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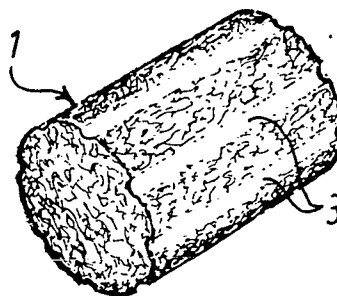
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54 **Improvements relating to filters.**

57 The present specification discloses a filter for use in a cigarette, and an apparatus and process for use in the manufacture of such filters. Particularly the present invention relates to a filter made from a number of thermoplastic polymer fibres folded transversely to the longitudinal axis of the filter at random orientations about the axis, the fibres being compressed and heat set in this position. However, such filters can easily be damaged during handling causing some of the fibres to separate. This is clearly undesirable.

The present invention provides an axial reinforcement (3, 17) in the outer surface region of the filter (1). The reinforcement (3, 17) strengthens the filter (1) and enables it to be handled without serious damage. The axial reinforcement can take the form of generally axially extending welds (3) adjacent fibres on the surface of the filter being welded together in strip regions, or alternatively the whole filter surface (17) can be effectively welded to encapsulate the filter. The desired form of axial reinforcement can be produced by passing the filter through an annular heating means (9, 5, 7) having radially inwardly directed fins (7, 13), to produce the axial welds, or alternatively through a heated ceramic ring (19) to produce the total encapsulation.



DESCRIPTION"IMPROVEMENTS RELATING TO FILTERS"

The present invention relates to a filter for use in a cigarette or the like, and an apparatus and process for use in the manufacture of such filters.

In particular the present invention relates to a filter made from a thermoplastic polymer fibre by means of the apparatus and process described in our copending British Patent Application No. 46096/78.

Such filters basically comprise a number of polymer fibres folded transversely to the longitudinal axis of the filter at random orientations about the axis, the fibres being compressed and heat set in this position. Integral tows of such filter material are produced and cut into individual filter plugs. However such integral tows of filter material require careful handling as they are not sufficiently integral in themselves to maintain their form and a relatively small axial or transverse force can at least slightly separate some of the fibres to produce a slackened and flexible region which cannot be reconstituted. Such slackened and flexible regions are clearly undesirable as they cannot be used to form filter plugs and thus are waste.

After cutting of the tow the individual filter plugs are used to form completed cigarettes. However, again the filter plugs are not sufficiently integral in themselves to be merely wrapped in the normal outer visible cigarette wrapping and as with known paper filters, a first strengthening wrapping has to be provided on the filter before the outer wrapping so that the completed cigarette will be sufficiently rugged to withstand the forces which can be applied during smoking.

Clearly provision can be made for the tow to be



5 handled satisfactorily and a first strengthening wrapping can be provided on each filter plug. However these provisions increase costs and the provision of a first strengthening wrapper does reduce the effective cross-section of a filter plug for a given cigarette.

10 An aim of the present invention is to provide a filter material which is sufficiently strong in itself to withstand mechanical handling during manufacture and to obviate the necessity for a first wrapping in a completed cigarette.

A further aim of the present invention is to provide apparatus for use in producing the filter of the present invention.

15 According to the present invention there is provided a filter for use in a cigarette, comprising a number of thermoplastic polymer fibres compressed and heat set into a cylindrical filter plug with an axial reinforcement provided in the outer surface of the plug.

20 The axial reinforcement may be in the form of at least one strip region of the outer surface of the plug, which extends generally axially of the plug e.g. axially or spirally, and is formed by the majority of the fibres in the strip region being welded together. Preferably a number of such generally axially
25 extending welded strip regions are provided on a plug at circumferentially spaced locations.

30 As an alternative to the welded strip regions one or more elongated strips of plastic may be welded to the cylindrical plug, generally axially thereof i.e. axially or spirally of the plug.

35 The axial reinforcement may alternatively be in the form of an outer skin on the cylindrical plug, which outer skin encapsulates the cylindrical wall of the plug and is formed by welding the fibres

forming the cylindrical surface of the plug, together. Thus the said outer skin is integrally formed with the plug.

5 By providing this axial reinforcement the tow of filter and the filters produced therefrom have an inherent strength capable of maintaining the filter constitution during cigarette manufacture and without the said first wrapping.

10 According to a further feature of the present invention there is provided an apparatus for strengthening a filter for use in a cigarette, which filter comprises a number of thermoplastic polymer fibres compressed and heat set into a cylindrical filter plug, said apparatus comprising heating means
15 through which the filter can be passed to form welds which constitute axial reinforcement of the filter.

In one embodiment of this further feature of the invention the heating means comprises an
20 annular member from which radially inwardly directed fins project. Preferably the fins are tapered to a point leaving a central space through which the filter tow can be passed. The annular member and fins may be heated by conduction from a surrounding heating
25 band which is heated electrically, or the annular member and/or fins may incorporate heating elements. Preferably the tow of filter material contacts the tips of the fins so that the fibre of the filter tow surface is melted by the conduction of heat from each tip
30 and smeared axially of the tow to provide axially extending reinforcement strips at circumferentially spaced apart locations. Alternatively the tow may be supported and not contact the tips, the actual strips being formed by the heat radiated from the tips of the fins. No
35 smearing however occurs in this latter arrangement, the limited flow of molten plastic being relied upon

to join the fibres.

As an alternative to heated fins, actual electric heating wires may be located around an annulus, to contact the fibre tow and directly apply heat, or to just radiate heat thereon, to form the axially extending reinforcement strips.

In a further embodiment of the said further feature of the present invention wherein total encapsulation of the cylindrical surface of the plug is required the heating means is in the form of an electrically heated ceramic ring, the tow of filter material being passed through the ceramic ring which is at a sufficient temperature to melt the outer surface of the tow. Preferably the ceramic ring is the required diameter for the finished filter, the tow being forced therethrough by two formed rollers or any other suitable drive means. As an alternative to the ceramic ring a single coil of electrical heating wire or a spiral heater may be provided, the coil and/or spiral heater providing direct or radiant heat to the tow. By arranging the ceramic ring, single coil and/or spiral heater so that the compressed fibre tow passes upwards or downwards therethrough it is possible to enhance the limited flow of molten plastic and to thus aid the welding between fibres which produces the encapsulation.

An important criterion in all of the above proposals is that the temperature and heating time are not so great that substantial degradation of the polymer results.

According to a still further feature of the present invention there is provided a process for strengthening a filter for a cigarette, which filter comprises a number of thermoplastic polymer fibres compressed and heat set into a cylindrical filter plug said process comprising the step of applying heat along

the length of the filter to form welds between adjacent fibres, which constitute axial reinforcement of the filter.

5 The process may apply heat to all parts of the cylindrical surface or only at localised generally axially extending strips i.e. axially or spirally extending strips.

10 The present invention will now be further described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective view of a preferred embodiment of a filter constructed according to the present invention.

15 Fig. 2 is an end view of another embodiment of filter constructed according to the present invention,

Fig. 3 is a perspective view of a further embodiment of filter constructed according to the present invention,

20 Figs. 4 and 5 are schematic representations of two embodiments of apparatus for use in the present invention to produce the filter of Fig. 1; and

25 Figs. 6 to 8 schematically illustrate various embodiments of the present invention for use in producing the filter of Fig. 3.

30 The filter 1, 2 and 4 shown respectively in Figs. 1, 2 and 4, are basically formed as described in our copending British Patent Application No. 46096/78, from a number of thermoplastic fibres which are folded transversely to the longitudinal axis of the filter at random orientations about the axis, the fibres being compressed and heat set in position.

35 In the embodiment of Fig. 1, the cylindrical filter plug 1 has a number of axially extending grooves 3 provided in its cylindrical surface at circumferentially spaced apart locations, these grooves 3 constituting

axial reinforcement of the filter, the fibres having been welded together by the apparatus of Fig. 4 or Fig. 5. These grooves 3 which are formed by the fibres melting and flowing, may be filled in in the completed filter or left as grooves, as desired. If left open, grooves 3 may allow a direct draught to be drawn from the cigarette, though in view of the high efficiency of polymer fibre as a tobacco filter, this direct draught may be considered desirable in order to provide the necessary taste for the smoker.

To form the filter of Fig. 1, the filter tow constructed as described in our copending British Patent Application No. 46096/78, is passed through the heating means of Fig. 4 said heating means comprising an annular ring 5 from which fins 7 project radially inwardly, and an electrically heated heating band 9 which encompasses ring 5. Fins 7 are tapered to pointed tips 13 so that heat conducted to the fins 7 is applied to the tow as it passes through central space 11 between the tips 13 of fins 7. The tips 13 of fins 7 actually contact the surface of the tow and thus smear the melted fibre along the filter ensuring a good weld. However, alternatively the tips 13 need not contact the tow, the welds being formed by radiation heat. No advantageous smearing however occurs in this latter arrangement.

Whilst Fig. 1 illustrates specifically axial grooves 3 i.e. welds, the grooves 3 can be spirally formed on the filter tow by using an annular ring 5 which has tips (not illustrated) which provide a point contact with the tow, the ring 5 being rotated as the tow is passed therethrough. As will be appreciated any number of grooves can be formed. In fact provision for only one groove is feasible, provided one weld is sufficient axial reinforcement.

Instead of having heated fins 7, electrical heating wires 15 (see Fig. 5) can be substituted and again these can contact the fibre tow to apply direct heat or be spaced from the tow, radiation heat then being relied upon to produce the required weld or welds constituting the axial reinforcement of the filter. The wires 15 project inwardly from annular support member 5a.

The cylindrical filter plug 2 shown in Fig. 2 is basically the same as the filter plug of Fig. 1 the sole difference being that plastic strips 3a are welded to the outer surface of the plug 2 to form the required axial reinforcement.

The cylindrical filter plug 4 shown in Fig. 3 is basically the same as the filter plugs of Figs. 1 and 2, the sole difference being that the filter is encapsulated in an outer cylindrical skin 17 which provides the axial reinforcement in place of the grooves 3 and strips 3a. This outer skin 17 is formed by applying heat to the surface of the plug so that the surface parts of the respective fibres melt and become welded together.

The apparatus of Fig. 6 comprises a heated ceramic ring 19 which contacts the surface of the fibre tow as it is passed therethrough, melting the outer surface of the tow to allow the fibres to weld together to form outer skin 17. Advantageously the ceramic ring can be dimensioned to the required filter cross-section, formed drive-rollers 21 being required to drive the tow through the ring 19. To enhance the operation the ring 19 is arranged with its axis vertical, the selected upward or downward movement of the filter tow enhancing the limited flow of the molten plastic over the filter tow to produce a uniform outer skin 17. Alternatively the

ring 19 may be arranged as desired to allow the filter tow to move in the desired direction.

5 Equivalent forms of apparatus are shown schematically in Figs. 7 and 8. The apparatus of Fig. 6 comprises a spiral heating coil 23 and the apparatus of Fig. 7 is a single annular heating coil 25.

10 The main criterion in all of the above apparatus embodiments is that temperature and heating time are selected so that there is not a substantial degradation of the polymer.

15 The present invention thus provides a reinforced filter for cigarettes wherein the filter tow can withstand handling in cigarette manufacture and the filter does not require a first wrapping for strengthening purposes before the application of the usual outer wrapping. Also, suitable apparatus are provided by the present invention, for the production of the filter of the present invention.

CLAIMS

1. A filter for use in a cigarette, comprising a number of thermoplastic polymer fibres compressed and heat set into a cylindrical filter plug (1, 2, 4) and characterised by an axial reinforcement (3, 3a, 17) provided in the outer surface of the plug (1, 2, 4).

2.. A filter as claimed in claim 1, characterised in that the axial reinforcement (3, 3a, 17) is in the form of at least one strip region (3) of the outer surface of the plug (1) which extends generally axially of the plug (1) and is formed by the majority of the fibres in the strip region (3) being welded together.

3. A filter as claimed in claim 1, characterised in that the axial reinforcement (3, 3a, 17) is produced by one or more elongated strips (3a) of plastic being welded to the cylindrical plug (2), generally axially thereof.

4. A filter as claimed in claim 1, characterised in that the axial reinforcement (3, 3a, 17) is in the form of an outer plastics skin (17) on the cylindrical plug (4).

5. A filter as claimed in claim 4, characterised in that the outer skin (17) is formed by welding the fibres forming the cylindrical surface of the plug (4), together.

6. Apparatus for strengthening a filter for use in a cigarette, which filter (1, 2, 4) comprises a number of thermoplastic polymer fibres compressed and heat set into a cylindrical filter plug (1, 2, 4), said apparatus being characterised by heating means (7, 5, 9; 15; 19; 23; 25) through which the filter plug (1, 2, 4) can be passed to form welds which constitute an axial reinforcement (3, 3a, 17) of the filter.

7. Apparatus as claimed in claim 6, characterised in that the heating means (7, 5, 9) comprises an annular member (5) from which radially inwardly directed fins

(7) project, leaving a central space (11) through which the filter (4) can be passed.

8. Apparatus as claimed in claim 7, characterised in that the fins (7) are tapered to a point (13).

5 9. Apparatus as claimed in claim 7 or 8, characterised in that the annular member (5) and fins (7) are heated by conduction from a surrounding heating band (9) which is electrically heated.

10 10. Apparatus as claimed in claim 7 or 8, characterised in that the annular member (5) incorporates electrical heating elements.

11. Apparatus as claimed in claim 7, 8 or 10, characterised in that the fins (7) incorporate heating elements.

15 12. Apparatus as claimed in claim 6, characterised in that the heating means comprises an annular member (5a) from which radially inwardly directed electric heating wires (15) project.

20 13. Apparatus as claimed in any one of claims 7 to 11, characterised in that the fins (7) are designed to just touch the filter surface.

25 14. Apparatus as claimed in any one of claims 7 to 11, characterised in that the fins (7) are designed to radiate localised heat but not to touch the filter surface.

15. Apparatus as claimed in claim 12, characterised in that the heating wires (15) are designed to touch the filter surface.

30 16. Apparatus as claimed in claim 12, characterised in that the heating wires (15) are designed not to touch the filter surface.

17. Apparatus as claimed in claim 6, characterised in that the heating means is in the form of an electrically heated ceramic ring (19).

35 18. Apparatus as claimed in claim 17, character-

erised in that the ceramic ring (19) has an internal diameter equivalent to that of the desired filter (1) diameter, two fomred rollers (21) being provided to feed the filter through the ring (19).

5 19. Apparatus as claimed in claim 6, characterised in that a single coil of electrical heating wire (27) forms the heating means.

10 20. Apparatus as claimed in claim 6, characterised in that a spiral heater (23) forms said heating means.

15 21. A process for strengthening a filter for a cigarette, which filter (1, 2, 4) comprises a number of thermoplastic polymer fibres compressed and heat set into a cylindrical filter plug, (1, 2, 4) said process being characterised by the step of applying heat along the length of the filter (1, 2, 4) to form welds between adjacent fibres, which welds constitute axial reinforcement (3, 3a, 17) of the filter.

20 22. A process as claimed in claim 21, characterised in that heat is applied to only localised generally axially extending strip regions (3) of the filter surface.

25 23. A process as claimed in claim 21, characterised in that heat is applied to the whole filter surface to form an encapsulated outer skin (17).

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