addition, a chute 34 is located between the roller 15 and rod forming section 17 to enclose the web 11 and layer of filter material 27 so as to contain any of the filter material which may fall off the web 11. In this way, any loose material is also delivered to the rod forming section along with the web 11.

In operation, with the nip 16 adjusted relative to the thickness of the web 11 and the layer of filter material 27, a continuous uniform layer of granulated filter material 27 is delivered from the feed means 26 down the slide 30 onto the top surface of the roller 15 at a point upstream of the nip 16 while a continuously travelling web 11 of tow is drawn off the supply bale 10 and delivered into the nip 16. As the web 10 and layer of granular material 27 travel through the nip 16 (FIG. 2), the particles 31 of the granular material which are of larger size than the nip 16 are crushed under the action of the two rollers 14, 15 and disintegrate into smaller pieces 32. At the same time, all the granular particles are pressed into the fibrous web 11 so as to penetrate into and embed in the web 10. Because of the crushing and pressing action of the rollers 14, 15 the particles of granular material are dispersed throughout the cross-section of the web 10 in a substantially uniform manner. Continued movement of the impregnated web 11 into the gathering and rod forming section 17 produces a rod 18 of impregnated material in which the granular particles are uniformly dispersed throughout the cross section of the rod 18 and throughout the length of the rod 18. Thereafter, the rod 18 is severed into the individual plugs 20 and deposited into a hopper 33 or other suitable storage means for subsequent usage.

It is noted that the initial clearance between the rollers 14, 15 can be set at a zero clearance without the tow web 11. This clearance will increase to about 0.3 millimeter during passage of the web 11 through the nip 16, varying, of course, with the type of tow web 11 used. Thus, filter particles greater than 0.3 millimeter in diameter would experience crushing such as in the case where granular carbon which falls within a particle size range of from 0.4 to 1.4 millimeters in diameter is used. The resulting reduction in average carbon particle size has an effect of increased filtration efficiency. In the case where very fine filter material particles are used, such as diatomaceous earth of a size of 0.15 millimeter or smaller, the pressing action of the rollers 14, 15 embeds the filter material into the web 11 without any significant crushing of the filter particles.

The invention thus provides a technique of forcing granular filter material into a tow web before the tow web is gathered to hold the particles captive within the fiber matrix and keep to a minimum any redistribution during rod forming. As a result, a greater percentage of additive can be embedded in the tow web and with greater uniformity. Also, a more efficient filter for a cigarette is obtained.

It is also noted that the web 11 of fibrous filter material which is of greater thickness than the initial height clearance of the nip 16 is of a resilient nature such that the web 11 compresses in passing through the nip 16 to permit embedding or crushing of the solid substantially non-compressible granular particles under the forces of the rollers 14, 15. The subsequent passage of the web 11 out of the nip 16 allows the fibrous filter material of the web 11 to expand to a free condition while at the same time the granular material is enmeshed within the fibers of the web 11.

The invention further provides an apparatus which can be easily incorporated into existing machinery in which travelling webs of tow are gathered together into rods.

The apparatus of the invention is further constructed of simple components which are easily used and which are of a relatively low cost. As a result, improved filter plugs can be produced with relatively small increases in the cost of the equipment used to produce such plugs.

It is finally noted that any additive material placed on the surface of the roller 15 at the nip 16 between the rollers 14, 15 which is not embedded into the tow matrix web 11 will tend to be carried along on the

upper surface of the web 11 and subsequently formed into the rod 18.

What is claimed is:

1. A method of impregnating a fibrous filter material web of predetermined thickness comprising the steps of conveying a length of the web through a path having a predetermined restricted passageway of a height less than said thickness of the web therein; placing a layer of granular filter material in adjacent relation to at least one side of said web upstream of said restricted passageway, said layer of filter material and said web defining a thickness larger than the height of said passageway;

moving said web and said layer of filter material through said passageway simultaneously to embed the particles of said filter material therein and to disperse the particles through the cross-section of said web; and

thereafter gathering said web with said particles of material therein into an axially elongated rod.

2. A method as set forth in claim 1 wherein said layer of particulate filter material is placed substantially uniformly adjacent one side of said web prior to movement through said restricted passageway.

3. A method as set forth in claim 2 wherein said web is moved through said passageway at an angle from a vertical plane and said layer of particulate filter material is placed on the underside of said web.

4. A method as set forth in claim 1 wherein said layer of particulate filter material is placed substantially uniformly and continuously adjacent said web.

5. A method as set forth in claim 1 wherein said restricted passageway is formed by a pair of rotating rollers.

6. A method as set forth in claim 1 wherein said restricted passage is adjustable in height to accommodate different sizes of particulate material and to vary the degree of embedding of said particles.

7. A method as set forth in claim 1 which further comprises the subsequent step of severing the rod into a series of impregnated filter elements.

8. A method as set forth in claim 1 wherein said filter material is granular and includes particles of sizes larger than the height of said passageway and wherein said larger sized particles are crushed in moving through said restricted passageway.

9. A method of impregnating a travelling web of fibrous filter material comprising the steps of

conveying the web through a predetermined path; placing a layer of granular filter material in adjacent relation to at least one side of said web within said path;

moving said web and said layer simultaneously in said path while compressing said web and pressing said layer into said web to crush and disperse the particles of said layer through the cross-section of said web; and

thereafter gathering said web with said particles of material therein into an axially elongated rod with said particles uniformly distributed therein.

10. An apparatus for impregnating a web of fibrous filter material comprising

a pair of rotatable rollers for driving a length of the web;

a third rotatable roller forming a nip with one of said pair of rollers downstream of said pair of rollers; means for placing a layer of granular filter material in adjacent relation to at least one side of said web upstream of said nip for passage through said nip simultaneously with said web; and

means for adjusting the height of said nip to cause embedding of the particles of said layer during passage through said nip for dispersal through the cross-section of said web.

11. An apparatus as set forth in claim 10 wherein said one roller is adjustably mounted with respect to said third roller to vary the height of said nip.

12. An apparatus as set forth in claim 10 wherein the filter material is granulated and said rollers forming said nip are disposed to cause crushing of the granulated filter material therebetween during embedment into the web.

13. An apparatus as set forth in claim 10 wherein said means for placing a layer of particulate filter material includes a distribution means for distributing said particles of said layer substantially uniformly across the width of said web.

14. An apparatus as set forth in claim 13 wherein said distribution means includes a hopper for supplying said filter material, a vibrating tray below said hopper for receiving and displacing the supplied filter material into a layer, and a slide extending from said tray to receive the layer of filter material from said tray and to disperse said layer across the width of said web.

15. An apparatus as set forth in claim 14 wherein said third roller is positioned under said slide to receive the distributed layer of filter material therefrom and to subsequently receive said web thereon over said distributed layer of filter material.

16. A method of making a filter for a cigarette comprising the steps of

conveying a length of a fibrous filter material web through a path having a predetermined restricted passageway therein;

placing a layer of granular filter material in adjacent relation to at least one side of said web upstream of said restricted passageway, said layer of filter material and said web defining a thickness larger than the height of said passageway; and

moving said web and said layer of filter material through said passageway simultaneously to crush the particles of said filter material therein and to disperse the crushed particles through the cross-section of said web.

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