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(19)

(54) SMOKE FILTER AND PROCESS

(71) We, CIGARETTE COMPONENTS LIMITED, a British Company, of Friendly House, 21/24 Chiswell Street, London, EC1Y 4UD, 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 smoke filters and provides a smoke filter rod comprising a smoke-permeable body of continuous filaments bonded at points of contact surrounding a smoke-permeable core of sorbent particles bonded together with thermoplastic binder, the core extending at least partially the length of the rod. It also provides a smoke filter rod comprising a smoke-permeable body of continuous filaments bonded at points of contact surrounding a smoke-permeable core of sorbent particles bonded together with thermoplastic binder, the core being in the form of a plurality of longitudinally spaced smoke-permeable pockets of the bonded sorbent particles.

The rod is preferably produced continuously and severed into shorter lengths; when the core is not continuous but is in the form of spaced pockets, the initial continuously produced rod may be severed transversely through and/or between the pockets.

The invention also provides a method for the production of a smoke filter rod, the method comprising continuously advancing longitudinally in the form of a channel-section band a tow of continuous filamentary smoke filtering material embodying a heat-activatable bonding agent for the filaments, continuously depositing along the base of the channel section a continuous line or discrete longitudinally spaced pockets of a particulate admixture of sorbent and thermoplastic binder therefor, and condensing the tow and deposited particulate admixture to rod form by continuous passage into and through a tubular former, heating fluid being passed through the wall of the former to penetrate and heat the condensed rod and activate the said heat-activatable bonding agent and the said thermoplastic binder, to form a continuous filter rod of bonded filaments with a core of bonded sorbent particles extending therethrough continuously or as longitudinally spaced discrete pockets. The continuously formed rod may be severed transversely into shorter lengths as indicated above.

Activated carbon is the preferred material for use as the particulate sorbent, due to its high absorptive efficiency, but other particulate materials possessing useful filtration properties, for example silica gel, activated alumina, perlite, sepiolite, Fullers earth, magnesium silicate, metal oxides such as iron oxide, and combinations thereof, may be employed in addition to or in place of activated carbon. The carbon may be of coal-, nutshell- or petroleum-base type, and the carbon and binder are preferably of about the same bulk density, e.g. carbon 0.16 to 0.50 and binder 0.38 to 0.42 gm/cc.

Polyethylene and like thermoplastic resins may be employed as the thermoplastic binder for the sorbent particles. The commercially available polyolefins such as polyethylene and polypropylene and their copolymers are non-toxic and thermally stable, and will set to give a strong bond without clogging the pores of the sorbent particles, which therefore retain their sorbent power in the finished product. These materials are therefore particularly well suited for use as the thermoplastic binder. Other polyhydrocarbons may be employed in place of or in addition to polyethylene or polypropylene, particularly polymers of hydrocarbons containing 4 to 10 carbon atoms, as may a variety of other thermoplastic materials having suitable melt flow indices, such as vinyl acetate and other vinyl homopolymers and copolymers, plasticised cellulose acetate, polyester resins, friable polyhydrocarbon resins such as Escorez, and combinations thereof. Microporous polyethylene possesses sorptive properties, and may be employed as a sorbent material and/or as thermoplastic binder.

A minor proportion of one or more fillers or additives may be incorporated in the core material, these preferably being mixed with the sorbent material and thermoplastic bin-

der in an initial mixing operation. For example, natural or synthetic fibres may form part of the core where a low density product is required and puffed and/or comminuted tobacco stocks and stems may be included, together with additives such as alkali and acid modifiers. Metal fibres can be included and the filler may comprise fibrous carbon if low weight is of particular significance. Chemicals may be included which affect the taste of smoke passing through the core and in particular certain active additives may be incorporated which eliminate some of the harmful constituents from tobacco smoke and hence enhance the efficiency of the filter. Examples of additives include polyvinyl acetate, polycarbonates obtained by reacting bisphenol A and diphenyl carbonates, polyamides of the nylon type, e.g. nylon 6, nylon 6/6 and nylon 6/10, modified cellulosic resins, e.g. cellulose acetate, and dimethyl cellulose, powdered natural gums, carbohydrates, e.g. the various sugars, powdered calcium carbonate and fibrised wool pulp. Additives having a mean melt temperature at or below the temperature to which the mixture is subsequently heated may function as an additional binder. Some resins mentioned as additives, e.g. polyvinyl acetate, have already been referred to as suitable binders.

The core may comprise 5%by weight or less of thermoplastic binder, or as much as 50% by weight, and from 50% to 95% by weight of sorbent particles. Preferably not more than 40% by weight of thermoplastic binder is employed, and not less than 60% by weight of sorbent particles. The most satisfactory core mixtures include at least 6½%, but not more than 30% by weight of thermoplastic binder and from 85% to 93½% by weight of sorbent (e.g. activated carbon) particles.

The sorbent particles, together with any filler or additive that is to be included, may be intimately mixed with particles of the thermoplastic binder. The particles of thermoplastic binder are preferably substantially smaller than the particles of sorbent material, so that that they adhere thereto as a dust-like coating on mixing. A predominant portion, e.g. at least 80%, of the sorbent particles may for example be from 9 to 200, preferably between 9 and 60, times larger than the binder particles. Each sorbent particle in the mixture is thus separated from adjacent sorbent particles by a contiguous layer of thermoplastic powder, which softens or fuses on heating, so that the formation of a firmly bonded yet porous core is ensured. Thermoplastic binder particles of an average diameter of 100 microns or less, preferably 50 microns or less, are particularly suitable, whilst at least 80% of the sorbent particles are preferably of about 100 to 12 or 10 mesh, U.S. standard, but may be as fine as 200 mesh. Any filler or additive employed is preferably of small particle size, e.g. 50 microns or less.

Instead of such a mixture of discrete sorbent and thermoplastic binder particles, sorbent particles coated with thermoplastic binder may be employed. For example, an aqueous polyethylene emulsion can be mixed with activated carbon particles to form a thermoplastic coating thereon, the coated particles, together with filler material or additive if required, then constituting the particulate core mixture. By co-blending at least a portion of the resin as an emulsion in a liquid carrier the formation of a homogeneous mixture is greatly facilitated and closer control over product quality is made possible.

The initial mixing of sorbent particles and thermoplastic binder, with or without a filler or additive, may be carried out in a conventional blending machine. Blending machines of the type incorporating a helical or like ribbon agitator may be suitable, providing a simultanous mixing and kneading action so that the particles are worked together during mixing.

The filamentary material of the tow is preferably crimped. A preferred material for the tow is cellulose acetate, but other continuous filamentary materials may be used including polyolefins – e.g. polyethylene, polypropylene, and copolymers of ethylene and propylene with other olefins; polyamides, e.g. nylon; and polyesters, e.g. polyethylene terephthalate. The heat-activatable bonding agent may be a plasticiser for the filamentary material, e.g. triacetin in the case of cellulose acetate. Other bonding agents for the tow may be used, e.g. a particulate heat-activatable bonding agent such as thermoplastic powder or granules. If the filaments of the tow are themselves theromplastic, e.g. of polyolefin, than an additional bonding agent may not be necessary.

One or more flavouring materials, e.g. menthol, can be deposited over the tow before it is condensed to rod form, preferably before deposition of the sorbent/binder mixture along the base of the channel section band and most preferably before the tow band is formed to channel section. Likewise one or more particulate sorbents (e.g. activated carbon, silica get etc.), can be sprinkled onto the tow prior to deposition of the sorbent/binder mixture, to result in a product in which the tow surrounding the continuous or discontinuous core has the particles dispersed therein.

The tow with deposited particulate core admixture is preferably carried through the tubular former enwrapped in a flexible pervious tape, the heating fluid passing through

the pervious material of the enveloping tape to activate the heat-activatable bonding agent for the filaments and the thermoplastic binder for the sorbent particles. The preferred heating fluid is steam, especially where the tow is of cellulose acetate and/or the sorbent particles comprise activated carbon.

It will generally be preferred to pass the rod from the tubular former through a cooling chamber; here a cooling gas such as air may be passed transversely into the heated rod, preferably counter-current to the direction of travel of the rod, to assist in setting of the rod to a coherent peremable product. The rod may be carried through such a cooling chamber enwrapped in the same flexible pervious tape as employed to carry it through the tubular former. Where such a flexible pervious tape is employed it will preferably be an endless tape, flattening out and separating from the completed rod after exit from the tubular former (or from the cooling chamber) for return to the entrance of the tubular former.

The completed continuous rod may be provided with a plug wrap in conventional manner, but this may not be required since the unwrapped rod will generally be coherent and self-supporting so that it can be handled satisfactorily in unwrapped condition.

Where the particulate core mixture is supplied and deposited as a continuous line on the tow substrate so as to produce a rod product having a core which extends continuously therethrough, it may be supplied simply from a continuous metering device mounted above the continuously advancing tow. Where the particulate core mixture is to be deposited as discrete longitudinally spaced pockets, this is suitably achieved by means of an applicator wheel or drum having peripherally spaced recesses around its applicator surface for receiving the individual doses of the particulate mixture, e.g. from a hopper, the rotating applicator being positioned so that the recesses apply their contents sequentially to the tow. The applicator wheel is preferably positioned so that the limbs of the tow channel section run on either side of the wheel at the deposition location with the additive pockets being deposited on the channel base. The recesses are preferably elongate in the transverse direction.

Pre-shaping of the tow to the channel form required for application of the particulate core mixture is suitably accomplished by passage through a tow trumpet. In shaping the tow to channel section employing a tow trumpet or like device, it is preferred to position upstream of the trumpet a former, e.g. of wire, which deforms the passing tow to a relatively broad and shallow, upwardly open trough, his being received by the trumpet and condensed further to the channel section form fed to the metering hopper or applicator wheel; this arrangement gives better uniformity of and control over the shape and orientation of the tow feed to the applicator than does use of a trumpet alone.

Where pockets of particulate core mixture are applied by means of a recessed applicator wheel or drum, the mixture can be positively ejected from its recess in the wheel or drum and into the rod of tow by operation of a plunger forming the base of the recess. Each recess may for example be provided with its own plunger or piston, the plungers or pistons being operated sequentially to empty their recesses by engagement with a stationary cam surface as they rotate past the deposition region. The pistons or plungers will be resiliently biased towards the axis of the wheel or drum, being shifted radially outwardly against this bias on engagement with this cam surface at the deposition region and then returning under the bias to a recessed position before receipt of a further pocket. The recesses will preferably be filled continuously, e.g. from a hopper, at the top of their travel path, with the plungers or pistons being operated to empty them at or adjacent to the bottom of their travel path, means such as a guard shoe being provided to prevent premature spillage from the recesses before operation of the plungers or pistons. It may be advantageous for each piston or plunger at the filling region to adopt a retracted position giving a recess volume greater than the volume of mixture required subsequently to be ejected from the recess into the tow rod, the piston or plunger then (preferably before exit from the filling region) moving radially outwardly (e.g. under the action of a second cam surface) a sufficient distance to help skimming off or discharge of any excess over the said required volume. This helps to ensure that each recess arrives at the deposition region containing a predetermined metered amount of the mixture. In passing from the filling to the deposition region, each piston or plunger may remain in its partially extended position, but will preferably adopt a more retracted position so that the metered amount of mixture does not fill the recess.

Embodiments of the invention will now be described, by way of example only, with reference to Figures 1 to 3 of the drawings accompanying the provisional specification, and Figs. 4 to 7 of the accompanying drawings. In the drawings,

Fig. 1 is a diagrammatic elevation view of an apparatus according to the invention,

Fig. 2 is a perspective view showing on an enlarged scale portions of the Fig. 1 apparatus,

Fig. 3 is a side elevation, in section, showing on an enlarged scale an applicator wheel which may be substituted in the Fig. 1 apparatus,

Fig. 4 is a perspective view of the bottom of a preferred metering device for use in the apparatus and procedure of Figs. 1 and 2,

Fig. 5 is a side elevation in section, of a preferred applicator wheel and tow trumpet,

Fig. 6 is a part sectional view along lines 6-6 of Fig. 5, and

Fig. 7 illustrates, in perspective, part of another embodiment.

In the Figures, some like parts are accorded like reference numerals.

Referring to Figs. 1 and 2 of the drawings, from a bale 1 of crimped cellulose acetate tow the tow 2 is drawn through an air banding jet 4 over a cylindrical guide 5 by rollers 3. Rollers 6 which rotate faster than rollers 3 stretch the tow between themselves and rollers 3. A further air banding jet 7 forms the tow into a band approximately 250 mm wide before it passes into a box 10 where it is sprayed with glyceryl triacetate by spray guns 8 and 9. The banding jets 4 and 7 are of known form and comprise a narrow slot through which the tow passes. On one side of the slot is a perforate wall communicating with a supply of compressed air and on the other side of the slot an imperforate wall retains the tow whilst the air impinges upon it. Rollers 11 hold the tow in the band form which form is continued until the tow passes under former 12 and through the tow trumpet 15 which convert it into a loosely condensed channel section 55, before it enters beneath a tongue 16. Between trumpet 15 and tongue 16 is positioned a continuous metering device 100 fed with the particulate core mixture 52 from hopper 54. The metering device 100 is in the form of an elongate V-section trough 102 having an exit slot along its boat-shaped base, particulate core mixture being fed into the trough at a constant rate by conveyor 104. Conveyor 104 is in close feeding engagement with the outlet of feed hopper 54 so that it carries away therefrom the core mixture 52 at a constant rate. At the region where the particulate admixture is delivered into trough 102 suction is preferably applied to remove dust, leaving only the heavier particles to be deposited into the trough and onto the tow. The base of trough 102 is disposed between the limbs of the channel section 55 of tow and deposits the core mixture continuously along the base of the advancing channel section. Former 12 has a lower profile such as to deform the band of tow to a shallow trough shape for passage to the trumpet. The former is suitably simply a curved wire. This pre-forming improves the stability of shape of the further condensed channel section presented to device 100 and and the stability of its symmetrical disposition about the device at the deposition location. If a tow trumpet is to be used alone, former 12 can be replaced by a plain roller. The tow trumpet 15 may have a downstream channel-section extension 106 (not shown in Fig. 1) extending to below device 100 to assist in supporting and guiding the channel section 55 of tow.

The tongue 16 serves to guide the tow and deposited mixture 52 into a heating enclosure 18 as well as to position a pervious tape 19 around the tow. Heating enclosure 18, with tape 19, acts as a tubular former to condense and shape the tow and core mixture to filter rod form with a sheath of tow surrounding the core. The pervious tape 19 which is drawn through the heating enclosure by drum 20 and which is further trained round rollers 21, 22, 23 and 24 has an open structure and may be made from woven nylon or polyethyleneterephthalate monofilament. The tape may have a surface coating of silicone resin or polytetrafluoroethylene in order to prevent the tow from adhering to it. The heating enclosure 18 is provided with a conduit 25 connected to a supply of steam which passes through passageways in the enclosure, thence through the tape and into the tow and core in order to heat them, causing the glyceryl triacetate to bond the filaments of cellulose acetate to each other and the thermoplastic binder of the core mixture to bond the sorbent particles together; there will generally be also some bonding between core and surrounding filaments.

Thus a rod 26 is formed. The longitudinal edges of the tape 19 may not meet each other perfectly so that some of the filaments of the tow press between the edges forming a ridge. This ridge is removed by a presser foot 27 which lies between the edges of the tape and serves to press upon the ridge thus reforming the rod into a substantially cylindrical shape. Then the rod passes into a cooling enclosure 28 wherein air or other gas supplied through conduit 30 passes through the tape and into contact with the filaments and core of the rod in order to cool them and to remove any condensate from the rod 26. Preferably, the cooling air passes through the tape at a multiplicity of points spaced along the length of the cooling enclosure 28. After passing through the rod, the air, with any entrained condensate, passes into receiver 17, which is vented towards the rear of the machine. The result of the action of the air is also to cause the rod to become more rigid. On leaving the cooling enclosure 28 the rod can pass directly to a cut off, but it may first be wrapped (e.g. in a paper wrapper, by passage through a conventional wrapping device) and then passed to a cut off. In either case the cut off subdivides the (wrapped or unwrapped) rod

into discrete lengths.

Whilst the tape is passing about the drum 20 and the rollers 21 to 24 it occupies a flat form. During its passage from roller 24 to the drum 20 it is folded into an incomplete cylindrical form with a slight gap between its edges. On leaving the cooling enclosure 28 it opens out and is separated from the rod. The apertures in the tape are of sufficient size to provide an easy passage for the steam and the air to pass into the rod and to effect heat transfer. The surface finish of the rod 26 is dependent upon the surface characteristics of the tape since the filaments of the tow press against the tape whilst they are in a softened condition under the influence of the steam. If a deeply embossed finish to the rod is desired a coarse weave tape may be used. If a smoother rod is required a finely woven tape may be used. The embossing serves to inhibit fibre separation upon the peripheral surface of the rod without the need, in general, of causing coalescence of the peripheral fibres of the rod.

If desired it may be arranged that the bore of the heating enclosure is slightly greater than the bore of the cooling enclosure. The latter then serves to set the rod in its final desired diameter.

Fig. 3 shows an applicator wheel 50 which may be substituted for the metering device 100 of Figs. 1 and 2 in order to deposit discrete longitudinally spaced pockets of core mixture 52 on the base of tow channel 55, resulting in the formation of a filter rod having a longitudinally discontinuous core of bonded sorbent particles; each discrete core section of the resulting integral and unitary rod will be surrounded by a sheath of bonded filaments and separated longitudinally from the next by a plug of the bonded filaments. The continuously formed rod, after wrapping if required, can be cut transversely in one or more stages (e.g. into convenient lengths by the rod manufacturer and then into shorter individual lengths during incorporation into a filter cigarette) across core sections and/or between core sections. Referring to Fig. 3, the applicator wheel 50 has recesses 56 spaced circumferentially around its cylindrical surface, and extends as shown down between the limbs of the channel section 55 of loosely gathered tow advancing from trumpet 15. The recesses 56 are fed with particulate core mixture 52 from hopper 54. Spillage of core mixture 52 from recesses 56 before deposition within the body of loosely gathered tow 55 is prevented by guard shoe 57. The pockets of mixture in the recesses 56 are thus carried around by rotation of applicator wheel 50 and deposited individually at longitudinally spaced locations within the body of tow, i.e. on the base of the channel of tow. The recesses 56 are preferably elongate, having a cross-sectional shape which is longer axially than peripherally of the applicator wheel, so as to result in discrete core sections of preferred configurations. The remainder of the apparatus, i.e. the tow preparation and feeding machinery, and the tubular former and its ancillary and succeeding equipment, is as described above with reference to Fig. 1.

Fig. 4 is a perspective side view, from below and downstream, of the bottom of a preferred metering device which can be substituted for that shown in Figure 2. Figure 4 shows, instead of the elongate V-section trough 102 of Figure 2, an elongate trough 200 having one vertical and one inclined longitudinal wall, the base of the trough (which has parallel vertical longitudinal walls) having at its bottom a longitudinal slot 204 through which the particulate sorbent/binder mixture falls onto the shaped band of tow as in Figure 2. The upstream end 208 of the base of trough 200 is in the shape of the bow of a boat, as shown in Figure 2. The downstream end 202, whilst projecting slightly downstream from the main body of the trough, ends however in a planar face as shown in Figure 4. The slot 204 does not extend the full length of the trough 200, but stops short of its upstream end as indicated in Figure 4. A downwardly protruding boss or keel 206 is preferably provided at the upstream end of the trough base as shown. The spacing of the slot 204 from the upstream end of the trough, and the presence of the keel 206, help to control the passing band tow and maintain it in its required channel section configuration, reducing any tendency for it to ride up into the slot.

The particulate core mixture 52 in the above embodiments may have any one of a variety of compositions, as previously described, but will preferably comprise activated carbon particles or granules admixed and coated with relatively fine thermoplastic (e.g. polyethylene) powder. Whether the product rod has a continuous (Figs. 1 and 2) or discontinuous (Fig. 3), core there will be bonding not only of filament to filament in the tow portion and of sorbent particle to sorbent particle in the core, but also bonding between core and adjacent filaments so that the rod can be cut across the core without appreciable loss of core material on cutting or during subsequent handling.

A preferred applicator wheel, which can be employed as the wheel 50 in the embodiment of Fig. 3 above, is illustrated by way of example in Figs. 5 and 6. Referring to Figs. 5 and 6, the applicator wheel 370 has radially extending cylindrical recesses 372 spaced equidistantly around its cylindrical surface. The base of each recess 372 is formed by the free end of a plunger or pis-

ton 374. Each piston 374 is resiliently biased by a spring 376 radially towards the centre 378 of the wheel, but is movable radially outwards against this spring bias to sweep through the recess and so positively eject its contents. Sequential operation of the pistons or plungers as the wheel rotates clockwise as seen in Fig. 5 is effected by means of stationary cam surface 380 which engages with the radially inner end of the pistons or plungers over a portion of their travel path as shown in Fig. 5. In use in the method according to the invention the wheel 370 will be mounted as shown in and described with reference to Fig. 3, the recesses being filled with additive from a hopper 371 as they pass around the top of their travel path, and the pistons or plungers being operated by cam surface 380 to empty the recesses over the region indicated in Fig. 5. Premature spillage of the additive from the recesses is prevented by means of a guard shoe 382.

In their recessed or retracted position the radially innermost ends of pistons 374 engage with cylindrical flange surface 384, being maintained in abutment therewith by springs 376.

As a preferred feature, the depth of a recess 372 when the piston or plunger 374 is in its retracted position in abutment with flange surface 384 is greater than is necessary for the recess to accommodate the volume of additive to be ejected into the tow as an individual pocket; on arrival at the hopper 371, each recess will thus tend to be overfilled; a second cam surface 383 is however provided as shown for engagement with the radially innermost ends of pistons or plungers 374, so that just before each recess moves out of communication with the hopper its plungers or piston is moved radially outwards a short distance, excess additive in the recess thus being skimmed off to leave in the recess a predetermined charge for subsequent ejection into the tow. As shown, each piston then preferably moves out of engagement with cam surface 383, moving under the action of the spring bias back to its retracted position in abutment with flange surface 384. In a typical example, where an additive depth of 5 mm is required in each recess, the recess depth with the piston or plunger in its retracted position is suitably 7 mm, with the cam surface 383 being mounted so as to move the piston or plunger radially outward through 2 mm. The various cam surfaces will preferably be adjustable according to the volume required for additive pocket.

Figs. 5 and 6 also illustrate another preferred feature of the apparatus according to the invention, which may be employed with the simplified applicator wheel of the type shown in Fig. 3, this being the use of a tow trumpet 15 which is provided with a channel section tow support 385 extending from its outlet to and past the region where the applicator wheel deposits the additive pockets. This extension piece 385 supports the tow at the time of additive deposition and controls the tow correctly either side of the applicator wheel.

In Figs. 5 and 6 the recesses 372 are shown as being of circular cross-section, but this is not essential. For the purposes of this invention, in those embodiments which employ an applicator wheel or drum or the equivalent for deposition of the additive pockets from dimples or recesses, the dimples or recesses are preferably of a cross-sectional shape which is as long or longer axially of the applicator than peripherally of the applicator. The dimples or recesses are thus preferably wholly symmetrical in cross-section, e.g. circular or square, or have a cross-sectional shape (e.g. elliptical or rectangular) whose longer axis is directed transversely rather than longitudinally of the direction of movement of the applicator and substrate at the deposition region. If the dimple or recess cross-section is elongate, the longer axis is preferably perpendicular to the direction of travel at the deposition zone.

Fig. 7 illustrates, in perspective, parts of another embodiment according to the invention. Fig. 7 employs like reference numerals from earlier Figures to indicate like items. In Fig. 7, the applicator wheel 370 is of the same type as illustrated in Figs. 5 and 6, except that the tow trumpet 15 does not have the channel section extension running from its throat to the deposition location. The Figure shows how the band of tow passing from the rolls 11 is deformed by former 12 into the shape of a shallow trough for delivery to the tow trumpet 15, this ensuring a stable and symmetrical channel section of loosely gathered tow 55 for delivery to the applicator wheel 370. The wire former 12 is shown in a different orientation from that indicated in Fig. 3, this being adjustable at will to control the form of the tow 55 issuing from the tow trumpet 15. The channel section 55 of tow with the pockets of additives deposited along its base passes from the applicator wheel 370 to rod-forming apparatus (not shown) as described for the other embodiments.

WHAT WE CLAIM IS:—

1. A smoke filter rod comprising a smoke permeable body of continuous filaments bonded at points of contact surrounding a smoke permeable core of sorbent particles bonded together with thermoplastic binder, the core extending at least partially the length of the rod.

2. A smoke filter rod comprising a smoke permeable body of continuous fila-

ments bonded at points of contact surrounding a smoke permeable core of sorbent particles bonded together with thermoplastic bonder, the core being in the form of a plurality of longitudinally spaced smoke permeable pockets of the bonded sorbent particles.

3. A smoke filter rod according to claim 1 or 2 wherein the particulate sorbent comprises activated carbon and/or the thermoplastic bonder comprises polyethylene.

4. A smoke filter rod according to any of claims 1 to 3 wherein the continuous filaments comprise cellulose acetate.

5. A smoke filter rod according to any of claims 1 to 4 wherein the body of continuous filaments embodies at least one flavouring agent and/or particulate sorbent.

6. A smoke filter rod according to any of claims 1 to 5 in which the core is bonded to the surrounding bonded filaments.

7. A method for the production of a smoke filter rod the method comprising continuously advancing longitudinally in the form of a channel section band a tow of continuous filamentary smoke filtering material embodying a heat activatable bonding agent for the filaments, continuously depositing along the base of the channel section a continuous line or discrete longitudinally spaced pockets of a particulate admixture of sorbent and thermoplastic binder therefor, and condensing the tow and deposited particulate admixture to rod form by continuous passage into and through a tubular former, heating fluid being passed through the wall of the former to penetrate and heat the condensed rod and activate the said heat activatable bonding agent and the said thermoplastic binder, to form a continuous filter rod of bonded filaments with a core of bonded sorbent particles extending therethrough continuously or as longitudinally spaced discrete pockets.

8. A method according to claim 6 including the step of severing the continuously produced rod transversely into shorter lengths.

9. A method according to claim 7 or 8 wherein the heat activatable bonding agent comprises a plasticizer for the filamentary material and/or thermoplastic particles.

10. A method according to any of claims 7 to 9 including the step of applying at least one flavouring agent and/or particulate sorbent to the tow.

11. A method according to any of claims 7 to 10 wherein the tow with deposited particulate core admixture is carried through the tubular former enwrapped in a flexible pervious tape, the heating fluid passing through the pervious material of the enveloping tape.

12. A method according to any of claims 7 to 11 wherein the heating fluid is steam.

13. A method according to any of claims 7 to 12 wherein the rod is passed from the tubular former through a cooling chamber wherein a cooling gas is passed transversely into the hot rod.

14. A method according to any of claims 7 to 13 including the step of enwrapping the continuously produced rod in a plug wrap.

15. A method according to any of claims 7 to 14 wherein the particulate core mixture is deposited as discrete longitudinally spaced pockets by means of an applicator wheel having peripherally spaced recesses around its applicator surface which receive the individual doses of particulate admixture and deposit them sequentially onto the tow.

16. A method according to claim 15 wherein the applicator wheel is positioned so that the limbs of the tow channel section run on either side of the wheel at the deposition location.

17. A method according to claim 18 or 19 wherein the recesses have an elongate cross-sectional shape whose longer axis extends transversely of the direction of movement of the applicator and tow at the deposition region.

18. A method according to any of claims 15 to 17 wherein the particulate mixture is positively ejected from its recess in the wheel by operation of a plunger forming the base of the recess.

19. A method according to claim 18 wherein each recess is provided with its own plunger, the plungers being operated sequentially to empty their recesses by engagement with a stationary cam surface as they rotate past the deposition region.

20. A method according to claim 18 or 19 wherein the plunger are resiliently biased towards the axis of the wheel.

21. A method according to any of claims 7 to 20 wherein preshaping of the tow to the channel section form is accomplished by passing the tow through a tow trumpet.

22. A method according to claim 21 wherein the tow is initially deformed into a broad and shallow upwardly open trough which is condensed further by the tow trumpet to the channel section form fed to the deposition region.

23. Apparatus for forming a smoke filter rod, the apparatus comprising means for continuously advancing longitudinally a banded tow of continuous filamentary smoke filtering material embodying a heat activatable bonding agent for the filaments, deforming means for continuously forming the advancing banded tow to a channel section, a metering device for continuously depositing along the base of the channel section a continuous line of a particulate admixture of sorbent and thermoplastic binder, and immediattely downstream of the metering device a tubular former for condensing the tow and deposited particulate admixture to rod form, means for passing a heating fluid laterally into the rod as it advances through the tubular former,

and means for transversely cutting the resulting continuously produced rod into finite lengths.

24. A method of making a smoke filter rod, the method being substantially as hereinbefore described with reference to Figs. 1 and 2 of the drawings accompanying the provisional specification.

25. A method of making a smoke filter rod, the method being substantially as hereinbefore described with reference to Figs. 1 and 2 of the drawings accompanying the provisional specification and Fig. 4 of the accompanying drawing.

26. A method of making a smoke filter rod, the method being substantially as hereinbefore described with reference to Figs. 1 and 3 of the drawings accompanying the provisional specification.

27. A method of making a smoke filter rod, the method being substantially as hereinbefore described with reference to Fig. 1 of the drawings accompanying the provisional specification and Figs. 5 and 6 of the accompanying drawings.

28. A method of making a smoke filter rod, the method being substantially as hereinbefore described with reference to Fig. 1 of the drawings accompanying the provisional specification and Fig. 7 of the accompanying drawings.

29. Apparatus for making a smoke filter rod, the apparatus being substantially as hereinbefore described with reference to Figs. 1 and 2 of the drawings accompanying the provisional specification.

30. Apparatus for making a smoke filter rod, the apparatus being substantially as hereinbefore described with reference to Figs. 1 and 2 of the drawings accompanying the provisional specification and Fig. 4 of the accompanying drawing.

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1592952 PROVISIONAL SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

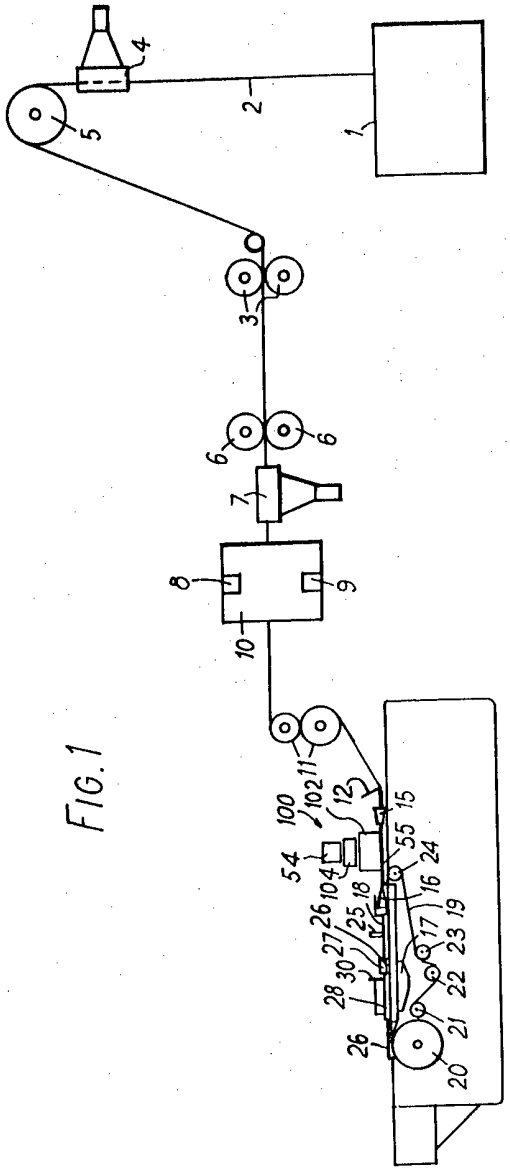
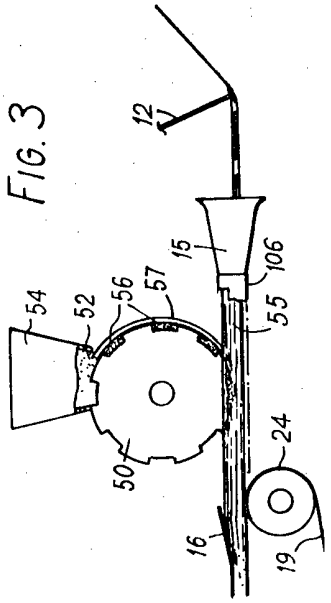


FIG. 1

FIG. 3



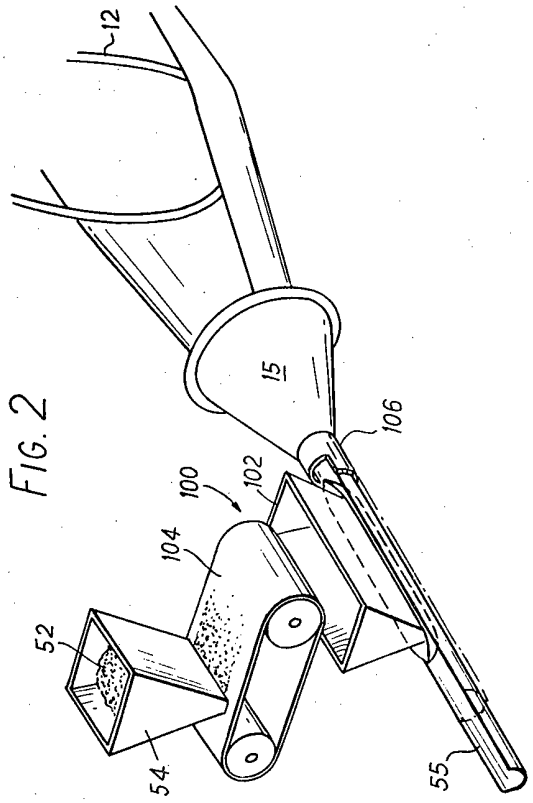
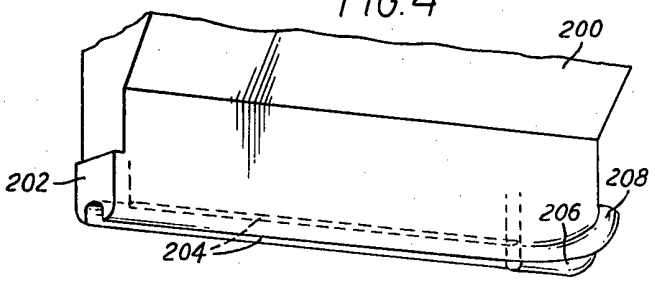


FIG. 2

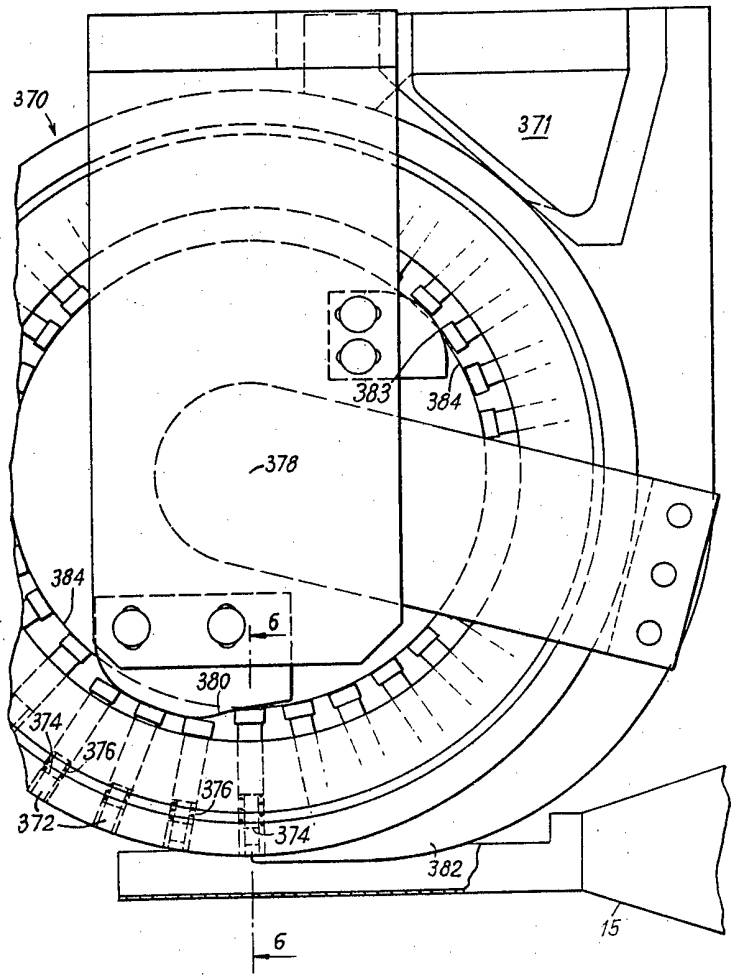
1592952 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 4



1592952 COMPLETE SPECIFICATION
4 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

FIG. 5



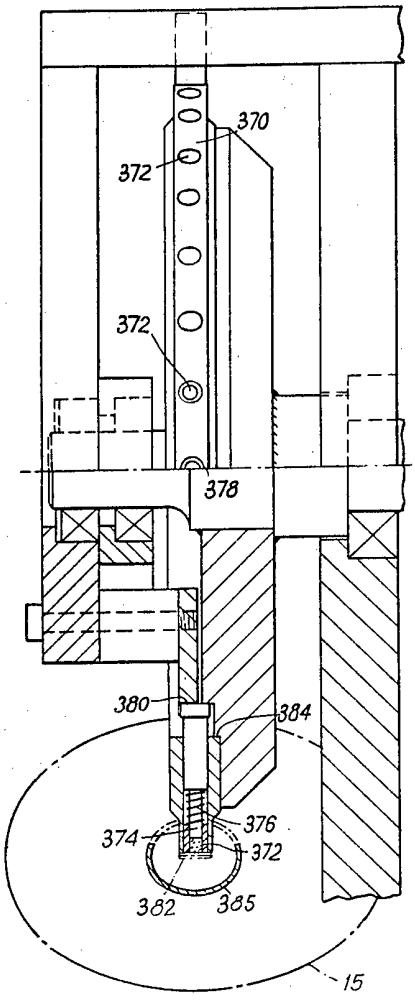


FIG. 6

1592952 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 4

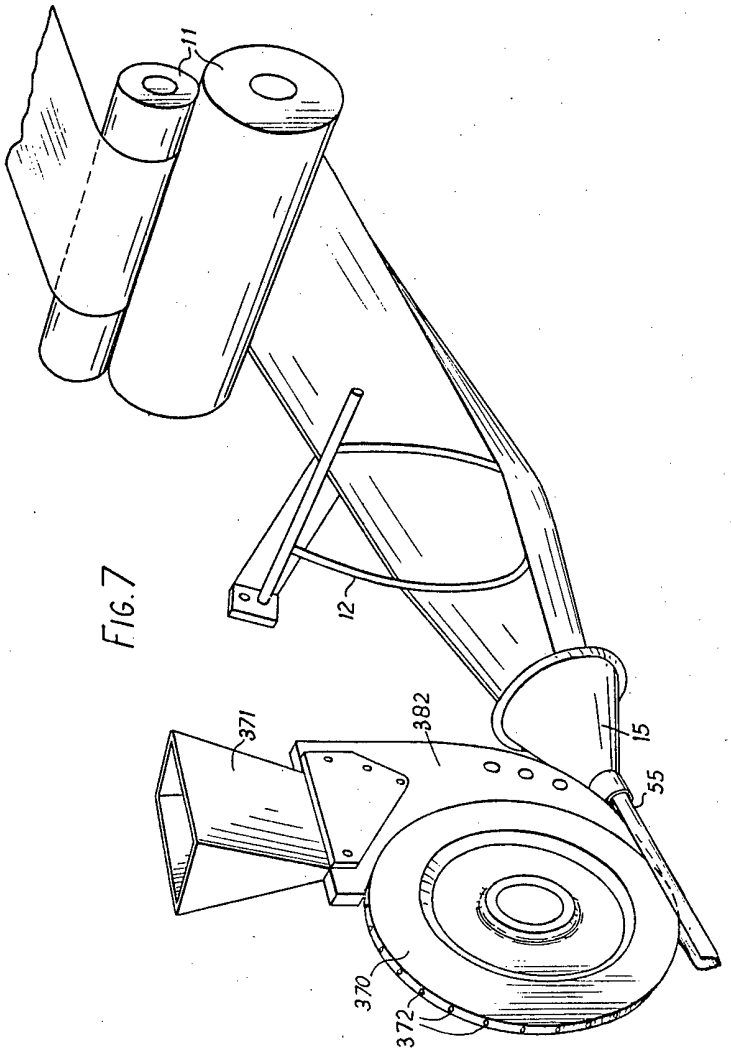


FIG.7