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(54) Sporting shoe with a sole having a number of studs

(57) The present invention relates to a sporting shoe with a sole (13) having a tip (26) and a heel (28), a longitudinal axis (L), a border line (20) with an external part (11) and an internal part (12) divided by the tip (26) and the heel (28), wherein the sole (13) is subdivided into a forefoot section (30), a mid foot section (32) and a rear foot section (34), the sole comprising a number of studs (14).

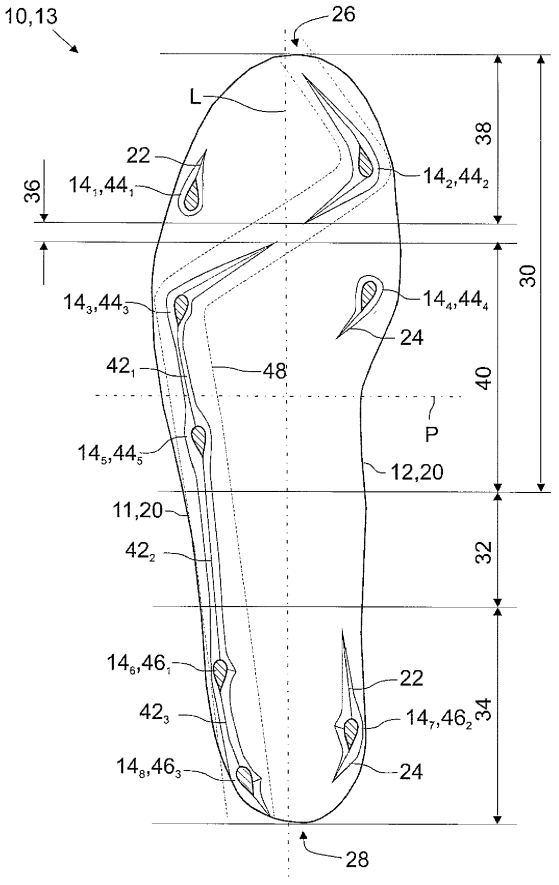

Fig.1

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Description

[0001] The present invention relates to a sporting shoe with a sole, the sole defining a tip, a heel and a border line with an external part and an internal part divided by a longitudinal axis of the sole, the sole is subdivided into a forefoot section, a mid foot section and a rear foot section, wherein the sole comprising a number of studs.

[0002] This kind of shoe is particularly used in ball games like football and rugby. The demands sporting shoes have to comply with are noticeably different from running shoes. In ball games the person wearing the shoe, i.e., the player, constantly accelerates, decelerates and changes the running direction. This pattern of movement requires a high amount of traction to the ground which is particularly crucial as these ball games are typically conducted on lawn that may be slippery. As a result, known sporting shoes have a number of studs that provide improved traction compared to running shoes. Examples of traditional sporting shoes with studs are disclosed in the US 200410107606 and in the EP 1 241 958. These studs are detachably fastened to the sole of the sporting shoe, enabling the replacement of the studs in case they are damaged or to account for different ground conditions.

[0003] In order to enable high running velocities and quick accelerations, one strives for reducing the weight of the sole as far as possible. The use of light materials such as thermoplastic polyurethane is one approach to reduce the weight. In this case the studs are usually fully integrated into the sole and not detachable. Reducing the number of studs is a further approach to reduce the weight. However, the reduction of studs is accompanied by a loss of traction so that this approach is only applicable to a certain extend.

[0004] The studs shown in the US 200410107606 and in the EP 1 241 958 have a conical or cylindrical shape. This shape leads to a suboptimal ground penetration and release. As a consequence, a certain amount of energy is lost in these processes that lead to a longer ground time and a reduced average velocity of the player. Moreover, the deceleration with these studs is very high which leads to a high adverse stress to the human tissue and ligament involved.

[0005] In traditional sporting shoes the studs located in the rear foot section of the sole are functionally disconnected from the forefoot section failing to interact in a complementary fashion. This functional disconnection through the mid foot between the rear foot and the forefoot section lends to suboptimal performance attributes, e.g. velocity or speed. Typically, replaceable or not, studs have not harmonised in such a way as to optimise flow of force, angle of approach, momentum, inertia and efficiency of ground penetration and release.

[0006] The geometry and dimensions of the studs shown in the US 200410107606 and in the EP 1 241 958 are symmetrical and generally uniform. This does not reflect the different foot and toe functionality and structural requirements to execute high force, frequency and velocity manoeuvring and running intrinsic to sport and in particular to ball games, resulting in suboptimal performance.

[0007] In order to allow the foot to follow the natural and physiological trajectory, the sole needs certain flexibility. However, sporting shoes known in the art are not optimally designed with respect to the needed flexibility. Moreover, the weight of the studs relocates the centre of gravity of the sole away from the foot of the player. This leads to an unnatural and non-physiological trajectory when running with these shoes.

[0008] It is thus the aim of the present invention to provide a sporting shoe that provides maximised traction at minimised weight, concurrently influencing the physiological trajectory of the foot as little as possible and reducing the stress to muscles and tissues. Moreover, the average velocity and dynamic stability of the player should be increased.

[0009] The aim is reached by a sporting shoe as initially described, in which at least one stud comprises a leading fin at least partially extending from the stud towards the tip and/or a trailing fin at least partially extending from the stud towards the heel, a contact path runs within the sole starting from the heel close to the external part through the rear foot section and the mid foot section into the forefoot section, changing to the internal part within the forefoot section and terminating at the tip, one or more of the studs comprising a leading fin and/or a trailing fin are located within the contact path, and the leading fin and/or the trailing fin are aligned within the contact path.

[0010] The course of the contact path is based on the following considerations: The physiological trajectory during ground contact of a running person can be subdivided into different phases. The first phase may be called the braking phase in which the heel of the foot contacts the ground, the forward momentum is reduced, shock is absorbed and the foot begins to pronate. A pronation is a rotation of the foot around its longitudinal axis lifting the external side and lowering the internal side of the foot. This phase is followed by a suspension phase in which the spring ligament captures weight, acting like a trampoline. In this phase the foot is supinating which is a rotation in the opposite direction of the pronation. Within the next phase that may be described as the locking phase the lateral portion of the foot becomes rigid, forming a forefoot lever. In the locking phase the foot supinates. The last phase is the gearing phase in which the big toe together with the first and second metatarsal propel the weight forward. In this phase the foot supinates. This movement is superposed by a dorsal and plantar flexion of the foot which are rotations around the pitch axis of the foot. Moreover, the foot rotates around an axis perpendicular to the longitudinal and the pitch axes leading to yaw. Considering that the movement of the foot when contacting the ground while running is three-dimensional.

[0011] One basic idea of the present invention is that

the physiological trajectory of the foot during ground contact should be disturbed as little as possible by the sporting shoe. Thus, the contact path is determined by a runner running barefoot which is the most natural and most physiological way of running. The area of the foot in contact with the ground is the physiological contact path. The contact path is extending along the external part of the foot up to approximately two thirds of the length of the foot starting from the rear foot before it turns to the internal part up to approximately five sixths of the foot length. Within the last sixth of the foot length the contact path is turning towards the tip of the sole where it terminates. The arrangement of the studs within the contact path reflects the pronation and supination of the foot when contacting the ground.

[0012] The studs located within the contact path are crucial for traction. According to the invention, the studs are located where they are mostly needed. The number of studs can be reduced without a significant loss in traction. Since the number of studs can be reduced, the ground penetration is easier. Concomitantly, the release of the shoe off the ground is easier which leads to a shorter time on the ground and thus to a higher average velocity of the player.

[0013] The leading and trailing fins are also located within the contact path support the foot to follow the physiological contact path. The physiological trajectory of the foot is only minimally disturbed when wearing the inventive sporting shoe which leads to a reduced stress of muscles and ligament. Optimal stud geometry is not symmetrical as human propulsion is not symmetrical. In this novel sole each stud orientation, dimension and design are optimised for traction, penetration, release and velocity gain.

[0014] In a preferred embodiment the leading fins and the trailing fins of two or more neighbouring studs are merging into each other forming a merged fin. Thus the rigidity of the studs is enhanced without disturbing the physiological trajectory of the foot.

[0015] Beyond that, the forefoot section comprises a flex zone allowing for the facilitated flexing of the sole, the flexing zone further subdividing the forefoot section into a frontal zone and a rear zone, the flex zone being free of studs, trailing fins and leading fins. The rear-foot section extends approximately up to one third of the length of the sole from the heel of the sole. The mid foot section joins the rear foot-section and accounts for approximately 15 to 20% of the length of the sole. The remaining portion is covered by the forefoot section. The flex zone is located approximately at three quarters of the length of the sole, starting from the heel. The propulsion of the player by the big toe together with the first and second metatarsal is supported by the flex zone. As stated above, the design soles of known sporting shoes does not consider the needed flexibility such that the physiological trajectory is disturbed. In contrast to that, the high flexibility of the sole in the flex zone only imposes little disturbances on the physiological trajectory increasing the average velocity of the player.

[0016] Preferably, the rear foot section comprises three rear studs, wherein one rear stud is located outside the contact path, the base of each rear stud has a tripod geometry. The design of the rear foot section is paramount since in ball games the majority, i.e., approximately 80% of ground contacts are initiated at the rear-foot section. The tripod geometry of each stud increases the stability of the sporting shoe even if the other studs have not yet reached the ground. Traditional sporting shoes do not functionally address the most common complaint afflicting sports, namely the lateral or inversion ankle sprain. Within the breaking and locking phase it is mainly the rear foot section that is in contact with the ground. The three rear studs together act as a tripod as well so that the sporting shoe is sufficiently stabilised when the three rear studs penetrate the ground. With the tripod geometry both of the studs themselves as well as of the rear foot section there is lateral resistance to the rolling of the ankle outwards which reduces the danger of rolled ankle and ligament injuries.

[0017] The inventive sole reflects three-dimensional and triplanar kinematics and kinetics of the initial contact trigger and subsequent actions which have been largely overlooked in the design of traditional sporting shoes as the crucial components optimising speed gains as the foot and boot engage to ground generating the GRF (Ground Reaction Force).

[0018] The inventive sole takes advantage of GRF location, magnitude and vector direction as a necessary factor producing velocity optimisation. So, rather than view a posterolaterally placed rear studs as an inefficient perturbation the inventive sole initiates and utilises the body's own muscle tuning and speed generation optimisation.

[0019] In another embodiment the side surface of the rear studs comprise at least two areas having a concave curvature and at least one area having a convex curvature with reference to a sectional plane parallel to the sole. The convex curvature enables the location of the studs together with their leading fins and trailing fins close to the border line of the sole. The stud in the very back position almost terminates with the heel of the sole. With this arrangement the centre of gravity of the player is closer to the initial contact point between stud and ground. The turning moment is reduced and the propulsion enhanced. At the same time the stress to muscles and ligament is reduced. Moreover, the flow of force is introduced into the sole more evenly and gently. As the stud in the very back position is located at a maximum distance from the rear stud outside the physiological path, the pronation of the foot is enhanced such that the rear stud outside the physiological path is more strongly introduced into the ground. The supported pronation produces an enhanced stability against rolled ankle injury.

[0020] In another favoured embodiment the mid foot section is free of studs but interstratified by one or more merged fins. Since the pronation and the supination of

the foot in this section are of minor degree, no studs are needed here. The merged fin however supports the flow of force such that there is a functional connection between the rear-foot section and the forefoot section.

[0021] Preferably, the forefoot section comprises five fore studs, two of them located outside the contact path. This arrangement secures high rotational stability which is crucial when the player wearing the sporting shoe wants to change the direction of movement that is predominantly done when the centre of gravity is located within the forefoot section.

[0022] Another embodiment is characterised in that the flex zone subdivides the forefoot section into a frontal zone and a rear zone, the studs have a top surface forming one apex, the apex of the studs located in the frontal zone essentially pointing to a tip of the sole and the apex of the remaining studs essentially pointing to the heel of the sole. In other words the top surface has the shape of an airfoil. The direction into which the apex is pointing indicates the task the stud predominantly has to fulfil. When the apex is pointing to the tip of the sole the respective stud is mainly involved in the acceleration of the sporting shoe.

[0023] In contrast, studs with surfaces whose apex is pointing towards the heel of the sole are mainly involved in the deceleration of the sporting shoe. As indicated before, the studs of the forefoot section engage the ground during the gearing phase. Since the big toe and the first and second metatarsal are propelling the player forwardly, the studs in the most frontal position mainly support the acceleration and propulsion. Hence, their apexes are pointing towards the tip of the sole. The remaining studs are mainly involved in the deceleration of the foot and thus the apex is pointing towards the heel. By this arrangement the side of the stud opposite of the apex has a higher resistance within the ground than the side forming the apex. During deceleration the sporting shoe tends to move forward whereas during acceleration the sporting shoe tends to move backward. The arrangement of the apex is considering the different direction of movement and secures optimal stability. However, the cross section of the studs is chosen such that the shoe can be stabilised irrespective of the movement of the sporting shoe.

[0024] Compared to conical studs the inventive studs have a reduced resistance within the ground along the longitudinal axis of the sole. When decelerating, the forward movement of the sporting shoe is not entirely reduced to zero but maintained at a level that is sufficient to stabilise the sporting shoe. This design enables reduced deceleration which reduces the stress to the ligament and muscles. Moreover less energy and time are needed to accelerate back to the velocity before ground contact. Moreover, the aerodynamic drag is reduced compared to conical or cylindrical studs. The average velocity is enhanced and the player gains more speed.

[0025] Furthermore, the side surfaces of the fore studs located in the forefoot section comprise at least one area having a convex curvature with reference to a sectional plane parallel to the sole. The convex curvature also serves for controlling the resistance of the studs in the ground. Depending on the radius of the curvature, the resistance in the ground can be increased in one direction and decreased in another direction. Thus, the specific requirements in the forefoot section can be met.

[0026] Moreover, the side surfaces of the studs comprise an upper area joining the top surface in which the side surface runs perpendicular to the top surface. This stud design improves the ground penetration and release such that the stud can be introduced into the ground and afterwards extracted from the ground more easily with less energy. The time on the ground is reduced and the average running velocity of the player is enhanced.

[0027] In addition, the side surface of the stud comprises a lower area joining the base in which the side surface is inclined to the top surface increasing the extension of the stud towards the base. The extending dimensions of the stud on one hand increases the stability of the stud itself and on the other hand the stability of the player since a greater surface compared to a straight stud is active that reduces the pressure between the stud and the ground.

[0028] It is preferred that the side surface in the base area comprises a curvature. The force flow within the studs and fins can be guided through the sole in a more physiological way. Moreover, edges that may provoke stress peaks are avoided.

[0029] Beyond that, each of the studs has a height, the height of the rear studs being greater than the height of the remaining studs. The greater height of the rear studs in the rear foot section supports the foot to rotate around the pitch axis such that the foot can reach the gearing phase more easily since the rear foot remains at an elevated level compared to the fore foot during ground contact. This also decreases the energy and time needed during ground contact such that the average running velocity of the player is increased. The rotation of the foot around the pitch axis may be supported by a curvature of the sole itself.

[0030] Whereas in the event of pure forefoot contact as in the infrequent case of short duration maximal effort sprinting episodes during a game, the forefoot stud positioning and geometry optimise plate traction with ground penetration and release utilising the trailing and leading edges or fins of the studs.

[0031] In another embodiment, the top surfaces the rear studs are located within the same plane. The tripod geometry of the rear studs already improves the stability of the player, whereas the top surfaces of the rear studs located within the same plane further enhance the stability.

[0032] Moreover, the top surfaces the two studs located within the rear zone and adjacent to the flex zone are located within the same plane. This design supports the foot to rotate along the pitch axis such that the foot can reach the gearing phase more easily. The energy and

time needed during ground contact is reduced such that the average running velocity of the player is increased.

[0033] In addition, the top surfaces of the two studs located within the rear zone and adjacent to the flex zone and the top surfaces of the rear studs are located within the same plane. It has turned out that this design reflects the most the physiological trajectory of the foot when contacting the ground. It is noted that the features regarding the top surfaced located within the same plane di not exclude that the sole comprises a curvature in itself such that the studs may have different heights in order to locate the top surfaces within the same plane.

[0034] Preferably, the sole has a rigidity that is increasing from the internal part to the external part. The changing rigidity reflects the human foot and ankle complex architecture and functional anatomy if one scrutinizes the medial and lateral aspects of the human specimen, where the lateral aspect acts more as a lever and the medial has more torsional capabilities.

[0035] The inventive sole considers the importance of the initial ground contact as a precursor to a mechanical 'preflex' mechanism acting as input to a centrally generated sensorimotor control being mediated via mechanoreceptors and neural connections to muscle. This is what delivers patterns of dynamic stability over speed ranges.

[0036] The player using the inventive sole can engage very fast providing sensory input and neural control or tuning which avoids energy loss via force dissipation which is only actively replenished through inappropriate levels of muscle action. The inventive sole favours optimal speed and efficiency.

[0037] The invention is now described in further detail by means of a preferred embodiment with reference to the attached drawings.

Figure 1 is a schematic bottom view of a sporting shoe according to the invention,

Figure 2 is a schematic bottom view of a first embodiment of a stud according to the invention,

Figure 3 is a perspective view of a stud according to the first embodiment,

Figure 4 is a perspective view of a second embodiment of a stud according to the invention,

Figure 5 is a schematic bottom view of a third embodiment of a stud according to the invention,

Figure 6 is a schematic side view of a forth embodiment of a stud according to the invention,

Figure 7 is a schematic side view of a fifth embodiment of a stud according to the invention,

Figure 8a) is a detailed view of a rear foot section of the sporting shoe according to the invention,

Figure 8b) is a detailed view of a rear foot section of the sporting shoe of the state of the art,

Figure 9a) is a plot of the velocity over time during ground contact for a sporting shoe according to the invention compared to a sporting shoe known in the art, and

Figure 9b) is a plot of the acceleration over time during ground contact for a sporting shoe according to the invention compared to a sporting shoe known in the art.

[0038] In Figure 1 an inventive sporting shoe 10 is schematically presented by means of a bottom view. It is thus the right sporting shoe 10 with a border line 20 having an external part 11 and an internal part 12. The sporting shoe 10 comprises a sole 13 with a longitudinal axis L and a plurality of studs 14, each stud 14 having at least one side surface 16 and a base 18 at which the stud 14 joins the sole 13 (cf. Figures 2 to 7). For the sake of clarity, only the sole 13 of the sporting shoe 10 is shown. However, the sole 13 is connected to the remaining parts of the sporting shoe 10 along the border line 20. The studs 14 comprise leading fins 22 and/or trailing fin 24, depending on their position (cf. Figures 2 to 7). Studs known in the art have a conical or cylindrical shape. In this context, a fin is considered as a part of the stud 14 extending in any direction from the stud 14 such that the shape of the stud 14 significantly deviates from a conical or cylindrical shape. More specifically, leading fins 22 are essentially extending along a longitudinal axis of the sporting shoe 10 towards a tip 26 of the sole 13 whereas trailing fins 24 are also essentially extending along the longitudinal axis but towards a heel 28 of the sole 13.

[0039] The sole 13 is subdivided into a forefoot section 30, a mid foot section 32 and a rear foot section 34. The forefoot section 30 comprises a flex zone 36 that is free of studs 14, trailing fins 24 and leading fins 22. The flex zone 36 subdivides the forefoot section 30 into a frontal zone 38 and a rear zone 40.

[0040] The sole is not to be considered as a plane surface. It rather comprises a curvature that considers the anatomical properties of the foot of a player.

[0041] As can be seen from Figure 1, the sole 13 comprises in total eight studs 14_1 to 14_8. The leading fins 22 and trailing fins 24 of the studs 14_3, 14_5, 14_6 and 14_8 are merging into each other forming merged fins 42_1 to 42_3. The mid foot section 32 does not comprise any studs but is interstratified by one merged fin 42_2. The forefoot section 30 comprises in total five fore studs 44_1 to 44_5. The stud 44_1 only has a leading fin 22 whereas the stud 44_4 only has a trailing fin 24. The rear foot section 34 comprises three rear studs 46_1 to 46_3 which have a base 18

of a tripod geometry (cf. Figures 2 and 3).

[0042] The studs 14_2, 14_3, 14_5, 14_6 and 14_8 are arranged within a contact path 48. The contact path 48 is based on the physiological contact path which is the path along which a foot is in contact with the ground when running barefoot. The contact path 48 is extending along the external part 11 of the border line 20 up to approximately two thirds of the length of the sole 13 starting from the heel 28 before it turns to the internal part 12 up to approximately five sixths of the sole length. Within the last sixth of the length of the sole 13 the contact path 48 is turning towards the tip 26 where it terminates. The studs 14_3, 14_5, 14_6 and 14_8 located contact path 48 are connected by merging fins 42. However, the flex zone 36 is free of studs and fins not to disturb the flexion of the sole 13 within the flex zone 36.

[0043] Figure 2 is a bottom view of a schematic drawing of a first embodiment of a stud 14_1 according to the invention. The side surface 16 comprises three areas 50_1 to 50_3. The area 50_1 has a convex curvature 52 and the areas 50_2 and 50_3 have a concave curvature 54. With this design three terminal points 56 are formed creating a tripod geometry within the stud 14_1, As also visible from Figure 3 that is a perspective view of an embodiment of a stud 14_{1a} similar to the stud 14_1, the stud 14_{1a} has a planar top surface 58. The top surface 58 has a shape that resembles an air foil and forms an apex 60.

[0044] With reference to Figure 1 the apexes 60 of the rear studs 46 and the fore studs 44 located within the rear zone 40 of the forefoot section 30 are essentially pointing towards the heel 28 of the sole 13. The apexes 60 of the fore studs 44 located within the frontal zone 38 are essentially pointing towards the tip 26 of the sole 13. The terms "heel" 28 and "tip" 26 are to be understood in a broad sense and are not to be reduced to a single point.

[0045] Figure 4 is a perspective view of a second embodiment of an inventive stud 14_2. It only comprises one trailing fin 24 but also has a tripod geometry when considering the terminal points 56.

[0046] Figure 5 is a schematic drawing of a third embodiment of a stud 14_3 according to the invention. The side surface 16 can be subdivided into two areas 50_1 and 50_2 which both have a convex curvature 52.

[0047] Figure 6 is a side view of a schematic drawing of a forth embodiment of a stud 14_4 according to the invention. The side surface 16 comprises an upper area 62 joining the top surface 58 and a lower area 64 joining the base 18. In the upper area 62 the side surface 16 runs perpendicular to the top surface 58 whereas in the lower area 64 the side surface 16 is inclined relative to the top surface 58. The lower area 64 forms the trailing fin 24 and the leading fin 22. Since the trailing fin 24 and the leading fin 22 have different inclinations, their longitudinal extension also differs. The studs 14 have the height h that is the distance between the base 18 and the top surface 58. The studs 14_1 to 14_8 have different heights h, e.g. as given in the following table:

Stud number	Height h (mm)
14_1	13
14_2	14
14_3	17
14_4	17
14_5	15
14_6	21
14_7	21
14_8	21

It is noted that the heights h given in the table are defined as the distance between the base 18 and the top surface 58 of the studs 14. The height h does not consider any curvatures of the sole 13.

[0048] The stud 14_5 according to a fifth embodiment shown in Figure 7 is slightly modified compared to the stud 14_4 of Figure 6. Still, the upper area 62 runs perpendicular to the top surface 58 and the lower area 64 is inclined relative to the top surface 58. However, the lower area 64 comprises a curvature such that the lower area 64 joins the upper area 62 without an edge.

[0049] In Figure 8 the rear foot section 34 of a sole 13 according to the invention (Figure 8a)) and of a sole 13_t of a traditional sporting shoe 67 are compared. The sole 13_t known in the art has cylindrical studs 68 without any trailing or leading fins 22, 24. As can be seen from Figure 8a) the trailing and leading fins 22, 24 of the rear studs 46 partly coincide with the border line 20 of the sole 13. In particular, the terminal point 56 of the trailing fin 24 of the rear stud 46_3 coincides with the initial contact line 70 which is the part of the border line 20 within the contact path 48 at the heel 28 of the sole 13. The leading and trailing fins 22, 24 of the rear stud 46_1 are almost coinciding with the border line 20.

[0050] Line C runs through the centre of gravity of a given person wearing the inventive sporting shoe 10 or the traditional sporting shoe 67. Due to the position of the rear stud 46_3 very close to the border line 20 and the heel 28 of the sole 13 the distance D_{c1} between the rear stud 46_3 and the centre of gravity is reduced compared to the distance D_{c2} of the traditional sporting shoe 67. The trajectory of the player wearing the inventive sporting shoe 10 is thus closer to the physiological trajectory.

[0051] In addition, the distance D_{s1} between the rear stud 46_3 and the rear stud 46_2 is larger compared to the distance D_{s2} of the traditional sporting shoe 67. As already explained in the introductory part, the foot starts to pronate immediately after having contacted the ground. Due to the larger distance D_{s2} the rear stud 46_2 is introduced into the ground with a higher turning moment. In the traditional sporting shoe 67 the interior studs 68 may not always be introduced into the ground which leads to a reduced traction. The inventive arrangement helps introducing the stud 14 such that the traction is guaranteed. As a result, three rear studs 46 are sufficient

and a tripod arrangement can be established which is the most efficient way to stabilise the rear foot section 34.

[0052] Figure 9a) is a theoretical plot of the velocity over time during ground contact for a sporting shoe 10 according to the invention compared to a traditional sports shoe 67, and Figure 9b) is a corresponding theoretical plot of the acceleration over the same time, both plots not scaled. Lines t represent the velocity and acceleration of the traditional sporting shoe 67 whereas lines i represent those of the inventive sporting shoe 10.

[0053] Starting with the traditional sporting shoe 67, the sporting shoe 67 is moved with a velocity V_{air} before it is contacting the ground. At t_{1t} the shoe 10 initially contacts the ground and the velocity is reduced to zero between t_{1t} and t_{2t}. The deceleration is shown in Figure 9b) as a negative acceleration having a relatively sharp peak which indicates a fairly abrupt deceleration. Between t_{2t} and t_{3t} the sporting shoe 10 rests on the ground and has the velocity zero. At t_{3t} the shoe 10 is lifted from the ground and accelerated back to the initial velocity V_{air}. This acceleration is shown in Figure 9b). At t_{4t} the traditional sporting shoe 67 reaches V_{air}. The period at which the velocity of the shoe 10 was below V_{air} is denominated with Δt_t.

[0054] In comparison to that, the inventive sporting shoe 10 according to the invention also contacts the ground at t_{1i} which leads to a reduction of the velocity. However, the velocity is never reduced to zero as the arrangement and the shape of the studs 14 allow for a controlled forward movement when introduced into the ground. The minimum velocity is reached at t_{2i} which is later than t_{2t}. The deceleration between t_{1i} and t_{2i} is not as sharp and distributed over a longer period which indicates a gentle deceleration leading to less stress to the muscles and ligament. The start of the acceleration is at t_{3i} which equals t_{2i}. As the velocity never reaches zero the deceleration is followed by acceleration until V_{air} is reached again at t_{4i}. The power and for accelerating the shoe 10 back to V_{air} is less compared to the traditional sporting shoe 67. The time the velocity of the inventive sporting shoe 10 is less than V_{air} (denominated wit Δt_i) is significantly reduced compared to Δt_t. This results in less time on the ground and a higher average velocity of the player.

[0055] It is noted that the plots of Figure 9 are mere theoretical plots and do not reflect any results of measurements. They thus only represent the basic concept underlying the present invention without representing any relations or magnitudes between the plotted units.

Reference list

[0056]

10	sporting shoe
11	external part
12	internal part
13, 13t	sole
14-14_8	stud
16	side surface
18	base
20	border line
22	leading fin
24	trailing fin
26	tip
28	heel
30	forefoot section
32	mid foot section
34	rear foot section
36	flex zone
38	frontal zone
40	rear zone
42 - 42_3	merged fin
44 - 44_5	fore stud
46 - 46_3	rear stud
48	contact path
50 - 50_3	area
52	convex curvature
54	concave curvature
56	terminal point
58	top surface
60	apex
62	upper area
64	lower area
66	curvature

67	traditional sporting shoe
68	cylindrical stud
70	initial contact line
a	acceleration
C	line
D_{c1}, D_{c2}	distance from centre of gravity
D_{S1},D_{s2}	distance between studs
h	height
L	longitudinal axis
P	pitch axis
t	time
V	velocity

Claims

1. Sporting shoe with a sole (13), the sole (13) defining a tip (26), a heel (28) and a border line (20) with an external part (11) and an internal part (12) divided by a longitudinal axis (L) of the sole (13),
the sole (13) is subdivided into a forefoot section (30), a mid foot section (32) and a rear foot section (34),
the sole (13) comprising a number of studs (14),
characterised in that

- at least one stud (14) comprises a leading fin (22) at least partially extending from the stud (14) towards the tip (26) and/or a trailing fin (24) at least partially extending from the stud (14) towards the heel (28),
- a contact path (48) runs within the sole (13) starting from the heel (28) close to the external part (11) through the rear foot section (34) and the mid foot section (32) into the forefoot section (30), changing to the internal part (12) within the forefoot section (30) and terminating at the tip (26),
- one or more of the studs (14) comprising a leading fin (22) and/or a trailing fin (24) are located within the contact path (48), and
- the leading fin (22) and/or the trailing fin (24) are aligned within the contact path (48).

2. Sporting shoe according to claim 1,
characterised in that the leading fins (22) and the trailing fins (24) of two or more neighbouring studs (14) are merging into each other forming a merged fin (42).

3. Sporting shoe according to claim 1 or 2,
characterised in that the forefoot section (30) comprises a flex zone (36) allowing for the facilitated flexing of the sole (13), the flexing zone further subdividing the forefoot section (30) into a frontal zone (38) and a rear zone (40), the flex zone (36) being free of studs (14), trailing fins (24) and leading fins (22).

4. Sporting shoe according any of the claims 1 to 3,
characterised in that the rear foot section (34) comprises three rear studs (14, 46), wherein one rear stud (46) is located outside the contact path (48).

5. Sporting shoe according claim 4,
characterised in that each stud (14) comprises a base (18) at which the stud (14) joins the sole (93), the base (18) of each rear stud (46) has a tripod geometry.

6. Sporting shoe according to claim 5,
characterised in that each stud (14) comprises at least one side surface (16), the side surface (16) of the rear studs (14, 46) comprises at least two areas (50) having a concave curvature (54) and at least one area (50) having a convex curvature (52) with reference to a sectional plane parallel to the sole (13).

7. Sporting shoe according to any of the claims 2 to 6,
characterised in that the mid foot section (32) is free of studs (14) but interstratified by one or more of the merged fins (42).

8. Sporting shoe according to any of any of the preceding claims,
characterised in that the forefoot section (30) comprises five fore studs (14, 44), two of them located outside the contact path (48).

9. Sporting shoe according any of the preceding claims,
characterised in that the studs (14) have a top surface (58) forming one apex (60), the apex (60) of the studs (14) located in the frontal zone (38) essentially pointing to the tip (26) and the apex (60) of the remaining studs (14) essentially pointing to the heel (28).

10. Sporting shoe according to any of the claims 8 or 9,
characterised in that the side surfaces (16) of the fore studs (14, 44) located in the forefoot section (30) comprise at least one area (50) having a convex curvature (52) with reference to a sectional plane parallel to the sole (13).

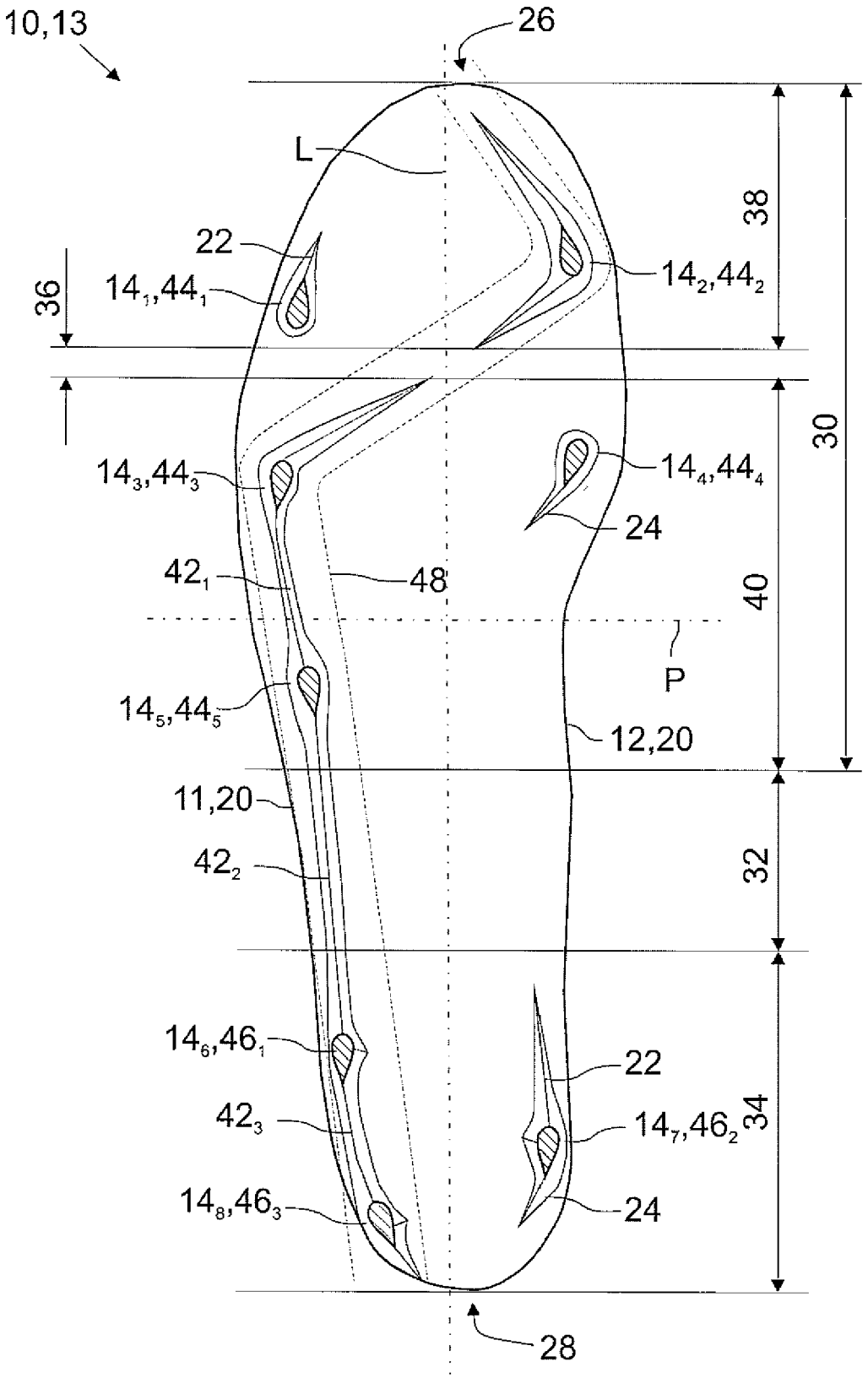
11. Sporting shoe according to any of the claims 9 or 10, **characterised in that** the side surfaces (16) of the studs (14) comprise an upper area (62) joining the top surface (58) in which the side surface (16) runs perpendicular to the top surface (58).

12. Sporting shoe according to any of the claims 9 to 11, **characterised in that** the side surface (16) of the stud (14) comprises a lower area (64) joining the base (18) in which the side surface (16) is inclined to the top surface (58) increasing the extension of the stud (14) towards the base (18).

13. Sporting shoe according to claim 12, **characterised in that** the side surface (16) in the base (18) area (50) comprises a curvature (66).

14. Sporting shoe according to any of the claims 4 to 13, **characterised in that** each of the studs (14) has a height (h), the height (h) of the rear studs (46) being greater than the height (h) of the remaining studs (14).

15. Sporting shoe according to any of the preceding claims, **characterised in that** the sole (13) has a rigidity that is increasing from the internal part (12) to the external part (11).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38
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36
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Fig.1

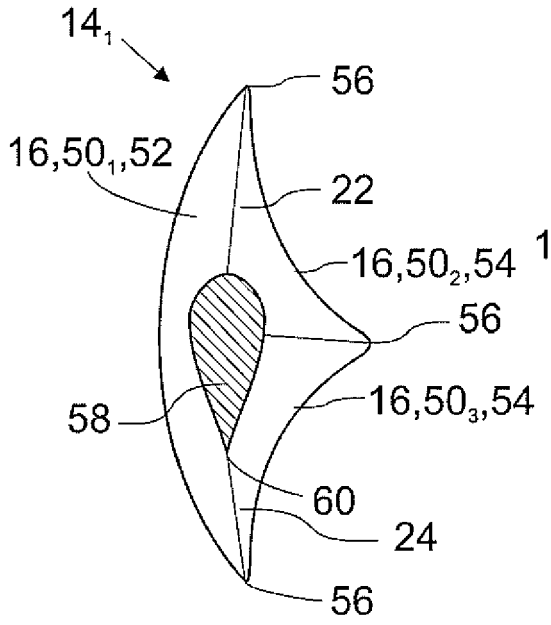


Fig.2

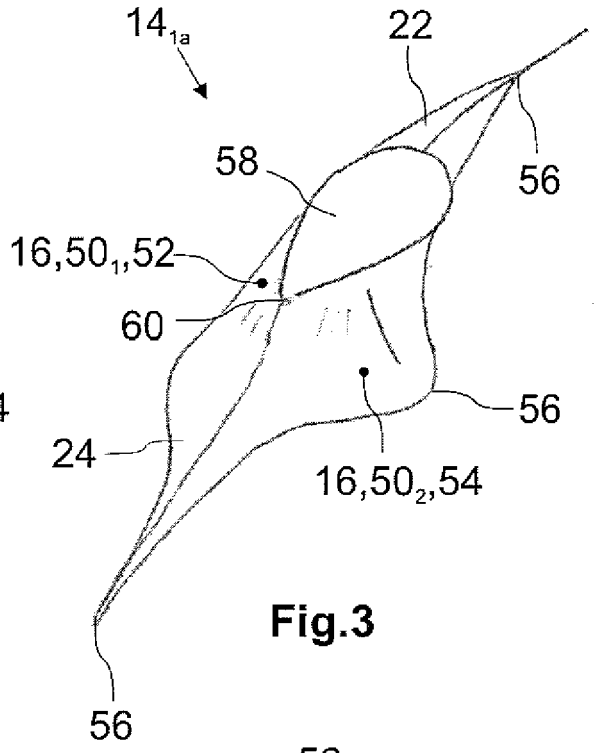


Fig.3

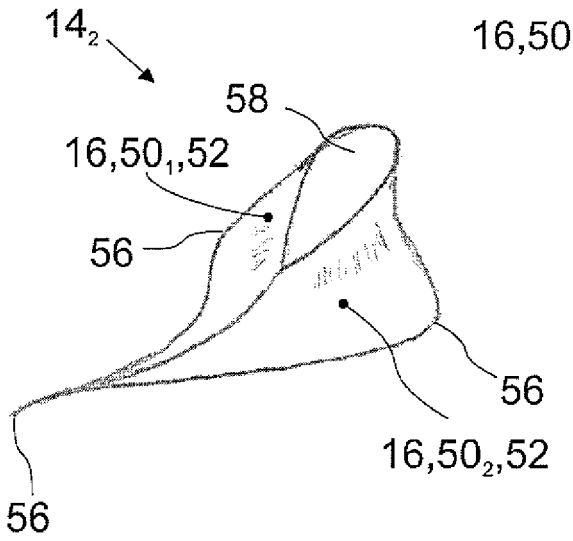


Fig.4

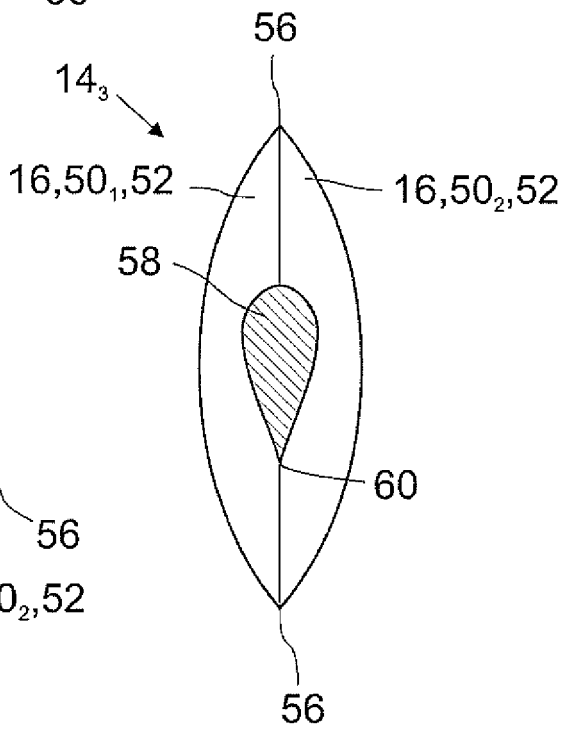


Fig.5

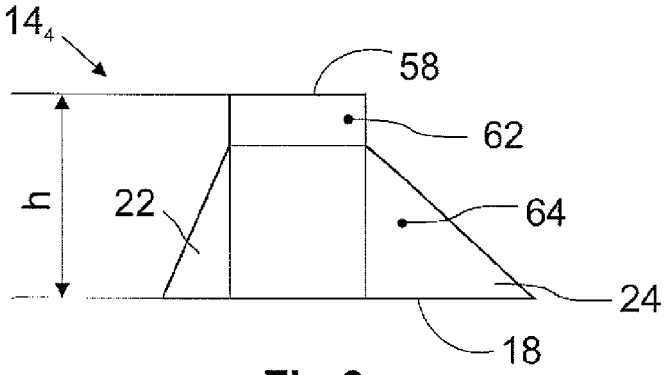


Fig.6

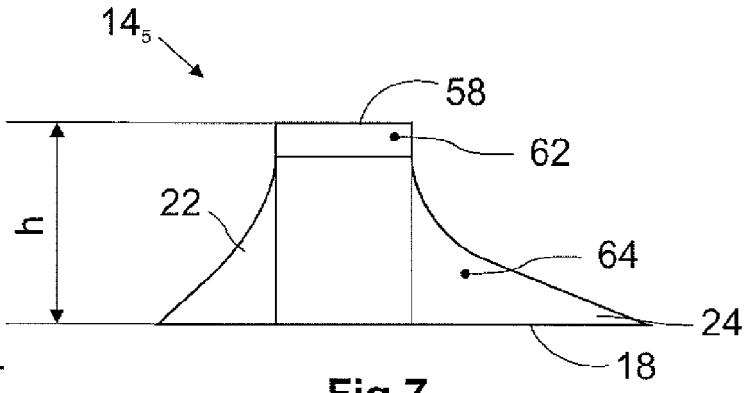


Fig.7

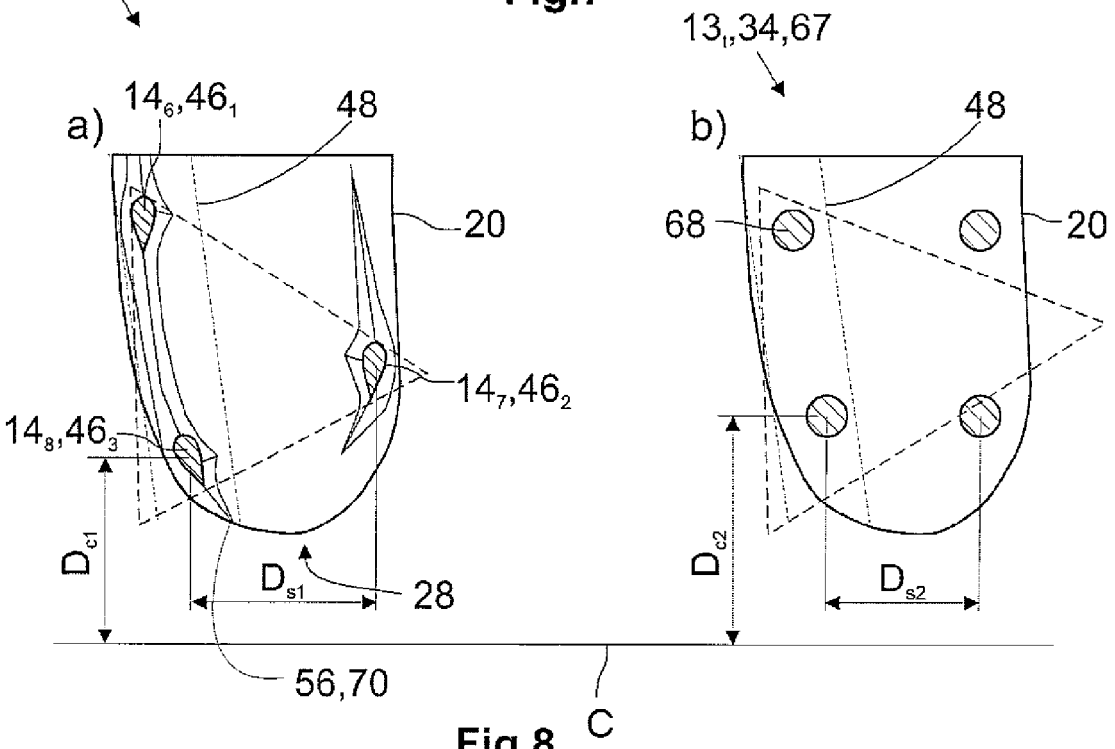
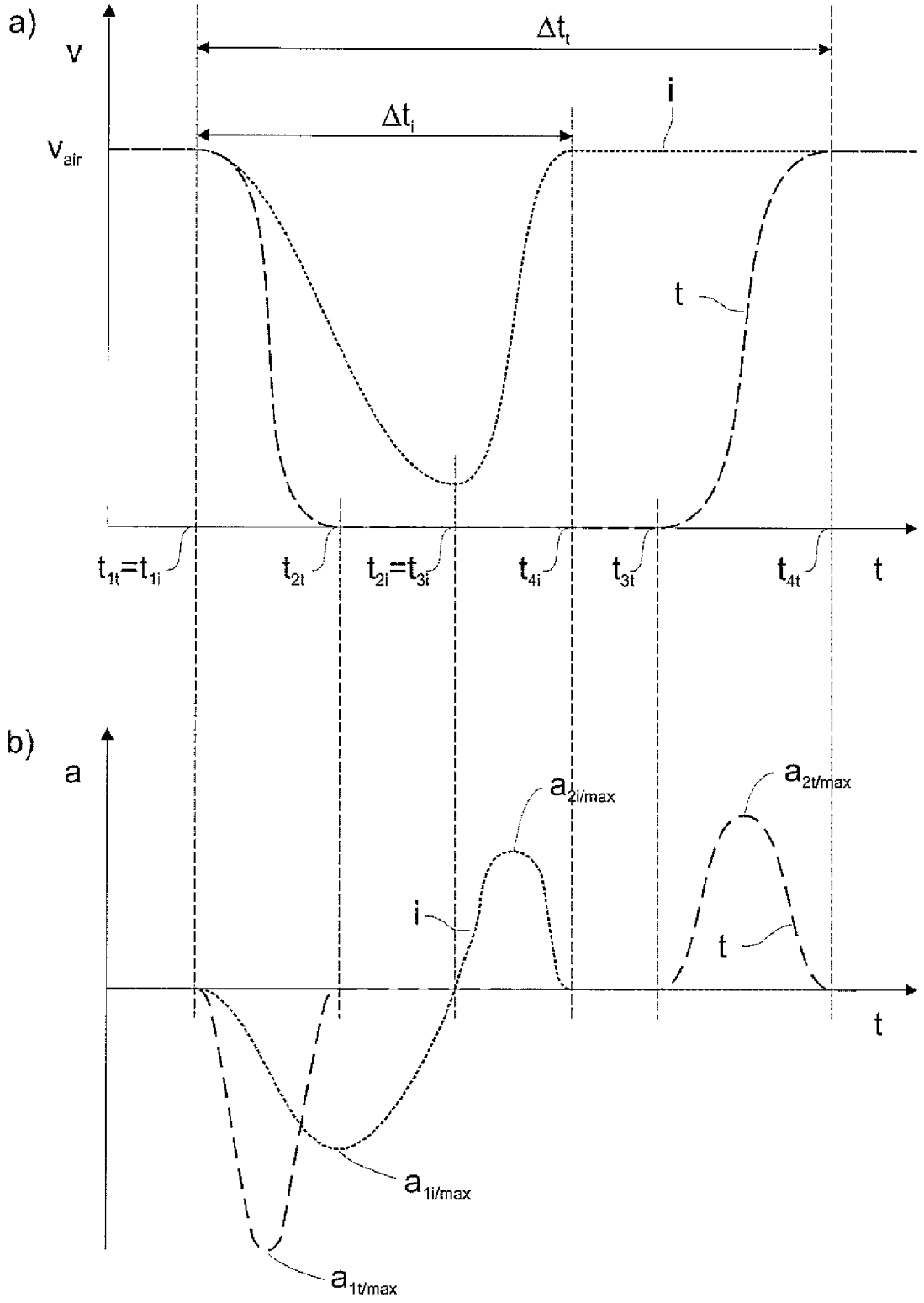


Fig.8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Δt_t
Δt_i
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v_{air}
t
$t_{1t}=t_{1i}$
t_{2t}
$t_{2i}=t_{3i}$
t_{4i}
t_{3t}
t_{4t}
t
b)
a
$a_{2i/max}$
$a_{2t/max}$
i
t
t
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$a_{1t/max}$

Fig.9

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EUROPEAN SEARCH REPORT

Application Number
EP 11 15 8809

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	WO 03/045182 A1 (MCKENZIE EVY [GB]) 5 June 2003 (2003-06-05) * page 10, line 1 - page 11, line 2; figures 7-10 *	1,2,7-13 3,8	INV. A43C15/16 A43B13/22 A43B5/02
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A43C
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 August 2011	Cianci, Sabino

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26-08-2011

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