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(54) Benævnelse: **Sål til en sko, navnlig en sportssko**

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Description

The invention relates to a sole of a shoe, particularly of an athletic shoe, wherein the sole has an extension in a longitudinal direction and an extension in a vertical direction perpendicular thereto, wherein a number of recesses is introduced into the sole, wherein the recesses extend in a transverse direction perpendicular to the longitudinal direction and perpendicular to the vertical direction and permeate the sole at least in part, wherein there is a first group of recesses which, without external forces on the sole, are larger in the vertical direction than in the longitudinal direction, wherein there is a second group of recesses which, without external forces on the sole, are smaller in the vertical direction than in the longitudinal direction, wherein at least in sections, at least one row of recesses is arranged adjacent to each other in the longitudinal direction, wherein a recess of the second group is arranged between two recesses of the first group, wherein an upper row of recesses and a lower row of recesses are arranged above one another at least in sections in the vertical direction.

In the case of sports shoes, an attempt is made to give the sole a certain and desired spring behaviour by means of the geometric design of the sole. This means that the sole exhibits a desired deformation behaviour in the vertical direction when subjected to the weight of the wearer of the shoe, in particular a certain characteristic curve between the force applied and the strain in the vertical direction.

A sole of the type mentioned above is known from **DE 20 2005 017 043 U1**. Similar and other solutions are shown in **US 2008/127513 A1**, **DE 34 40 206 A1**, in **US 2009/0064542 A1** and in **US 2 983 056 A**.

Another sole is known from **US 2 983 056 A**. The body of the sole is provided here in transverse direction with a plurality of recesses, which are formed circularly, laterally on the sole, thus seen in transverse direction. The recesses have different diameters, whereby one with a smaller diameter is located between two recesses with a larger diameter. Such recesses can be used to influence the spring or damping behaviour of the sole.

The invention is based on the object to further develop a shoe sole of the type mentioned above in such a way that it becomes possible to influence the spring and damping behaviour of the sole in a desired, predetermined improved manner.

The invention solves the object according to independent claim 1.

The solution of this object by the invention is characterized in that the two rows are arranged relative to each other in such a way that a recess of the first group lies vertically above a recess of the second group, wherein, without external forces on the sole, the largest dimension of a recess in a first direction is at least 150 % of the largest dimension of the recess in a second direction perpendicular to the first direction and wherein the recesses, seen in the transverse direction, have a peripheral contour which has the shape of an eight. The recesses penetrate preferably at least partially the sole completely in the transverse direction.

The recesses extend thereby preferably along a straight line, they are thus designed straight and linear respectively.

Without external forces on the sole, preferably the largest dimension of a recess in a first direction is thereby at least 180 % of the largest dimension of the recess in a second direction perpendicular to the first direction. The recess has in this case in a central region preferably a restriction with a minimum extension which is at most 90%, preferably at most 80%, of the largest dimension in the second direction.

The largest dimension is thereby preferably between 8 mm and 18 mm, specifically preferred between 10 mm and 15 mm.

The wall thickness of the material of the sole remaining between the recesses is preferably substantially constant at least in sections. Insofar, it is preferred that the wall thickness at least in sections is in a range between 80 % and 120 % of an average value of the wall thickness (the average value of the wall thickness is the arithmetic mean, which is determined for the respective wall thicknesses between adjacent recesses over a given defined area of the lateral surface of the sole).

The sole consists preferably of polyurethane material, thermoplastic polyurethane (TPU) or thermoplastic elastomer (TPE) or comprises at least this material. The material of the sole is thereby preferably foamed.

The material of the sole has preferably a density between 0.20 and 0.50 g/cm^3. It has preferably a hardness between 30 and 50 Asker C.

The sole can be designed as a midsole. Thereby, it is possible that an outer sole is placed below the midsole.

The recesses are preferably arranged in the longitudinal direction over at least 33 % of the total longitudinal extension of the sole. They are preferably arranged at least in a midfoot region and a rearfoot region of the sole.

The proposed design of the sole makes it possible to influence the control of the spring and cushioning properties or the hardness of the sole in a simple way. By the design of the recesses it is possible to realize a desired spring deflection when the sole is loaded with the weight of the wearer of the shoe equipped with the sole.

The present invention is based on the use of so-called "Mechanical Meta Material", in which it is intended that various rows of openings (known are mainly round or oval recesses in cross-section) of different sizes are or are to be introduced into the sole in order to achieve a certain spring or cushioning behaviour of the sole. This enables "Engineered Damping", in which the spring or damping properties obey a desired characteristic curve.

When a deformation force – caused by the weight of the wearer of the shoe – is applied, the resulting cells collapse in a special way so that special spring or damping characteristics can be realized.

In this respect, a "programmable folding or collapsing" of the sole structure is achieved, so to speak, since the structure itself forms a coherent system and the individual material sections are interdependent.

The advantages of the proposed structure can lead to a "negative stiffness", i.e. if the sole is slightly compressed in a vertical direction, the sole collapses in a defined way. It is also possible to structure the sole in the way described above in such a way that it has a sufficient degree of elasticity on the one hand and absorbs deformation energy as a result of a deformation force on the other.

In the drawings an embodiment of the invention is shown.

Fig. 1 shows a sole of a sports shoe, wherein said sole comprises a midsole and an outsole,

Fig. 2 shows the section "X" according to figure 1 in more detail, seen in a transverse direction perpendicular to the longitudinal direction of the sole and perpendicular to the vertical direction, and

Fig. 3 shows a recess in the sole with details of its geometry.

Figure 1 shows a sole 1, which extends in a longitudinal direction L (corresponding to the longitudinal axis of the shoe with the sole) and in a vertical direction V (the vertical direction V indicates the direction when the shoe or the sole is standing on the ground when used as intended). Furthermore, sole 1 extends in a transverse direction Q, which is perpendicular to both the longitudinal direction L and the vertical direction V.

Sole 1 is here designed as a midsole, to the upper side of which the (not shown) shoe upper is attached in the known manner. An outer sole 6 is attached to the bottom of the sole.

Recesses 2 are incorporated into the sole 1. Preferably, these recesses extend in transverse direction Q over the entire width of the sole 1. Details on the design and arrangement of recesses 2 are shown in figures 2 and 3. For this purpose, figure 2 shows the detail "X" according to figure 1 and figure 3 shows the geometrical design of a preferred design of a single recess 2.

As can be seen in figure 2 in combination with figure 1, two rows 3 and 4 of recesses 2 are incorporated into the sole 1. Thereby, two groups of recesses 2 are employed:

A first group of recesses 2' is designed in such a way that – without external forces on the sole 1 – the recesses 2' are larger in vertical direction V than in longitudinal direction L. Then there is a second group of recesses 2", which – again without external forces on the sole 1 – are smaller in vertical direction V than in longitudinal direction L. As can be seen in figure 2, in each row 3, 4 in longitudinal direction L the recesses 2', 2" are arranged next to each other in such a way that between two recesses 2' of the first group a recess 2" of the second group is arranged.

The individual recesses 2', 2" are each designed in such a way that they have the shape of an "eight" when viewed in transverse direction Q. Reference is made in particular to figure 3.

Accordingly, each recess 2', 2" has in a first direction R1 a largest dimension G (which is preferably between 10 mm and 15 mm); in a second direction R2, which is perpendicular to the first direction R1, the largest dimension of recess 2', 2" is denoted with K. The dimension G is at least 150 % (particularly preferably even at least 180 %) of the dimension K.

In the central area along the extension in the first direction R1, the recess 2', 2" has a restriction 5 (which results in the shape of an "eight"), so that the recess 2', 2" has a minimal extension k here. This minimum extension k is preferably at most 90 %, especially preferably at most 80 %, of the dimension K.

The remaining wall thickness t, which results between adjacent recesses 2', 2", must also be mentioned. This is denoted in figure 2 at various points. If one determines an (arithmetic) mean value between the respective wall thicknesses t over a selected area (such as the area shown in Figure 2), it is preferably intended that the wall thickness t remains essentially constant. Specifically, this can be quantified to the effect that the wall thickness t at any point of the selected area is not less than 80 % and not more than 120 % of the mean wall thickness t.

Through the proposed design, it can be achieved that the sole of the shoe has a special spring or cushioning behaviour, whereby, in particular when subjected to the weight of the

wearer of the shoe, a predetermined collapse of the sole occurs as a result of the recesses, which provides a pleasant feeling of wear.

Reference Numerals:

1	Sole
2	Recess
2‘	Recess of the first group
2‘‘	Recess of the second group
3	Row of recesses
4	Row of recesses
5	Restriction
6	Outer sole

L	Longitudinal direction
V	Vertical direction
Q	Transverse direction

R1	First direction
R2	Second direction
G	Biggest dimension of the recess in the first direction
K	Biggest dimension of the recess in the second direction
k	Smallest extension
t	Wall thickness

PATENTKRAV

1. Sål (1) til en sko, navnlig en sportssko, hvorved sålen (1) har en udstrækning i længderetningen (L) såvel som en udstrækning i en herpå vinkelret, vertikal retning (V), hvorved der i sålen (1) er indføjet et antal udsparinger (2), hvorved udsparingerne (2) strækker sig i en tværretning (Q) vinkelret på længderetningen (L) såvel som vinkelret på vertikalretningen (V) og mindste delvist trænger gennem sålen (1),

hvorved der foreligger en første gruppe udsparinger (2'), som uden ydre kræfter på sålen (1) er dannet som større i vertikal retning (V) end i længderetning (L),

hvorved der foreligger en anden gruppe udsparinger (2'') som uden ydre kræfter på sålen (1) er dannet som mindre i vertikal retning (V) end i længderetning (L),

hvorved der i det mindste afsnitsvist i længderetning (L) ved siden af hinanden er arrangeret mindst en række (3, 4) af udsparinger (2', 2''), hvorved der mellem to udsparinger (2') i den første gruppe er arrangeret en udsparing (2'') i den anden gruppe,

hvorved der i det mindste afsnitsvist i vertikal retning (V) oven over hinanden er arrangeret en øvre række (3) af udsparinger (2', 2'') og en anden række (4) af udsparinger (2', 2''),

kendetegnet ved, at

de to rækker (3, 4) er arrangeret således i forhold til hinanden, at en udsparing (2') i den første gruppe ligger vertikalt oven over en udsparing (2'') i den anden gruppe, hvorved, uden ydre kræfter på sålen (1), den største dimension (G) for en udsparing (2) i en første retning (R1) mindst andrager 150% af den største dimension (K) for udsparingen (2) i en anden retning (R2), som er vinkelret på den første retning, og hvorved udsparingerne (2), set i tværsnit (Q), har en periferikontur, der har form som et ottetal.

2. Sål ifølge krav 1, **kendetegnet ved, at** udsparingerne (2) i det mindste delvist trænger helt gennem sålen (1) i tværgående retning (Q).

3. Sål ifølge krav 1 eller 2, **kendetegnet ved, at** udsparingerne (2) strækker sig langs en ret linje.

4. Sål ifølge et af kravene 1 til 3, **kendetegnet ved, at,** uden ydre kræfter på sålen (1), den største dimension (G) for en udsparing (2) i en første retning (R1) mindst andrager 180% af den største dimension (K) for udsparingen (2) i en anden retning (R2), der er vinkelret på den første retning.

5. Sål ifølge et af kravene 1 til 4, **kendetegnet ved, at** udsparingen (2) i et midterområde omfatter en indsnøring (5) med en minimal udstrækning (k), som højst andrager 90%, fortrinsvis højst 80% af den største dimension (K) i den anden retning (R2).

6. Sål ifølge et af kravene 1 til 5, **kendetegnet ved, at** den største dimension (G) er mellem 8 mm og 18 mm, fortrinsvis mellem 10 mm og 15 mm.

7. Sål ifølge et af kravene 1 til 6, **kendetegnet ved, at** vægtykkelsen (t) af materialet i sålen (1), og som forbliver mellem udsparingerne (2), er konstant, i det mindste afsnitsvist.

8. Sål ifølge krav 7, **kendetegnet ved, at** vægtykkelsen (t), i det mindste afsnitsvist, ligger i et interval mellem 80% og 120% af den gennemsnitlige værdi for vægtykkelsen (t).

9. Sål ifølge et af kravene 1 til 8, **kendetegnet ved, at** den består af polyurethan-materiale, af termoplastisk polyurethan (TPU) eller af termoplastisk elastomer (TPE) eller omfatter dette materiale.

10. Sål ifølge krav 9, **kendetegnet ved, at** materialet i sålen (1) er skummet.

11. Sål ifølge et af kravene 1 til 10, **kendetegnet ved, at** materialet i sålen har en densitet mellem 0,20 og 0,50 g/cm^3.

12. Sål ifølge et af kravene 1 til 11, **kendetegnet ved, at** materialet i sålen har en hårdhed mellem 30 og 50 Asker C.

13. Sål ifølge et af kravene 1 til 12, **kendetegnet ved, at** den er eller omfatter en mellemsål, hvorved der navnlig under mellemsålen er arrangeret en ydre sål (6).

14. Sål ifølge et af kravene 1 til 13, **kendetegnet ved, at** udsparingerne (2) er arrangeret i længderetningen (L) over mindst 33% af hele længdeudstrækningen for sålen (1).

15. Sål ifølge et af kravene 1 til 14, **kendetegnet ved, at** udsparingerne (2) i det mindste er arrangeret i et midterfod-område og et bagfod-område for sålen (1).

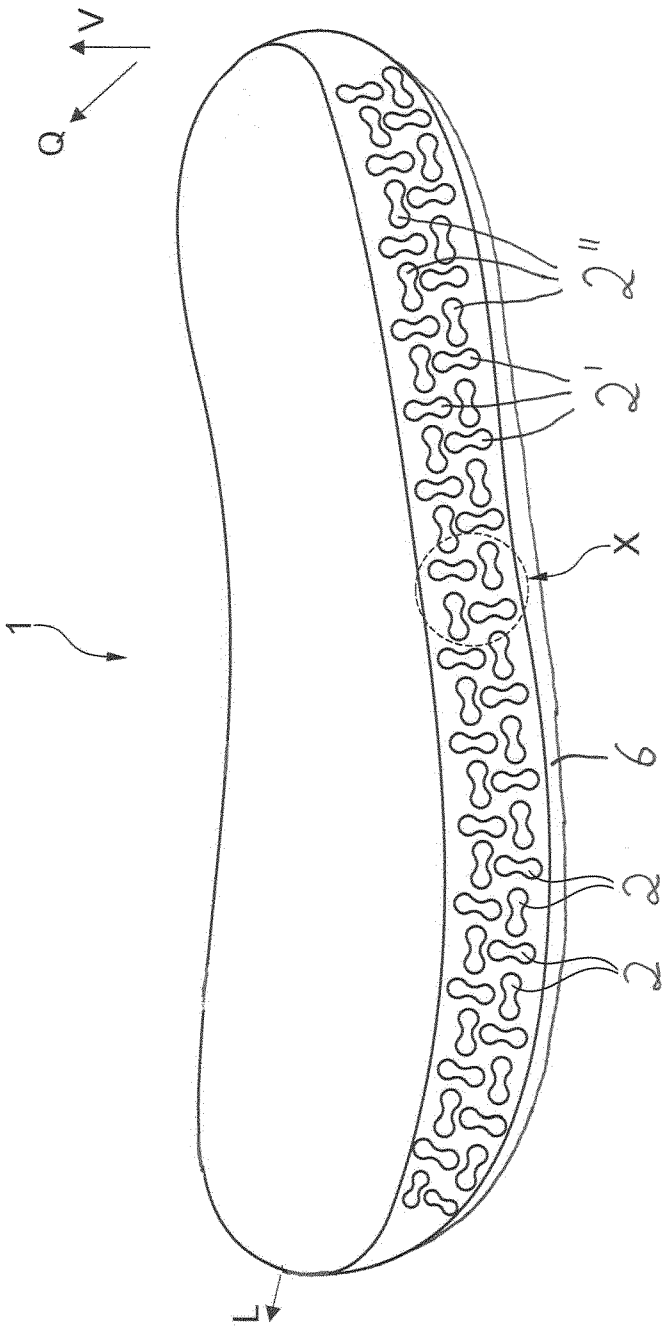

Fig. 1

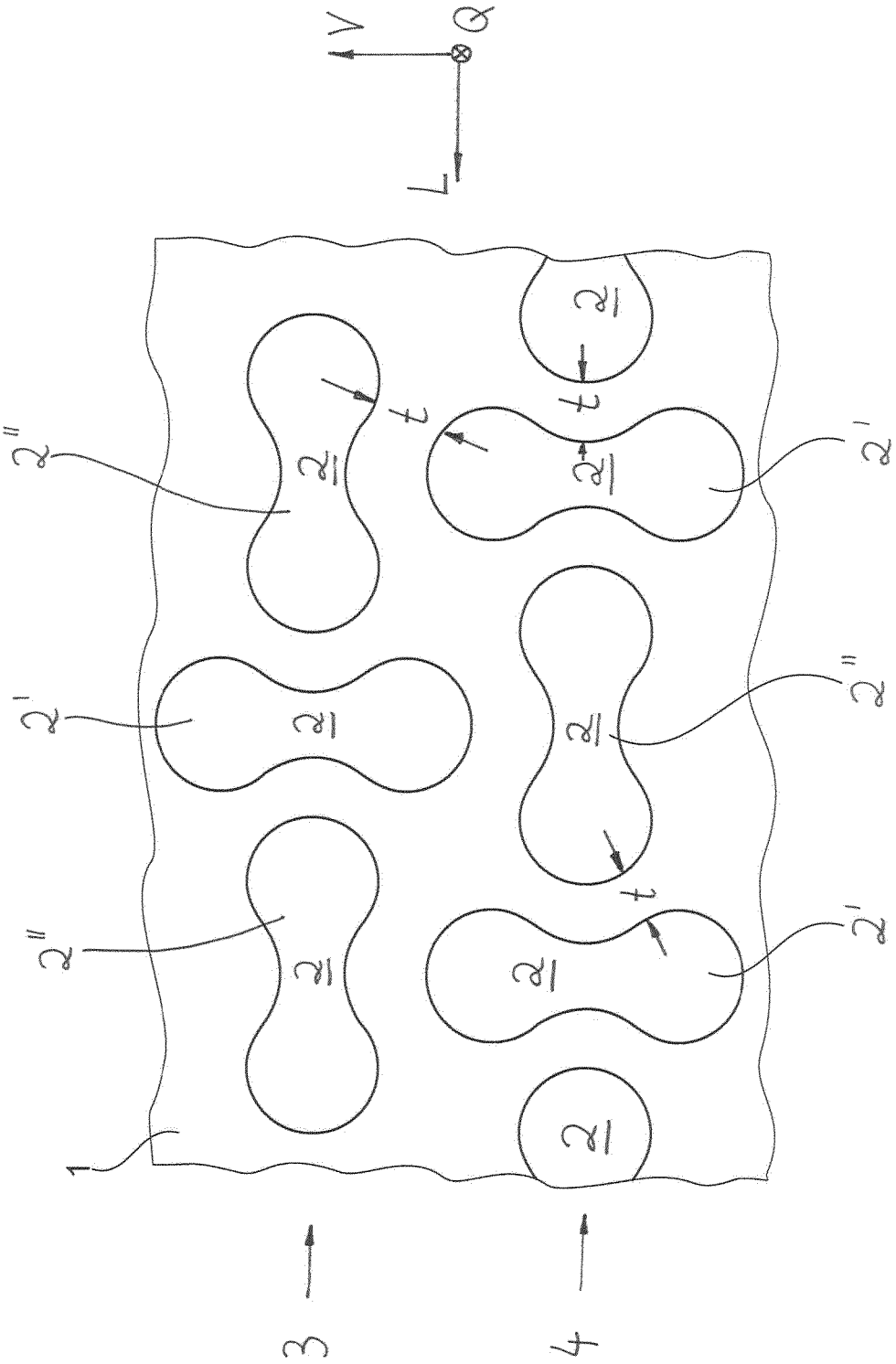

Fig. 2

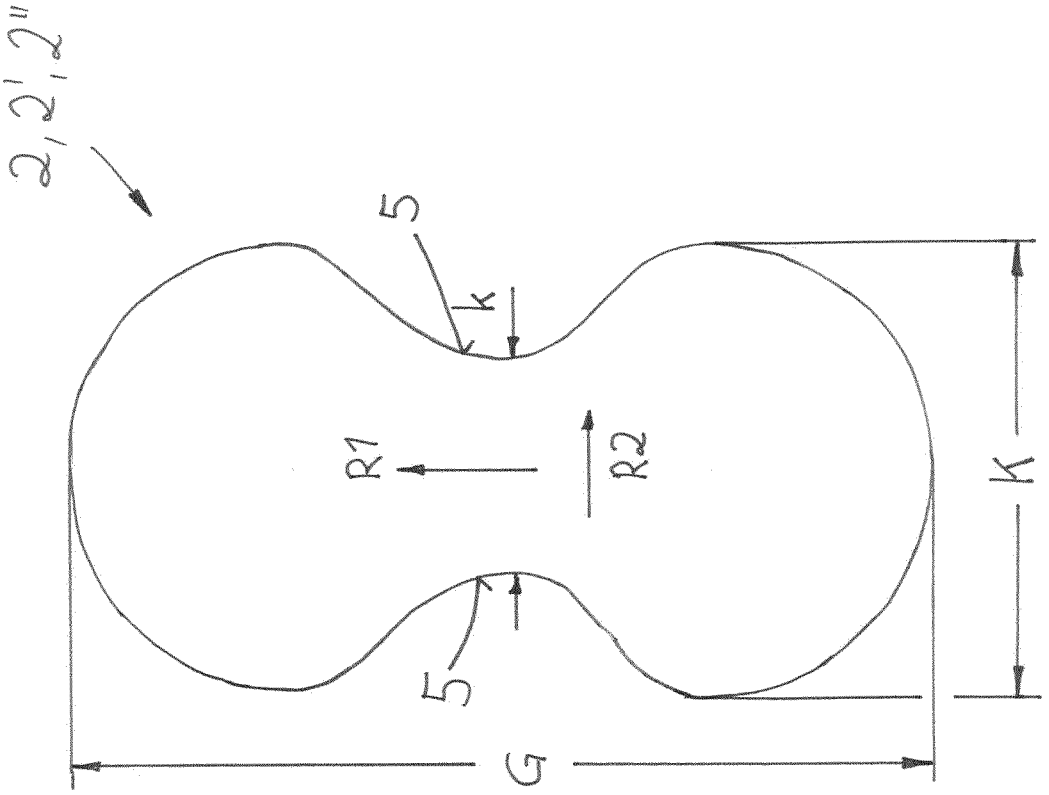

Fig.3