L’invention concerne un élément filtrant pour filtre à air, constitué d’une cartouche filtrante (2; 8; 10) pourvu de plis en zigzags, en papier filtré ou en non tissé filtrant, et d’un joint (6) s’étendant sur les bords extérieurs du côté plat de la cartouche filtrante (2; 8; 10), joint par l’intérimaire duquel l’élément filtrant (1; 7; 9; 10) repose sur une partie d’un corps de filtre. La cartouche filtrante à plis (2; 8; 10) présente, sur un côté, un contour s’écartant, au moins dans des zones prédéfinies, en ce qui concerne la surface, d’un plan, et également un pliage en zigzags allant d’un bord à l’autre.
(54) Title: FILTER ELEMENT FOR AN AIR FILTER AND A METHOD FOR THE PRODUCTION THEREOF

(54) Bezeichnung: FILTERELEMENT FÜR EINEN LUFTFILTER UND EIN VERFAHREN ZU DESSEN HERSTELLUNG

(57) Abstract

The invention relates to a filter element for an air filter, comprising a filter insert (2; 8; 10) and a seal (6) running around the outer edges of said filter insert (2; 8; 10) on the flat side. This filter insert (2; 8; 10) is folded in a zigzag format and consists of filter paper or filter fabric. The filter element (1; 7; 9; 10) rests against the casing parts of a filter casing through the seal (6). The folded filter insert (2; 8; 10) has a contour on one side deviating extensively from one plane in at least certain predetermined areas, thus creating a continuous zigzag fold.

(57) Zusammenfassung

Die Erfindung betrifft ein Filterelement für einen Luftfilter, bestehend aus einem zick-zack-förmig gefalteten Filtereinsatz (2; 8; 10) aus Filterpapier oder Filtervlies und einer auf der ebenen Seite des Filtereinsatzes (2; 8; 10) an den Außenkanten umlaufenden Dichtung (6), mit der das Filterelement (1; 7; 9; 10) an Gehäuseteilen eines Filtergehäuses anliegt. Der gefaltete Filtereinsatz (2; 8; 10) weist an einer Seite eine zumindest in vorgegebenen Bereichen flächenhaft von einer Ebene abweichende Kontur und dabei eine durchgehende Zick-Zack-Faltung auf.
Filter Element for an Air Filter and a Method for the Production Thereof

State of the art

The invention relates to a filter element for an air filter with a folded filter insert, in particular for the filtering of the intake air of an internal combustion engine, in accordance with the type in the principal claim and the claim for the process.

It is known from DE 42 18 396 A1 that filter elements, particularly when used in the internal combustion engines of trucks and building machinery, are produced with a relatively large filter surface. These filter elements are provided on one side with a seal which runs at least around the edge in order to seal the unfiltered air side from the filtered air side.

The known filter element can be structured additionally such that particular geometries in the filter housing or on the bordering aggregates are accommodated by combining individual filter elements with folds of differing heights. The individual filter elements are then each produced separately and are joined to each other with

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additional connection links which also function as hinges.

Objects of the Invention

The object of the invention is to develop a filter element of the kind described in the introduction such that a contour of the folded filter insert, adjustable for optimization, can be achieved simply.

Advantages of the invention

The folded filter insert of the filter element according to the invention advantageously exhibits on its one side a contour which is two-dimensional and at least partially deviates from a plane and additionally exhibits a continuous zigzag folding. According to the invention, in order to optimize the functioning of the filter by better utilizing the space in the region of this side of the filter insert, the filter element can easily be adapted to fit complex structures in the intake region of an internal combustion engine. Due to the good layout of the filter element with respect to the geometry in the intake path, the invention also helps improve the flow pattern on this air intake side of the filter element.

For example, also slopes, pointed or curved contours can be provided on the appropriate side of the filter insert, where, due to the continuous zigzag folds, a largely even functioning of the filter is ensured over the entire filter surface. On the other side of the filter element, a uniformly flat surface is present there without connection links since the regions of different fold height transition continuously into one another.
In a simple method for producing the filter element according to the invention, folded regions of the filter insert with differing fold heights are prefabricated and, during assembly of the filter element, are glued together, stamped together or firmly fixed together in some other way with the fold that adjoins each one.

Separately, it is known from DE 42 23 723 C2 that, in order to produce the zigzag-shaped filter insert, webs with filter paper from a supply roll are unrolled and are imprinted in preparation for folding. These imprinted filter paper webs are then folded in a device at the imprints. In order to produce a filter element in accordance with the invention, the distances between the imprints are varied in a simple way such that different fold heights are achieved and therefore on one side of the folded web a correspondingly changed contour is created.

Other advantageous exemplary embodiments are given in the subclaims.

**Drawing**

Exemplary embodiments of the inventive filter element with a folded filter insert are explained using the drawing. Shown are:

Figure 1 a first exemplary embodiment with a contour of different levels on one side of the filter insert;

Figure 2 another view of the exemplary embodiment according to Figure 1;
Figure 3 a second exemplary embodiment with a slope contour on one side of the filter insert;

Figure 4 a third exemplary embodiment with a curved contour on one side of the filter insert;

Figure 5 a fourth exemplary embodiment of a filter element with areas of different fold direction for the filter insert regions;

Figure 6 a representation of the exemplary embodiment in accordance with Figure 2 with parts of a housing and

Figure 7 a representation of the exemplary embodiment in accordance with Figure 3 with part of a housing.

Description of the Working Embodiment

Shown in Figure 1 is a cross section of a filter element 1 with a zigzag-structured filter insert 2, which on its underside has a folded region 3 with a relatively low fold height and a folded region 4 with a relatively high fold height. A different view of the filter element 1 can be seen in Figure 2, in which on the right side there is a folded region 5 likewise with a low fold height. These regions can be arranged in different positions in additional exemplary embodiments, not pictured here, depending on the situation of their use.

The filter element 1 has, running around its upper side, a seal 6 with which the filter element 1 can be tightly fit into a filter housing, not pictured here, for an air filter in the air intake path of an internal combustion engine. The unfiltered air which is sucked in flows in accordance with an arrow 11 through the filter.

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element 1 from the contour adapted side to the other side, pictured here above, whereby optimal flow patterns occur here due to the contour of the one side of filter insert 2, adapted to the geometry of the intake path.

The production of the filter insert 2 in accordance with Figures 1 and 2 can occur with the individual regions 3 and 4 being produced separately and then the respective adjoining folds of folded regions 3, 4, 5 being attached to each other.

For an exemplary embodiment in accordance with Figure 3, a filter element 7 is provided with a filter insert 8 which runs in a slope on the contour adapted side. The fold height, changing here along the surface of this side of filter insert 8, can be achieved by changing the distance between folds when folding the paper webs or fabric webs, based on the (DE 42 23 723 C2) folding process, already assumed known in the introduction to the specification.

In order to have an optimum adaptation of the contour for curved geometries in the intake path, one side of a filter insert 10 is also correspondingly curved to fit in the exemplary embodiment of a filter element 9 in accordance with Figure 4. This changing curve, for example, can also be produced by correspondingly directing a change in the distance between folds or between the imprinting in the folding process.

In the exemplary embodiment in accordance with Figure 5, a filter element 12 is provided with two folded regions 13 and 14 which each fold in different directions.

Figure 6 shows the filter element in accordance with Figure 2, having a housing 20, in which the unfiltered
air enters on the side according to arrow 21. Due to this, an even volume flow can be achieved since, because of the relatively large filter surface in the back region 4, a relatively large volume flow can occur here in spite of the distance from the entrance point. This effect can be seen with equal clarity in Figure 7, since here with the filter surface becoming continuously smaller in accordance with Figure 3, the volume flow can be reduced in the front area at the entrance point and thus be evened out.
Reference Numeral List

1 = Filter element
2 = Filter insert
3 = Fold region
4 = Fold region
5 = Fold region
6 = Seal
7 = Filter element
8 = Filter insert
9 = Filter element
10 = Filter insert
11 = Arrow (direction of flow)
12 = Filter element
13 = Fold region
14 = Fold region
20 = Housing
21 = Arrow (raw air inflow)
1) Filter element for an air filter, comprising

- a zigzag-shaped folded filter insert (2;8;10) made of filter paper or filter fabric,

- a seal (6) running around the outer edges of the flat side of the filter insert (2;8;10), with which the filter element (1;7;9;12) touches the housing parts of a filter housing, whereby

- the folded filter insert (2;8;10) exhibits on one side a contour which, at least in specified areas, is two-dimensional and deviates from a plane and exhibits thereby a continuous zigzag folding.

2) Filter element in accordance with claim 1, characterized in that

- on the side where the folded filter insert (2;8;10) lies on a component with a two-dimensional uneven contour, it has on its locating face a corresponding contour which likewise deviates from a plane.

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3) Filter element in accordance with claim 1, characterized in that
- the folded filter insert (2;8;10) exhibits on the unfiltered air side a fold height which can be changed such that the volume flow is even over the total surface of the filter insert.

4) Filter element in accordance with claim 3, characterized in that
- at the entrance point of the unfiltered air, the folded filter insert (2;8;10) exhibits the relatively smallest filter surface due to a relatively low filter height and that the fold height steadily or unsteadily increases in the direction away from the entrance point.

5) Filter element in accordance with one of the previous claims, characterized in that
- the contour is formed on one side of the filter insert (2) by folded regions (3,4,5), each with fold heights different from each other, which each are glued together, pressed together, stamped together or affixed together in some other way with the adjoining folds of the neighboring folded region (3,4,5).
6) Filter element in accordance with one of claims 1 through 3, characterized in that

- the contour on one side of the filter insert (2;8;10) is produced in one stage by variably changing the fold height of individual folds or a group of folds.

7) Filter element in accordance with one of the proceeding claims, characterized in that

- the contour on one side of the filter insert (2;8;10) is formed by a variable changing of the fold height in one coordinate at a time.

8) Filter element in accordance with one of the claims 1 through 6, characterized in that

- the contour on one side of the filter insert (2;8;10) is formed by a variable changing of the fold height in both coordinates.

9) Filter element in accordance with one of the proceeding claims, characterized in that

- the contour on one side of the filter insert (2;8;10) is determined by the geometry of the neighboring aggregate present on this side after the filter element (1;7;9;10) is installed in the intake path of an internal combustion engine.
10) Process for producing a filter element in accordance with one of the claims 5 through 8, in which

- filter material webs for the filter insert (8;10) are imprinted in preparation for folding at predetermined distances which differ in part from each other and then are folded according to the imprints and then

- the filter material webs are separated from a supply web, fixed in their position and provided with the surrounding seal.