

Smoke Filtering Device

Technical Field

The present disclosure relates to the technical field of tobacco, particularly to a smoke filtering device.

Background Art

With the progress of society, the problem of “smoking and health” attracts extensive social concerns. As the living standard is improved continuously, people are becoming conscious of health more and more. “Smoking and health” has become one of the main challenges confronted with in the development of the tobacco industry.

Smoking can bring about spiritual enjoyment, but smoking is harmful to health because the tobaccos will form in a combustion process a series of substances harmful to human's body. Similarly, tobacco products such as cigars also have the same problem. Harmful compounds produced by the tobaccos in the combustion process include: nicotine, nitrosamine, carbonic oxide, polycyclic aromatic hydrocarbon (PAHs), tar, cyanide, formaldehyde, acrolein, heavy metals and so on.

Summary

An object of the present disclosure is to provide a smoke filtering device to overcome defects of the prior art.

Another object of the present disclosure is a use of a one-time injection-molded smoke filtering device in cigarettes.

In order to achieve the above objects, the present disclosure provides following technical solutions.

The present disclosure provides a smoke filtering device, including a body which is provided therein with flow channels configured for allowing smoke to flow therethrough, wherein the flow channels filter the smoke by prolonging duration of the smoke staying in the flow channels.

According to a preferred embodiment of the smoke filtering device of the present disclosure, the body is a cylindrical body, with a diameter of 4-10mm, and a height of 3-25mm.

Preferably, the body is internally symmetrical in structure, and the symmetrical structure is axially symmetrical along a linear line perpendicular to an axis of the body.

Preferably, the flow channels have an inner diameter of 0.2-1.0mm.

Preferably, a sectional shape of each flow channel is a circular shape, an oval shape, a polygonal shape or an irregular shape. For the polygonal shape, a square shape is the most common shape.

A shape of a longitudinal profile of each flow channel can be a triangular shape, a shape formed by rectangles connected in a front-rear direction or a bent shape.

In the present disclosure, the flow channels are distributed in a discrete and uniform manner or regularly distributed in rows or columns inside the body.

According to a preferred embodiment of the above smoke filtering device of the present disclosure, an upper end face and/or a lower end face of the body are/is a structure of a concave platform.

According to another preferred embodiment of the above smoke filtering device, the flow channels each have a first inner diameter segment and a second inner diameter segment in communication with each other, wherein an inner diameter size of the first inner diameter segment is smaller than an inner diameter size of the second inner diameter segment. Therefore, the shape of the longitudinal profile of the flow channel is formed by two rectangles connected in a front-rear direction.

According to another preferred embodiment of the above smoke filtering device, the flow channels each have a first inner diameter end and a second inner diameter end, wherein an inner diameter size of the first inner diameter end is smaller than an inner diameter size of the second inner diameter end. The shape of the longitudinal profile of the flow channels is a trapezoidal shape.

According to another preferred embodiment of the above smoke filtering device, the flow channels are in a straight-through structure and/or a bent structure.

According to another preferred embodiment of the above smoke filtering device, the shape of the longitudinal profile of the flow channel is formed by two rectangles connected in a front-rear direction and has a bent structure having a middle portion as the bent portion.

In the present disclosure, the smoke filtering device is made through a one-time injection-molding process.

In the present disclosure, the smoke filtering device can use injection-molding raw materials, such as PS (polystyrenes), PP (polypropylene), AS (styrene-acrylonitrile copolymers), ABS (acrylonitrile-butadiene-styrene), PLA (polylactic acid), PBS (polybutylene succinate), and PBAT (polybutylene adipate terephthalate). Any raw materials that can realize one-time injection molding can be used for implementing the solutions of the present disclosure.

According to another preferred embodiment of the above smoke filtering device, the flow channels are each provided therein with at least one smoke filtering component.

According to another preferred embodiment of the above smoke filtering device, the smoke filtering component includes a light-free catalyst filtering layer and a polypropylene electret filtering layer, wherein the light-free catalyst is a catalyst capable of achieving catalysis without light.

According to another preferred embodiment of the above smoke filtering device, the smoke filtering component includes an inner barrel, an outer barrel and swirling blades provided between the inner barrel and the outer barrel, wherein the inner barrel and the outer barrel are coaxially provided; the inner barrel is detachably connected with a blocking mechanism configured for blocking an inner passage of the inner barrel.

Preferably, a torsion angle between a top edge and a bottom edge of each swirling blade is 30°-60°.

According to another preferred embodiment of the above smoke filtering device, the flow channels are each provided therein with at least one baffle plate. The baffle plate and an inner wall of the flow channel define a flow guide passage.

Preferably, the flow channels are each provided therein with a plurality of baffle plates arranged in parallel at intervals, and two adjacent baffle plates and an inner wall of the flow channel define a flow guide passage.

Preferably, the baffle plate is provided with a plurality of curved portions.

Preferably, the curved portions each include a first bent sheet, a second bent sheet and a third bent sheet connected in sequence, and the first bent sheet and the second bent sheet are both provided to define an angle with the third bent sheet.

The present disclosure further relates to a use of the above smoke filtering device in a cavity-combined filter rod.

The smoke filtering device provided in the present disclosure has the following effects:

through a particular flow channel design of the present disclosure, the staying duration of the smoke is prolonged, a flow state of the smoke is changed, and further, a part of harmful substances such as tar are settled and adsorbed.

Brief Description of Drawings

FIG. 1 is a schematic structural diagram of a smoke filtering device;

FIG. 2 is a schematic structural diagram of another smoke filtering device;

FIG. 3 is a schematic structural diagram of another smoke filtering device;

FIG. 4 is a longitudinal section schematic diagram of a flow channel;

FIG. 5 is a schematic structural diagram of a smoke filtering component;

FIG. 6 is a schematic structural diagram of another smoke filtering component; and

FIG. 7 is a schematic structural diagram of a curved portion of a baffle plate.

In the figures: 1. body; 2. flow channel; 3. first inner diameter segment; 4. second inner diameter segment; 5. first inner diameter end; 6. second inner diameter end; 7. bent portion; 8. concave platform; 9. smoke filtering component; 10. light-free catalyst filtering layer; 11. polypropylene electret filtering layer; 12. inner barrel; 13. outer barrel; 14. swirling blade; 15. blocking mechanism; 16. baffle plate; 17. flow guide passage; 18. curved portion; 19. first bent sheet; 20. second bent sheet; 21. third bent sheet.

Directions of arrows in FIG. 1 and FIG. 2 represent smoke flow directions.

Detailed Description of Embodiments

Non-limited embodiments below are used to describe the present disclosure in more details.

The present disclosure provides a smoke filtering device, including a body 1, wherein there are flow channels 2 configured for allowing smoke to flow therethrough in the body 1, and the flow channels 2 filter the smoke by prolonging duration of the smoke staying in the flow channels.

According to a preferred embodiment of the smoke filtering device of the present disclosure, the body 1 is a cylindrical body, with a diameter of 4-10mm, and a height of 3-25mm.

Preferably, the body 1 is internally symmetrical in structure, and the symmetrical structure is axially symmetrical along a linear line perpendicular to an axis of the body 1. In the present disclosure, the term "the body is internally symmetrical in structure" should be construed that a shape of a longitudinal profile of the body is symmetric in a front-rear direction. For a structure of the body having the flow channels 2, the smoke enters from a front end and is discharged from a rear end, or enters from the rear end and is discharged from the front end, wherein paths that the smoke flows through in both cases are same.

Preferably, the flow channels 2 have an inner diameter of 0.2-1.0mm.

Preferably, a sectional shape of the flow channel 2 is a circular shape, an oval shape, a polygonal shape or an irregular shape. For the polygonal shape, a square shape is the most common shape.

A shape of a longitudinal profile of the flow channels 2 can be a triangular shape, a shape formed by rectangles connected in a front-rear direction or a bent shape.

In the present disclosure, the flow channels 2 are distributed in a discrete and uniform manner or regularly distributed in rows or columns inside the body 1.

According to a preferred embodiment of the above smoke filtering device, an upper end face and/or a lower end face of the body 1 are/is in a structure of a concave platform 8.

According to another preferred embodiment of the above smoke filtering device, the flow channels 2 each have a first inner diameter segment 3 and a second inner diameter segment 4 in communication with each other, an inner diameter size of the first inner diameter segment 3 is smaller than an inner diameter size of the second inner diameter segment 4. Therefore, the shape of the longitudinal profile of the flow channel 2 is formed by two rectangles connected in a front-rear direction.

According to another preferred embodiment of the above smoke filtering device, the flow channels 2 each have a first inner diameter end 5 and a second inner diameter end 6, an inner diameter size of the first inner diameter end 5 is smaller than an inner diameter size of the second inner diameter end 6. Therefore, the shape of the longitudinal profile of the flow channel 2 is a trapezoidal shape.

According to another preferred embodiment of the above smoke filtering device, the flow channels 2 are in a straight-through structure and/or a bent structure.

According to another preferred embodiment of the above smoke filtering device, the shape of the longitudinal profile of the flow channel 2 is formed by two rectangles connected in a front-rear direction and has a bent structure, having a middle portion as the bent portion 7.

In the present disclosure, the smoke filtering device is made through a one-time injection-molding process.

In the present disclosure, the smoke filtering device can use injection-molding raw materials, such as PS (polystyrenes), PP (polypropylene), AS (styrene-acrylonitrile copolymers), ABS (acrylonitrile-butadiene-styrene), PLA (polylactic acid), PBS (polybutylene succinate), and PBAT (polybutylene adipate terephthalate). Any raw materials that can realize one-time injection molding can be used for implementing the solutions of the present disclosure.

According to another preferred embodiment of the above smoke filtering device, the flow channels 2 are each provided therein with at least one smoke filtering component 9.

According to another preferred embodiment of the above smoke filtering device, the smoke filtering component 9 includes a light-free catalyst filtering layer 10 and a polypropylene electret filtering layer 11.

According to another preferred embodiment of the above smoke filtering device, the smoke filtering component 9 includes an inner barrel 12, an outer barrel 13 and swirling blades 14 provided between the inner barrel 12 and the outer barrel 13, wherein the inner barrel 12 and the outer barrel 13 are coaxially provided; the inner barrel 12 is detachably connected with a blocking mechanism 15 for blocking an inner passage of the inner barrel 12. Preferably, the blocking mechanism 15 is in form of blind plates connected to two ends of the inner barrel 12. When the smoke passes through the above smoke filtering component 9, the smoke flows in a swirling manner along the swirling blades 14, which prolongs smoke passages to a certain extent, further prolongs duration of the smoke staying in the flow channels 2, and improves a filtering effect for the smoke in the flow channels 2.

Preferably, a torsion angle between a top edge and a bottom edge of the swirling blade 14 is 30° - 60° . The swirling blades 14 are designed in a torsional manner, wherein the angle between the top edge and the bottom edge of one swirling blade 14 is the torsion angle, which torsion angle can be 30° , 45° or 60° . A torsional rotation direction of the swirling blades 14 can be of two types, i.e. the clockwise direction and the anticlockwise direction.

According to another preferred embodiment of the above smoke filtering device, the flow channels 2 are each provided therein with at least one baffle plate 16. The baffle plate 16 and an inner wall of the flow channel 2 forms a flow guide passage 17.

Preferably, the flow channels 2 are each provided therein with a plurality of baffle plates 16 arranged in parallel at intervals, and two adjacent baffle plates 16 and an inner wall of the flow channel 2 form a flow guide passage 17.

Preferably, the baffle plate 16 is provided with a plurality of curved portions 18. The curved portions 18 on the baffle plate 16 can enhance a turbulent degree of gas in the flow guide passages 17, and can prolong the duration of the gas staying in the flow guide passages 17, improving the filtering efficiency. The curved portions 18 can be in an arc shape or also can be in an angular shape (formed by bent sheets with an angle therebetween), of which a section also can be in an isosceles trapezoidal shape.

Preferably, the curved portions 18 each include a first bent sheet 19, a second bent sheet 20 and a third bent sheet 21 connected in sequence, and the first bent sheet 19 and the second bent sheet 20 are both provided to

define an angle with the third bent sheet 21. Such arrangement manner increases the turbulent degree of the smoke inside the flow guide passages 17, and increases random motion of the gas, such that the probability of the smoke striking the baffle plates 16 is increased, meanwhile, the duration of the smoke staying in the flow guide passages 17 is also prolonged, thus greatly improving the filtering efficiency of the smoke filtering device.

According to certain embodiments, referring to FIG. 1, an appearance of the body 1 is in a cylindrical shape, the body has six flow channels 2 uniformly distributed therein, and the flow channels each have a cross section in a circular shape. Among the six flow channels 2, the first inner diameter segments 3 of two flow channels 2 face up, the second inner diameter segments 4 of the other four flow channels 2 face up. The six flow channels are distributed uniformly, ensuring that this smoke filtering device has a symmetrical structure which is symmetrical in a front-rear direction. Here, the smoke enters from an end A and is discharged from an end B.

Optionally, in specific implementation, also, in the six flow channels 2, the first inner diameter segments 3 of three flow channels 2 may face up, the second inner diameter segments 4 of the other three flow channels 2 may face up.

According to certain embodiments, referring to FIG. 2, the appearance of the body 1 is in a cylindrical shape, the body has seven flow channels 2 uniformly distributed therein, and the flow channels each have a cross section in a circular shape. There is a bent portion 7 in a middle portion of the flow channel 2. This smoke filtering device is in a symmetrical structure which is symmetrical in a front-rear direction. Here, the smoke enters from an end A and is discharged from an end B.

According to certain embodiments, referring to FIG. 3, the appearance of the body 1 is in a cylindrical shape, with a concave platform 8 at both upper and lower ends. The body has 16 flow channels 2 uniformly distributed therein, and the flow channels each have a cross section in a circular shape. The flow channels 2 are uniformly distributed, ensuring that this smoke filtering device has a symmetrical structure which is symmetrical in a front-rear direction.

According to certain embodiments, referring to the structure of the flow channel 2 shown in FIG. 4, a shape of a longitudinal profile of this flow channel 2 is a trapezoidal shape.

According to certain embodiments, referring to the structure of the smoke filtering component 9 shown in FIG. 5, a light-free catalyst filtering layer 10 and a polypropylene electret filtering layer 11 are provided in a stacking manner; in use, cigarette smoke enters the flow channel 2, passes through the polypropylene electret filtering layer 11, to filter out most of smoke particle pollutants. Then, the cigarette smoke passes through the light-free catalyst

filtering layer 10 to filter out most of harmful substances such as nicotine, nitrosamine, and benzopyrene. Finally, the cigarette smoke enters a mouth of a smoker. Harm of the cigarette smoke to the body in the smoking process is significantly reduced. Increasing or decreasing the number of the polypropylene electret filtering layer can change the filtering efficiency, so as to satisfy requirements of different population to health.

According to certain embodiments, referring to the structure of the smoke filtering component 9 shown in FIG. 5, this smoke filtering component 9 includes an inner barrel 12, an outer barrel 13, swirling blades 14, a support ring, and a blocking mechanism 15 (for example, a blind plate). The support ring is connected to an upper edge of an outer wall of the outer barrel 13, and four holes are circumferentially provided uniformly on the support ring for connection and fixation. The inner barrel 12 and the outer barrel 13 are provided coaxially, the swirling blades 14 are between the inner barrel 12 and the outer barrel 13, and a torsional rotation direction of the swirling blades 14 is the clockwise direction. The blind plate blocks a top end of the inner barrel.

The present disclosure further relates to a use of the above smoke filtering device in a cavity-combined filter rod.

Embodiment 1

A polystyrene smoke filtering device with a diameter of 6mm and a length of 20mm is manufactured through a one-time injection molding process. An appearance of the polystyrene smoke filtering device is in a cylindrical shape. The polystyrene smoke filtering device has six flow channels 2 uniformly distributed therein. The flow channels each have a cross section in a circular shape. The flow channels 2 each have an inner diameter of 0.2mm for a front 10mm segment, and an inner diameter of 0.4mm for a rear 10mm segment. Among the six flow channels 2, first inner diameter segments 3 of three flow channels 2 face up, second inner diameter segments 4 of the other three flow channels 2 face up, the six flow channels are distributed uniformly, ensuring that this smoke filtering device has a symmetrical structure which is symmetrical in a front-rear direction.

Embodiment 2

A polybutylene succinate smoke filtering device with a diameter of 10mm and a length of 5mm is manufactured through a one-time injection molding process. An appearance of the polybutylene succinate smoke filtering device is in a cylindrical shape. The polybutylene succinate smoke filtering device has eight flow channels 2 uniformly distributed therein. The flow channels each have a cross section in a circular shape with a diameter of 1mm. There is a bent portion 7 in a middle portion of the flow channel 2.

Embodiment 3

A styrene-acrylonitrile copolymer smoke filtering device with a diameter of 4mm and a length of 25mm is manufactured through a one-time injection molding process. An appearance of the styrene-acrylonitrile copolymer smoke filtering device is in a cylindrical shape, which has two ends (i.e. the upper and lower ends) each provided with a concave platform 8 with a height of 3mm. The styrene-acrylonitrile copolymer smoke filtering device has a plurality of flow channels 2 uniformly distributed therein. The flow channels each have a cross section in a circular shape. The flow channels are uniformly distributed, ensuring that this smoke filtering device has a symmetrical structure which is symmetrical in a front-rear direction.

As a variation, the structure of the flow channel 2 as shown in FIG. 4 also can be used. This flow channel 2 has a front end in a square shape with a side length of 0.2mm, and a tail end in a square shape with a side length of 0.3mm, and has a longitudinal profile in a trapezoidal shape. Among the eight flow channels 2, first inner diameter ends 5 of four flow channels 2 face up, second inner diameter ends 6 of the other four flow channels 2 face up, thus ensuring that the filtering device has a symmetrical structure which is symmetrical in a front-rear direction.

60 commercially available common cigarettes were chosen as control sample.

The smoke filtering device of Embodiment 1 was processed to manufacture a filter rod by combining cavities, then another 60 commercially available common cigarettes were taken, and tows therein were drawn out and replaced by the combined filter rod.

Similarly, the smoke filtering devices of Embodiments 2 and 3 were processed respectively to manufacture a filter rod by combining cavities. Another 60 commercially available common cigarettes were taken for each case, and tows therein were drawn out and replaced by the compounded filter rods. Smoke test was carried out for the above 240 cigarettes in 4 groups, and results are as follows:

Item	TPM	H ₂ O	NIC	NFDPM	CO
	mg/per cigarette	mg/per cigarette	mg/per cigarette	mg/per cigarette	mg/per cigarette
Control Sample	13.5	1.5	0.76	11.24	10.6
Embodiment 1	11.6	1.6	0.75	9.25	9.8
Embodiment 2	11.3	1.55	0.71	9.04	9.7
Embodiment 3	11.5	1.48	0.73	9.29	10.1

In the above, TPM refers to a total particulate matter in the smoke, NIC refers to the content of nicotine in the smoke, and NFDPM (nicotine-free dry particulate matter) refers to a tar content. Detection methods thereof are

conventional methods existing in the art, for example, detections are carried out according to the methods recorded in GB/T19069-2004.

Data analysis:

Through the conventional smoke detection of the cigarettes, compared with the control sample, Embodiments 1-3 according to the present disclosure have a significantly reduced tar content (NFDPM), about 17% in average.

Thus, the smoke filtering device of the present disclosure has the following effects.

Due to its particular external structure design, the smoke filtering device of the present disclosure can be directly used in the cavity-combined filter rod. The smoke filtering device of the present disclosure has good mechanical processability.

Due to its particular internal structure design, the smoke filtering device of the present disclosure increases the length of the flow channels for the smoke, increases the duration of the smoke staying in the flow channels, improves the collision efficiency of the smoke, and thus reduces the harmful substances such as tar in the smoke.

In the smoke filtering device of the present disclosure, all the materials used are food-grade raw materials, and the raw materials are odorless, tasteless, heat-proof and so on. Therefore, on the basis of reducing the harmful substances such as tar in the smoke, no unfavorable odor will be introduced or generated.

It is worth noting that the smoke filtering device of the present disclosure not only can be used in the conventional cigarettes, but also can be used in heat-not-burn cigarettes.

Industrial Applicability

The smoke filtering device of the present disclosure can settle and adsorb a part of harmful substances such as tar in the smoke, and has industrial applicability.

Claims:

1. A smoke filtering device, characterized by comprising a body, in which flow channels are provided for allowing smoke to flow therethrough, with the flow channels filtering the smoke by prolonging duration of the smoke staying in the flow channels.
2. The smoke filtering device of claim 1, characterized in that the body is a cylindrical body, with a diameter of 4-10mm, and a height of 3-25mm.
3. The smoke filtering device of claim 1 or 2, characterized in that the body is internally symmetrical in structure, and the structure symmetrical is axially symmetrical along a linear line perpendicular to an axis of the body.
4. The smoke filtering device of any one of claims 1-3, characterized in that the flow channels have an inner diameter of 0.2-1.0mm.
5. The smoke filtering device of any one of claims 1-4, characterized in that a sectional shape of each flow channel is a circular shape, an oval shape, a polygonal shape or an irregular shape.
6. The smoke filtering device of any one of claims 1-5, characterized in that the flow channels are distributed in a discrete and uniform manner, or regularly distributed in rows or columns inside the body.
7. The smoke filtering device of any one of claims 1-6, characterized in that an upper end face and/or a lower end face of the body has a structure of a concave platform.
8. The smoke filtering device of any one of claims 1-7, characterized in that the flow channels each have a first inner diameter segment and a second inner diameter segment in communication with each other, wherein an inner diameter size of the first inner diameter segment is smaller than an inner diameter size of the second inner diameter segment.
9. The smoke filtering device of any one of claims 1-7, characterized in that the flow channels each have a first inner diameter end and a second inner diameter end, wherein an inner diameter size of the first inner diameter end is smaller than an inner diameter size of the second inner diameter end.
10. The smoke filtering device of any one of claims 1-9, characterized in that the flow channels are in a straight-through structure and/or a bent structure.
11. The smoke filtering device of any one of claims 1-7, characterized in that a shape of a longitudinal profile of each flow channel is formed by two rectangles connected in a front-rear direction and has a bent structure having a middle portion as a bent portion.

12. The smoke filtering device of any one of claims 1-7, characterized in that the flow channels are each provided therein with at least one smoke filtering component.
13. The smoke filtering device of claim 12, characterized in that the smoke filtering component comprises a light-free catalyst filtering layer and a polypropylene electret filtering layer.
14. The smoke filtering device of claim 12, characterized in that the smoke filtering component comprises an inner barrel, an outer barrel and swirling blades provided between the inner barrel and the outer barrel, wherein the inner barrel and the outer barrel are coaxially provided; and the inner barrel is detachably connected with a blocking mechanism configured for blocking an inner passage of the inner barrel.
15. The smoke filtering device of claim 14, characterized in that a torsion angle between a top edge and a bottom edge of each swirling blade is 30°-60°.
16. The smoke filtering device of any one of claims 1-7, characterized in that the flow channels are each provided therein with at least one baffle plate, and the at least one baffle plate and an inner wall of the flow channel define a guide flow passage.
17. The smoke filtering device of any one of claims 1-7, characterized in that the flow channels are each provided therein with a plurality of baffle plates arranged in parallel at intervals, and two adjacent baffle plates and an inner wall of the flow channel define a flow guide passage.
18. The smoke filtering device of claim 16 or 17, characterized in that the baffle plate is provided with a plurality of curved portions.
19. The smoke filtering device of claim 18, characterized in that the curved portions each comprise a first bent sheet, a second bent sheet and a third bent sheet connected in sequence, and the first bent sheet and the second bent sheet are both provided to define an angle with the third bent sheet.
20. The smoke filtering device of any one of claims 1-19, characterized in that the smoke filtering device is used in a cavity-combined filter rod.