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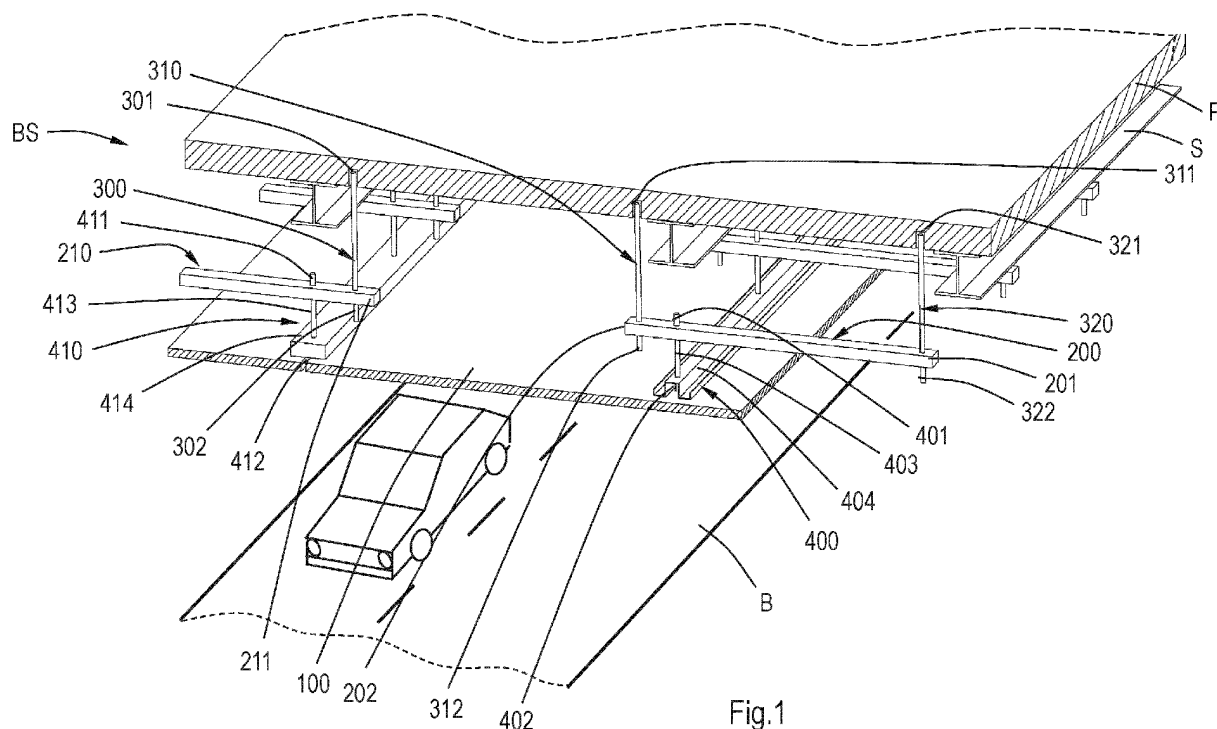
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(54) FIRE RESISTANT SYSTEM CEILING

(57) A fire-resistant system ceiling for obtaining a fire compartmentation under a ceiling with support structures, comprising a plurality of fire-resistant boards arranged at a distance from the ceiling such that a fire-compartmenting plenum is formed; a plurality of suspension profiles situated between the ceiling and the plurality of fire-resistant boards; a plurality of anchoring means, each comprising a first outer end and a second outer end, wherein the first outer end is anchored in the ceiling

and wherein the second outer end is coupled to one of the plurality of suspension profiles, wherein the plurality of anchoring means are arranged adjacently of the support structures of the ceiling; a plurality of connecting means having a first outer end which is connected to one of the plurality of suspension profiles and having a second outer end which is coupled to at least one of the plurality of fire-resistant boards.



Description

Field of the invention

[0001] The present invention relates to a fire-resistant system ceiling for obtaining a fire compartmentation under a ceiling with support structures.

Background

[0002] When a building or tunnel is struck by fire, this has disastrous results for the integrity of a ceiling. The ceiling is supported by support structures. The support structures are typically manufactured from metal or reinforced concrete. In the case of fire, the strength and stiffness of metal decreases. Special requirements in respect of fire-resistance are usually not imposed on reinforced concrete structures, unless the nature of the building requires it. When concrete is heated rapidly due to a thermal load, for instance in the case of fire, an internal pressure results in the concrete because moisture present in the concrete is converted into steam in a short time. The density of steam is many times smaller than that of liquid water. The volume taken up by the steam hereby increases greatly and rapidly, whereby the internal pressure in the concrete increases. Because the pressure also increases rapidly and greatly as a result, the concrete is torn off the structure. This is known as the exploding of concrete. Recent disasters involving fires in tunnels and other structures have shown that the exploding of concrete forms a threat to the safety of structures and to the users in particular.

Summary of the invention

[0003] Embodiments of the invention have the object of providing a fire-resistant system ceiling of the type stated in the preamble in order to obtain an improved fire-resistance of a ceiling with support structures.

[0004] The invention provides for this purpose a fire-resistant system ceiling for the purpose of obtaining a fire compartmentation under a ceiling with the support structures. The system ceiling comprises:

- a plurality of fire-resistant boards arranged at a distance from the ceiling such that a fire-compartmenting plenum is formed;
- a plurality of suspension profiles situated between the ceiling and the plurality of fire-resistant boards;
- a plurality of anchoring means, each comprising a first outer end and a second outer end, wherein the first outer end is anchored in the ceiling and wherein the second outer end is coupled to one of the plurality of suspension profiles, wherein the plurality of anchoring means are arranged adjacently of the support structures of the ceiling;
- a plurality of connecting means having a first outer end which is connected to one of the plurality of sus-

pension profiles and having a second outer end which is coupled to at least one of the plurality of fire-resistant boards.

[0005] Because the fire-resistant boards are arranged at a distance from the ceiling, a fire-compartmenting plenum is formed. The fire-compartmenting plenum prevents fire penetration of a thermal load, for instance a fire, such that the ceiling and the support structure are not exposed to high temperatures. The inventiveness of this solution lies inter alia in the insight that the fire-resistant boards should not be attached directly to the support structures. By making use of suspension profiles, anchoring means and connecting means which are coupled to the fire-resistant boards, the support structures are unimpeded by the elements of the fire-resistant system ceiling. The fire-resistant system ceiling can thus be mounted on the ceiling in flexible manner. The fire-resistant system ceiling hereby also has an improved stability. A lowered ceiling structure is thus formed, which prevents the fire penetration in improved, simple and flexible manner by means of the fire-resistant boards.

[0006] According to an embodiment, the plurality of anchoring means comprise for each suspension profile at least a first and a second anchoring means, which extend at a mutual distance between the suspension profile and the ceiling. In this way each suspension profile can be mounted in simple manner and be placed at a desired distance from the ceiling. The suspension profile can for instance be mounted parallel and at a distance to the ceiling in simple manner. It will be apparent that the suspension profile can also be mounted at an angle.

[0007] According to an embodiment, a connecting means is coupled to one of the suspension profiles, such that the connecting means is displaceable along the suspension profile. The inventiveness of this solution lies inter alia in the insight that the support structures of the ceiling are typically placed at irregular mutual distances for structural reasons. Because the connecting means are displaceable along the suspension profile, the irregular placing of the support structures can be compensated for. In other words, the connecting means can be displaced independently of the placing of the support structures. The plurality of connecting means are preferably arranged at a mutual pitch distance. In this way the connecting means form a regular structure which can be adjusted if desired. This allows standardized fire-resistant boards to be used. In this way the fire-resistant system ceiling can be mounted as a whole more conveniently.

[0008] According to an embodiment, the fire-resistant system ceiling can comprise a plurality of board suspension profiles which are fixed against an upper side of the plurality of fire-resistant boards and are connected to the plurality of connecting means. In this way the fire-resistant boards can be mounted in simple manner.

[0009] According to an embodiment, the plurality of connecting means comprise a plurality of rods. A rod is preferably a solid, round bar provided over a part of its

length or over its whole length with a screw thread. An advantage of the embodiment is that the suspension profiles and the board suspension profile can be coupled in simple manner. A rod is preferably connected at a first outer end to one of the plurality of suspension profiles and is connected at a second outer end to the board suspension profile. It is a further advantage that a distance at which a suspension profile is arranged relative to the board suspension profile can be adjusted in simple manner.

[0010] According to an embodiment, the plurality of board suspension profiles are oriented transversely relative to the plurality of suspension profiles. In this way a battening is formed. This improves the structural integrity of the ceiling.

[0011] According to an embodiment, the fire-resistant system ceiling can further comprise at least one suspension element which is coupled at a first outer end to one of the plurality of suspension profiles and is configured at a second outer end for fixing of a ceiling element, wherein the suspension element extends through an opening provided in the fire-resistant board. The inventiveness of this solution lies inter alia in the insight that ceiling elements cannot be fixed to the suspension profile or the fire-resistant boards without the fire-resistant effect suffering. In this way a sealing element can be coupled via the at least one suspension element to the suspension profile in simple manner.

[0012] According to an embodiment, the fire-resistant system ceiling can further comprise a sealing element which seals the opening around the suspension element. In this way the fire-resistant effect of the fire-resistant system ceiling can be preserved. The sealing element is preferably manufactured from the same material as a material of the fire-resistant board. The advantage of this embodiment is that the material of the fire-resistant board can be processed to be used as sealing element in situ in simple manner. A fitter can for instance cut a fire-resistant board to form the sealing element. A further advantage is that the material properties of the fire-resistant board and the sealing element correspond. This preserves the fire-resistant effect without complex conduit seals having to be used. It will be apparent to the skilled person that the sealing element can also be manufactured from a different material, to the extent that this other material has substantially the same material properties as the fire-resistant board.

[0013] According to an embodiment, the sealing element is fixed by means of adhesive, a bolt connection, a screw connection, or a combination thereof. In this way the sealing element can be fixed to the fire-resistant board in simple manner, whereby the time needed for mounting of the sealing element is reduced.

[0014] According to an embodiment, one of the following is fixed to the second outer end of the suspension element: a camera, an air conditioning system, a light fixture system, a smoke detection system, a traffic sign, a signalling system, a cable system, an extinguishing

system or a scaffold. It will be apparent to the skilled person that many alternative elements can be fixed to the second outer end of the suspension element.

[0015] According to an embodiment, the plurality of anchoring means and/or the plurality of suspension profiles and/or the plurality of connecting means are manufactured from metal. The inventiveness of this solution lies inter alia in the insight that metal has a critical temperature which is higher than the temperature prevailing in the fire-compartmenting plenum when a fire occurs. The temperature of the metal wherein a yield point of the metal decreases to a stress level prevailing in the metal, such that the metal yields, is called the critical temperature. Such a critical temperature can for instance be 700°C. Because metal has a higher critical temperature than for instance wood, the fire-resistance of the plurality of anchoring means and/or the plurality of suspension profiles and/or the plurality of connecting means is higher. The metal is preferably certified for 20 minutes of fire-resistance, more preferably for 30 minutes, still more preferably for 60 minutes, still more preferably for 90 minutes, most preferably for 120 minutes.

[0016] According to an embodiment, the plurality of board suspension profiles are manufactured from metal.

[0017] According to an embodiment, the metal is stainless steel.

[0018] According to an embodiment, the plurality of suspension profiles are C-profiles. In this way the embodiment makes use of suspension profiles available as standard. This simplifies the mounting of the fire-resistant system ceiling.

[0019] According to an embodiment, the plurality of board suspension profiles are Omega-profiles. In this way the embodiment makes use of suspension profiles available as standard. This simplifies the mounting of the fire-resistant system ceiling. A further advantage is that the fire-resistant boards connect better owing to the use of Omega-profiles. This improves the fire-resistant effect of the system ceiling.

[0020] According to an embodiment, the plurality of anchoring means and/or the plurality of suspension profiles and/or the plurality of connecting means are coupled by means of a bolt connection, screw connection, adhesive connection, welded connection, clamping connection, or a combination thereof. In this way the plurality of anchoring means and/or the plurality of suspension profiles and/or the plurality of connecting means can be coupled in simple manner. The time needed for mounting is hereby reduced.

[0021] According to an embodiment, the fire-resistant boards are mineral-bonded calcium silicate boards, preferably fibre-reinforced calcium silicate boards, optionally comprising additives. Suitable fire-resistant boards are for instance PROMATECT-H and AESTUVER.

[0022] According to an embodiment, the fire-resistant boards have at 20°C a thermal conductivity lower than 0.400 W/mK, preferably lower than 0.300 W/mK, still more preferably lower than 0.250 W/mK, most preferably

lower than 0.200 W/mK. Because the fire-resistant boards have a low thermal conductivity, the fire-resistant effect of the system ceiling is improved.

[0023] According to an embodiment, the fire-resistant boards have a thickness greater than 6 mm, preferably greater than 10 mm, more preferably greater than 15 mm, most preferably greater than 20 mm.

Brief description of the figures

[0024] The above stated and other advantageous features and objects of the invention will become more apparent, and the invention better understood, on the basis of the following detailed description when read in combination with the accompanying drawings, in which:

Figure 1 is a perspective view of an embodiment of a system ceiling according to the invention;
Figure 2 is a perspective view of a part of the embodiment of the system ceiling of figure 1;
Figure 3A is a lateral section of an embodiment of a system ceiling according to the invention;
Figure 3B is a detail view of a part of figure 3A;
Figure 4 is a schematic cross-section of an embodiment of a system ceiling according to the invention;
Figures 5A, 5B and 5C are perspective views of alternative embodiments of a suspension profile according to the invention.

Detailed embodiments

[0025] The invention will now be further described on the basis of an exemplary embodiment shown in the drawing. The same or similar elements are designated in the drawing with the same reference numerals.

[0026] Figures 1 and 2 illustrate an embodiment of a fire-resistant system ceiling BS with support structures S. Embodiments of the invention are based on the insight that a concrete ceiling is composed of several materials. This is typically a combination of concrete and reinforcement steel. Concrete is an artificial stone-like material composed of a cement and one or more aggregate materials such as sand, gravel or stone chippings. The cement is a binder that hardens by means of hydration. Research has shown that at a relative humidity of 55% in a space, such as a tunnel or an interior space of a building, an equilibrium moisture content in the concrete is about 7%. The equilibrium moisture content is the term used to indicate an equilibrium between the moisture content in a hygroscopic substance and its environment. This moisture is located in pores of the concrete. In addition to this pore water, the concrete also comprises physically and chemically bound water. When the temperature rises, the pore water will evaporate first. Above 100°C, the physically bound water will evaporate. Above 250°C, the chemically bound water will escape. At temperatures of between 400°C and 450°C the calcium hydroxide of the cement formed during the hydration will

also begin to decompose into calcium oxide. Depending on the type and quality of steel, the reinforcement steel will maintain a tensile strength up to 300°C.

[0027] The fire-resistant system ceiling BS is arranged above a roadway of a tunnel. It will be apparent that the fire-resistant system ceiling can also be arranged in other structures, for instance in a space of a building. The fire-resistant system ceiling is arranged on a ceiling P with support structures S. The ceiling P is the upper wall in the tunnel or space. The support structures S lie at a mutual distance. The support structures are shown as steel profiles with a quadrangular form, these are typically quadrangular beams. It will be apparent to the skilled person that the support structures can be I, H, U, T, Z and L-profiles, and more generally any profile with a suitable shape. It will further be apparent that the support structures can also be concrete support structures, for instance with the same form as that of the above described steel profiles. The concrete support structures can also be a reinforced concrete support structure.

[0028] A plurality of anchoring means 300, 310, 320 are arranged on ceiling P. The anchoring means 300, 310, 320 are arranged adjacently of support structures S, such that they do not act on each other. Anchoring means 300, 310, 320 take the form of a rod having a first outer end 301, 311, 321 and a second outer end 302, 312, 322. The first outer end 301, 311, 321 of anchoring means 300, 310, 320 is anchored in ceiling P. It will be apparent to the skilled person that several embodiments of the anchoring means 300, 310, 320 are possible for the anchoring in the ceiling.

[0029] The first outer end 301, 311, 321 is thus for instance anchored in the ceiling using a chemical anchor. According to an alternative, the first outer end 301, 311, 321 is provided with a cotter bolt. Anchoring means 300, 310, 320 extend from ceiling P in a downward direction, toward the bottom B of the space, over a distance greater than a height of the support structure S, such that when anchoring means 300, 310, 320 are anchored in the ceiling, the second outer end 302, 312, 322 protrudes beyond a lower edge of support structure S. Anchoring means 300, 310, 320 are preferably provided at least at their outer end with screw thread, still more preferably anchoring means 300, 310, 320 are a threaded rod provided over substantially a whole length with a screw thread.

[0030] A suspension profile 200 is coupled to the second outer end 322 of anchoring means 320. Suspension profile 200 extends from a first outer end 201 to a second outer end 202 opposite the first outer end 201. Suspension profile 200 is preferably coupled close to the first and second outer end 201, 202 thereof to an anchoring means 310, 320, although it is also possible for suspension profile 200 to be coupled to anchoring means 310, 320 wherein the anchoring means 310, 320 can be coupled over the whole length of suspension profile 200. Because the second outer ends 312, 322 protrude beyond the lower edge of support structure S, suspension

profile 200 is arranged under the support structure S. The suspension profile is preferably a C-profile and the second outer end 302, 312, 322 of anchoring means 300, 310, 320 preferably extends through an opening provided in suspension profile 200. It will be apparent to the skilled person that in figure 1 the suspension profile 200 is coupled to two anchoring means 310, 320, but that more than two anchoring means can also be coupled to suspension profile 200, for instance three or more anchoring means, as shown in figure 2. A plurality of anchoring means have the advantage that the bearing load of the system ceiling is distributed over the plurality of anchoring means. Each of the plurality of anchoring means then bears a part of the bearing load of the system ceiling.

[0031] A connecting means 400, 410 having a first outer end 401, 411 and a second outer end 402, 412 is connected to suspension profile 200 at first outer end 401, 411. Connecting means 400 extends from suspension profile 200 in a downward direction, toward the bottom B of the space, over a distance which can be adjusted if desired. Connecting means 400 is coupled at second outer end 402 to an upper side of at least one fire-resistant board 100. Connecting means 400 takes the form of a rod 403, 413 and can be coupled for instance by means of a board suspension profile 404, 414 to an upper side of the fire-resistant boards 100. According to an alternative, a coupling piece can be used per connecting means 400, 410 in order to couple the connecting means 400, 410 to at least one fire-resistant board 100. According to another alternative, connecting means 400, 410 can be fixed directly in a fire-resistant board 100.

[0032] A fire-resistant board 100 has an upper side and an underside lying opposite the upper side. The upper side is directed toward ceiling P. The fire-resistant board typically has a quadrangular form, wherein fire-resistant board 100 preferably has a length dimension of between 1000 mm and 4000 mm and preferably has a width dimension of between 500 mm and 2000 mm. The fire-resistant board has a board thickness, this being the plumb distance between the upper side and the underside of the board. The fire-resistant board 100 has a board thickness of preferably between 5 mm and 80 mm. It will be apparent that the dimensions of the fire-resistant boards 100 can differ depending on the application. For a relatively great surface area, fire-resistant boards of 1250 mm to 3000 mm can for instance be used, such that the mounting is simplified and sped up. For a relatively smaller surface area, fire-resistant boards 100 with dimensions of 1250 mm to 2500 mm can be used. Fire-resistant board 100 preferably has an upright board wall. It will however be apparent to the skilled person that the fire-resistant board 100 can also have a board edge which can be coupled in mutually engaging manner (not shown) to a board edge of another fire-resistant board. According to an alternative, the board edge can also be a board edge with a thickness decreasing or increasing in tapering manner. Because the fire-resistant boards 100 are arranged at a distance from the ceiling P, a ple-

num is formed. The plenum prevents fire penetration of a thermal load by means of the fire-resistant boards 100, such that the ceiling and the support structures are not exposed to temperatures above 300°C for a period of at least 10 minutes, preferably at least 15 minutes, most preferably at least 20 minutes.

[0033] Board suspension profile 404, 414 comprises an upper surface which is coupled to the second outer end 402 of the rod. Board suspension profile 404, 414 further comprises at least a lower surface which is configured to be coupled to the upper side of the fire-resistant boards 100. The at least one lower surface is connected to the upper surface by at least one, substantially upright, wall surface. Board suspension profile 404, 414 is preferably an Omega-profile. It will however be apparent to the skilled person that different embodiments of suspension profile 404, 414 are possible. Two embodiments are illustrated in figure 1 by way of example. A first embodiment shows a beam-like board suspension profile 414 having an upper side and an underside. Fire-resistant board 100 is coupled on the upper side thereof to the underside of the beam-like board suspension profile 414. Fixing means fix the fire-resistant board 100 to the beam-like suspension profile 414. According to an alternative embodiment, figure 1 shows a board suspension profile 404 in an Omega shape. This embodiment will be described below in detail and differs substantially from the beam-like suspension profile in the form of the suspension profile. Board suspension profile 404, 414 extends from a first connecting means 400 to at least one other connecting means, as shown in figure 2, such that a lattice is formed to which the fire-resistant boards 100 can be fixed in simple manner. In this way the system ceiling BS can be mounted in form-retaining manner, this giving the structure an improved stability.

[0034] Figure 2 illustrates the lattice formed by the plurality of elements of the fire-resistant system ceiling BS working together. The ceiling P is not shown in figure 2, but it will be apparent that the plurality of anchoring means 300, 310, 320, 330, 340 are each anchored at a first outer end in ceiling P. The anchoring means 300, 310, 320, 330, 340 are anchored in ceiling P adjacently of the support structures S. The plurality of anchoring means are each coupled at a second outer end to one of the plurality of suspension profiles 200, 210. Anchoring means 300, 310 are each coupled at a second outer end to suspension profile 200. Anchoring means 300, 310 extend at a mutual distance between the ceiling and the suspension profile. The distance between each of the anchoring means 300, 310 can be a pitch distance or differ from each of the plurality of anchoring means to another anchoring means, depending on the placing of support structures S. The skilled person will appreciate that the distance between the anchoring means 300, 310 differs from the distance between the anchoring means 320, 330, 340 relative to each other. Anchoring means 320, 330, 340 are then in turn anchored to ceiling P at a mutual pitch distance. It will be apparent that a distance

between anchoring means 300, 320 corresponds to a distance between anchoring means 310, 340. Suspension profile 200 is coupled to a first anchoring means 300 and a second anchoring means 310. In figure 2 the anchoring means are each coupled close to an outer end of suspension profile 200 to the suspension profile 200. It will however be apparent that suspension profile 200 can also extend further beyond the anchoring means 300, 310, which is illustrated by the broken line which illustrates the further progress of suspension profile 200. Suspension profile 210 is coupled to ceiling P by means of three anchoring means 320, 330, 340. It will be apparent to the skilled person that suspension profile 200, 210 can also be coupled to more than three anchoring means.

[0035] Suspension profiles 200, 210 are arranged at a distance from ceiling P so that the suspension profiles lie under support structures S. Suspension profiles 200, 210 are preferably arranged parallel to ceiling P, but in an alternative embodiment (not shown) can also be arranged at an angle to the ceiling. Suspension profiles 200, 210 extend substantially parallel to each other. In the figure the suspension profiles are arranged transversely relative to the support structures. It will however be apparent that the suspension profiles can also be arranged parallel to the support structures. The suspension profiles 200, 210 form a lattice together with the plurality of connecting means.

[0036] In this embodiment the plurality of connecting means 400, 410, 420, 430, 450 take the form of a plurality of rods 403, 413, 423, 433 which are coupled to the suspension profiles 200, 210. The plurality of rods 403, 413, 423, 433 are arranged at a mutual pitch distance along a longitudinal direction of the suspension profile. Rods 403, 413, 423, 433 are coupled in displaceable manner to suspension profiles 200, 210. Suspension profiles 200, 210 are coupled to each other by means of a plurality of board suspension profiles 404, 414 and by means of rods 403, 413, 423, 433. In this way an improved stability of the fire-resistant system ceiling BS is obtained. Each board suspension profile 404, 414 is coupled to at least one suspension profile 200, 201 by means of a rod 403, 413, 423, 433. Board suspension profile 404 is coupled to a first suspension profile 200 by means of a rod 403 and extends from the first suspension profile 200 to the second suspension profile 210, wherein the board suspension profile 414 is coupled to the second suspension profile 210 by means of a rod 423. Board suspension profiles 404, 414 are hereby oriented transversely relative to the plurality of suspension profiles 200, 210 and the board suspension profiles form a lattice together with the plurality of suspension profiles. In this way the fire-resistant system ceiling BS has an improved flexibility in respect of mounting. Although not shown, it will be apparent to the skilled person that board suspension profile 404, 414 can also be coupled to more than two suspension profiles 200, 210. Because the rods 403, 413, 423, 433 are arranged at a mutual pitch distance along a longitudinal direction of suspension profile 200, 210, the plu-

ality of board suspension profiles 404, 414 are oriented parallel to each other.

[0037] Figure 3A shows a lateral section of an embodiment of a system ceiling BS transversely of the direction wherein the support structures are arranged on the ceiling. The figure shows a fire-resistant system ceiling similar to the embodiment of figures 1 and 2, with the difference that multiple embodiments of the board suspension profiles 404, 414, 424, 434, 444 are shown and that a suspension element 500 is shown. It will be apparent to the skilled person that several alternative embodiments of the board suspension profiles 404, 414, 424, 434, 444 are possible here. Fire-resistant boards 100 are fixed with the upper side to an underside of board suspension profiles 404, 414, 424, 434, 444.

[0038] Figure 3A particularly shows a suspension element 500 which is coupled at a first outer end 501 to suspension profile 200. Suspension element 500 extends through a fire-resistant board 100 and is configured at a second outer end 502 to be fixed to a ceiling element 510. Ceiling element 510 is illustrated as a camera, although it will be apparent to the skilled person that several alternative ceiling elements are possible. Ceiling element 510 can for instance be an air conditioning system, a light fixture system, a smoke detection system, a traffic sign, a signalling system, a cable system, an extinguishing system or a scaffold. Although not shown, it will be apparent to the skilled person that cables can for instance also be located in the plenum between the support structures.

[0039] Figure 3B shows a detail view of the circled part of figure 3A. The detail view particularly shows that suspension element 500 is coupled to suspension profile 200 by means of a bolt connection. Suspension element 500 extends through an opening which is arranged in fire-resistant board 100. A sealing element 600 seals the opening around suspension element 500. It will be apparent that for the fire-resistant effect of the fire-resistant board substantially no opening can be present in the board. Sealing element 600 is placed in front of the opening and encloses suspension element 500. Sealing element 600 is placed against an underside of fire-resistant board 100 by means of a screw connection, wherein the screws extend through the sealing element and anchor in the fire-resistant board 100. It will be apparent that sealing element 600 can be arranged against the underside of fire-resistant board 100 in different ways. A heat-resistant adhesive or sealant can optionally be arranged between the sealing element and the fire-resistant board 100 for a better adhesion and sealing of the opening.

[0040] Figure 4 shows a cross-section transversely of the direction of the support structures of an embodiment of the system ceiling according to the invention. The figure particularly shows that anchoring means 300 is a threaded rod which is anchored at a first outer end 301 in ceiling P and is coupled at a second outer end 302 to suspension profile 200. The anchoring threaded rod 300 is provided at least at the outer ends with a screw thread.

According to an embodiment, the screw thread is a metric thread, and the anchoring threaded rod preferably has a nominal diameter greater than 6 mm and smaller than 15 mm. It will be apparent to the skilled person that other embodiments of the anchoring means are possible, the nominal diameter and the pitch can for instance be altered depending on the bearing load of the system ceiling.

[0041] Board suspension profile 404 comprises an upper wall which is parallel to the ceiling. The board suspension profile further comprises at least two downward directed side walls, each arranged on the upper wall on either side of the upper wall. Each side wall has a board fixing flange which is parallel to the upper side of the board suspension profile. The board fixing flanges extend from the side walls, in a direction away from the side walls, over a distance which is preferably greater than 25 mm, more preferably greater than 50 mm, more preferably greater than 70 mm

[0042] Figures 5A and 5B show a perspective view of the suspension profile according to figure 4. Suspension profile 200 is shown as a C-profile. The profile comprises at least two upright walls 250, 251 which lie opposite each other and are arranged on an upper wall 260 of the profile. The profile further has an underside 261 provided with an opening 270. The opening extends over the whole length of the profile and is bounded by two opening flanges 271, 272 which are each arranged, opposite each other and parallel to upper wall 260, on the two upright walls 250, 251. A profile substantially in the shape of a C is thus formed. In an embodiment the C-profile comprises one or more openings 280 which are provided in the upper wall 260 of the C-profile, such that the anchoring means 300 extend through the opening 280 in upper wall 260. It will be apparent to the skilled person that a user can also make an opening 280 in upper wall 260, for instance using a drilling device (not shown). In figure 4 the anchoring means 300 are coupled at underside 261 to opening flanges 271, 272 of the C-profile by means of at least two nuts 290. However, as shown in figure 5A, anchoring means 300 can also be coupled to the upper side 260 of the C-profile in a similar manner. In a preferred embodiment a ring is arranged between each nut 290 and a side of the underside 261 of the C-profile. The ring encloses the anchoring means and distributes a pressure force on the connection over a greater area, whereby the C-profile will begin to deform.

[0043] Connecting means 400 is shown as a threaded rod 403 which is coupled to a board suspension profile 404. In a preferred embodiment this threaded rod corresponds to the threaded rod as described above. The connecting threaded rod is coupled at a first outer end 401 to the C-profile in similar manner as the anchoring threaded rod, so with at least two nuts 290 and at least two rings.

[0044] Figure 5B shows an alternative embodiment of suspension profile 200. Figure 5B particularly shows that the suspension profile can be oriented in different ways in order to realise a similar effect as demonstrated above. Figure 5C shows another alternative embodiment of sus-

pension profile 200. Two openings 270 are in particular provided in profile 200. In this way the fire-resistant system ceiling BS can be mounted in a more flexible manner.

[0045] The skilled person will appreciate on the basis of the above description that the invention can be embodied in different ways and on the basis of different principles. The invention is not limited here to the above described embodiments. The above described embodiments and the figures are purely illustrative and serve only to increase understanding of the invention. The invention will not therefore be limited to the embodiments described herein, but is defined in the claims.

Claims

1. Structure comprising a ceiling with support structures (S) and a fire-resistant system ceiling (BS) for the purpose of obtaining a fire compartmentation under the ceiling (P) with support structures (S), comprising:

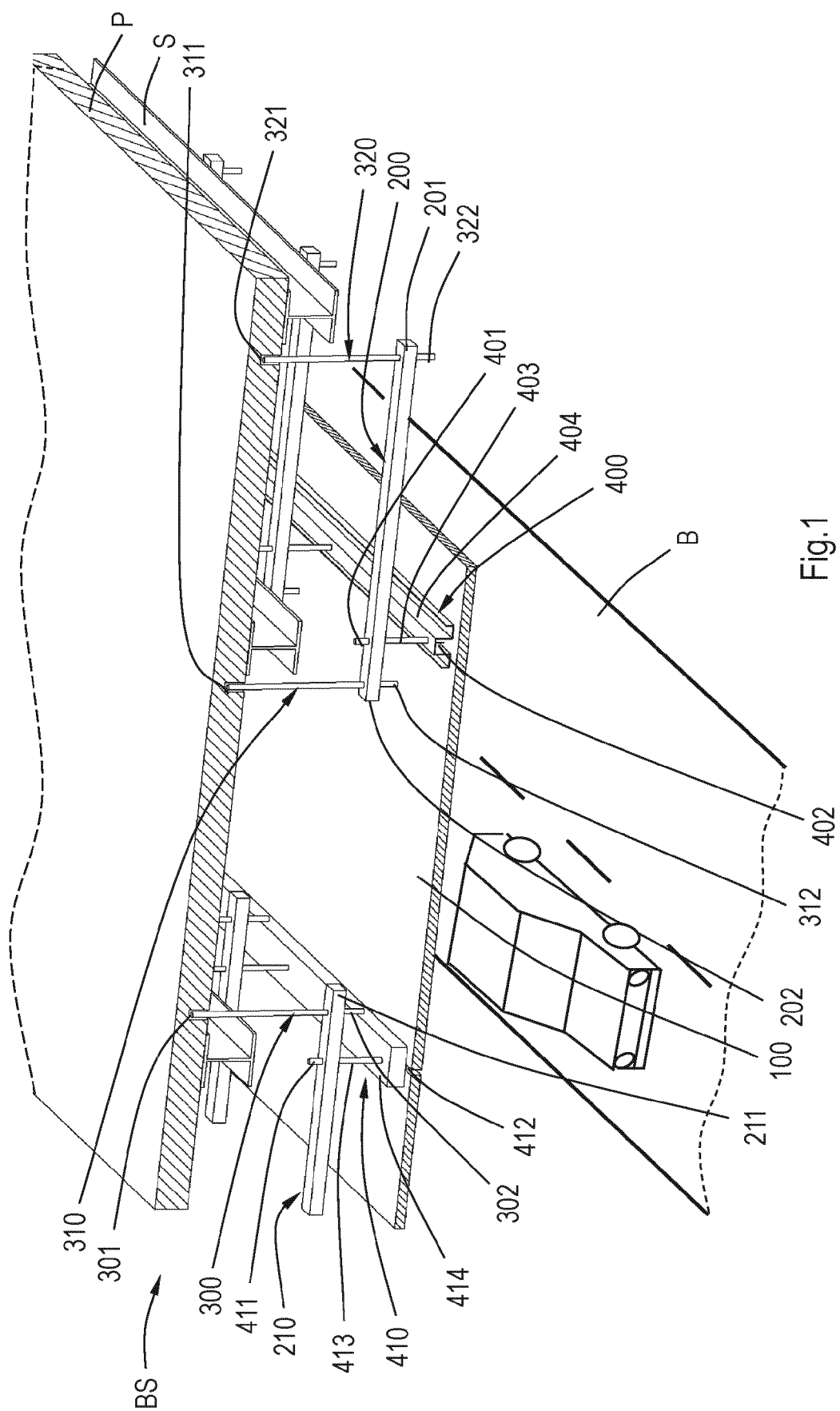
- a plurality of fire-resistant boards (100) arranged at a distance from the ceiling (P) such that a fire-compartmenting plenum is formed;
- a plurality of suspension profiles (200) situated between the ceiling and the plurality of fire-resistant boards (100);
- a plurality of anchoring means (300), each comprising a first outer end and a second outer end, wherein the first outer end is anchored in the ceiling and wherein the second outer end is coupled to one of the plurality of suspension profiles (200), wherein the plurality of anchoring means (300) are arranged adjacently of the support structures (S) of the ceiling (P);
- a plurality of connecting means (400) having a first outer end which is connected to one of the plurality of suspension profiles (200) and having a second outer end which is coupled to at least one of the plurality of fire-resistant boards (100).

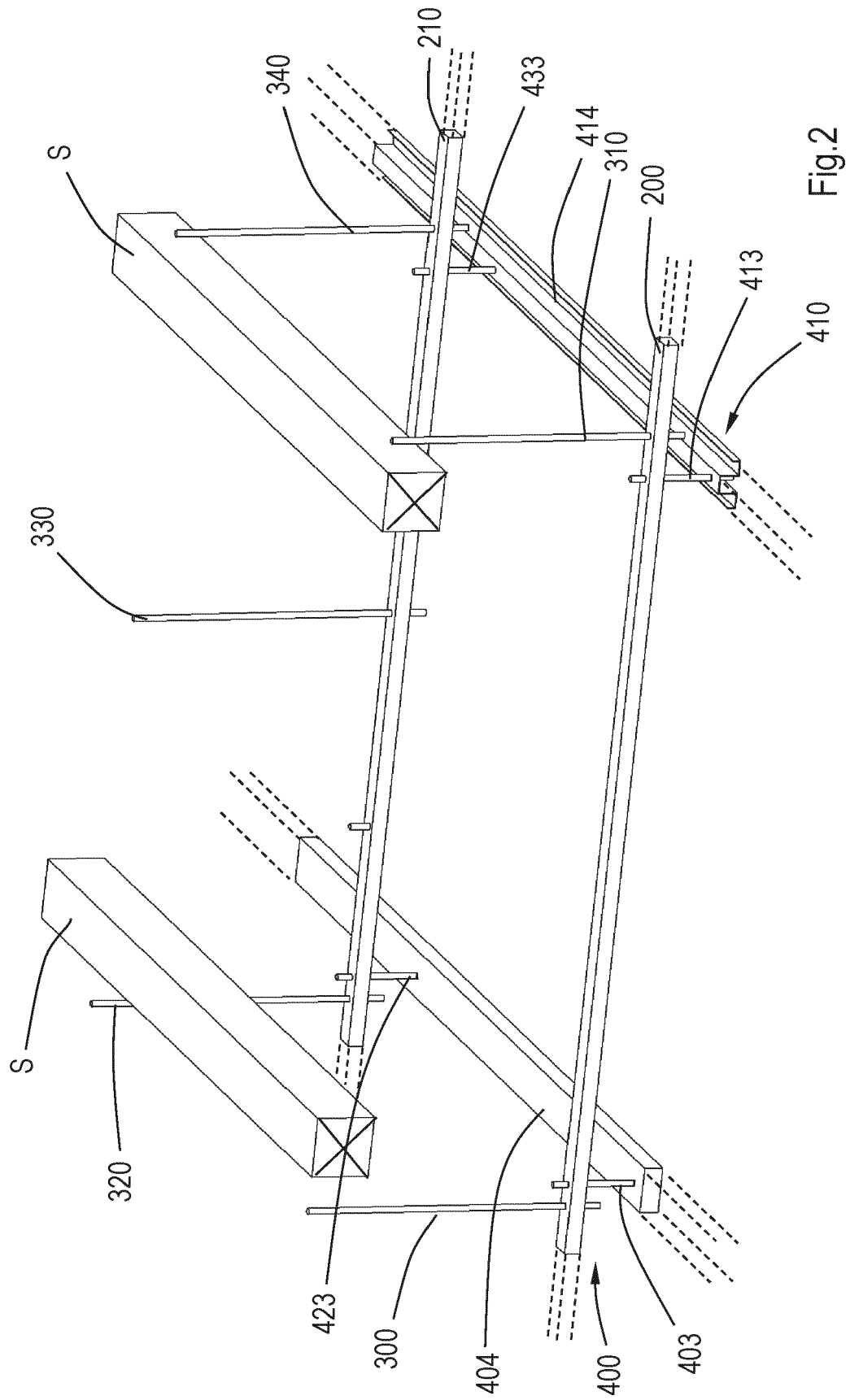
2. Structure according to claim 1, wherein the plurality of anchoring means (300) comprise for each suspension profile (200) at least a first and a second anchoring means, which extend at a mutual distance between the suspension profile and the ceiling.

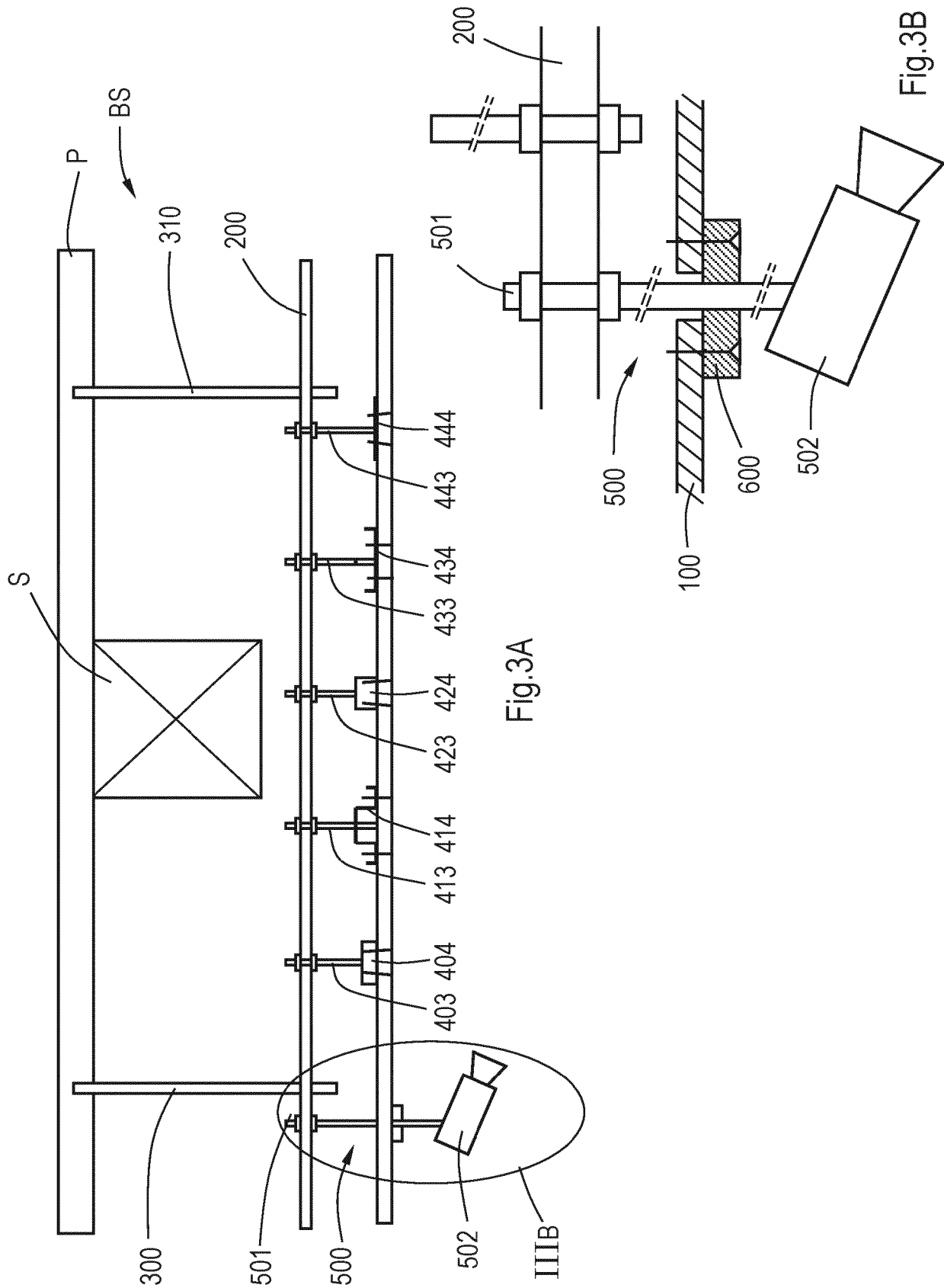
3. Structure according to any one of the foregoing claims, wherein a connecting means (400) is coupled to one of the suspension profiles (200), such that the connecting means is displaceable along the suspension profile.

4. Structure according to any one of the foregoing claims, wherein the plurality of connecting means (400) are arranged at a mutual pitch distance.

5. Structure according to any one of the foregoing claims, further comprising a plurality of board suspension profiles which are fixed against an upper side of the plurality of fire-resistant boards (100) and are connected to the plurality of connecting means (400). 5
6. Structure according to any one of the foregoing claims, wherein the plurality of connecting means comprise a plurality of rods (410, 411, 412), wherein a rod is preferably connected at a first outer end to one of the plurality of suspension profiles (200) and is connected at a second outer end to the board suspension profile (420). 10
7. Structure according to any one of the claims 5-6, wherein the plurality of board suspension profiles (420) are oriented transversely relative to the plurality of suspension profiles (200, 210). 15
8. Structure according to any one of the foregoing claims, further comprising at least one suspension element (500) which is coupled at a first outer end to one of the plurality of suspension profiles and is configured at a second outer end for fixing of a ceiling element (510), wherein the suspension element extends through an opening provided in the fire-resistant board; and/or 20
a sealing element (600) which seals the opening around the suspension element (500), wherein the sealing element (600) is preferably manufactured from the same material as a material of the fire-resistant board, wherein the sealing element (600) is preferably fixed by means of adhesive, a bolt connection, a screw connection, or a combination thereof; and/or 25
wherein one of the following is fixed to the second outer end of the suspension element: a camera, an air conditioning system, a light fixture system, a smoke detection system, a traffic sign, a signalling system, a cable system, an extinguishing system or a scaffold. 30
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9. Structure according to any one of the foregoing claims, wherein the plurality of anchoring means and/or the plurality of suspension profiles and/or the plurality of connecting means are manufactured from metal. 40
10. Structure according to any one of the claims 5, 6 or 7, wherein the plurality of board suspension profiles are manufactured from metal. 45
11. Structure according to claim 9 or 10, wherein the metal is stainless steel. 50
12. Structure according to any one of the foregoing claims, wherein the plurality of suspension profiles are C-profiles. 55
13. Structure according to any one of the foregoing claims 5, 6, 7, 10, wherein the plurality of board suspension profiles are Omega-profiles.
14. Structure according to any one of the foregoing claims, wherein the plurality of anchoring means and/or the plurality of suspension profiles and/or the plurality of connecting means are coupled by means of a bolt connection, screw connection, adhesive connection, welded connection, clamping connection, or a combination thereof.
15. Structure according to any one of the foregoing claims, wherein the fire-resistant boards are mineral-bonded fibre-reinforced calcium silicate boards, optionally comprising additives; and/or wherein the fire-resistant boards have at 20°C a thermal conductivity lower than 0.400 W/mK, preferably lower than 0.300 W/mK, still more preferably lower than 0.250 W/mK, most preferably lower than 0.200 W/mK; and/or wherein the fire-resistant boards have a thickness greater than 6 mm, preferably greater than 10 mm, more preferably greater than 15 mm, most preferably greater than 20 mm.







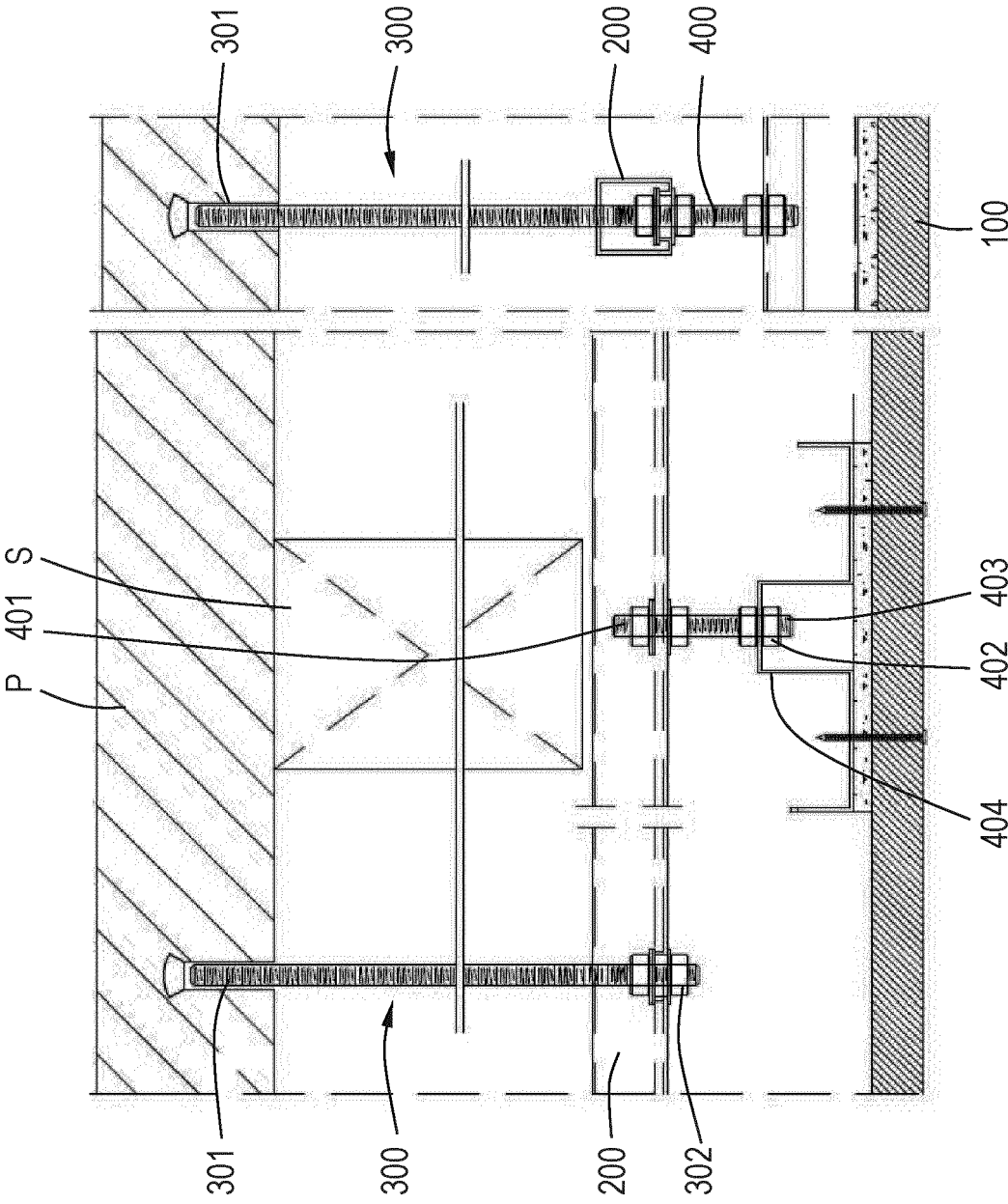


Fig.4

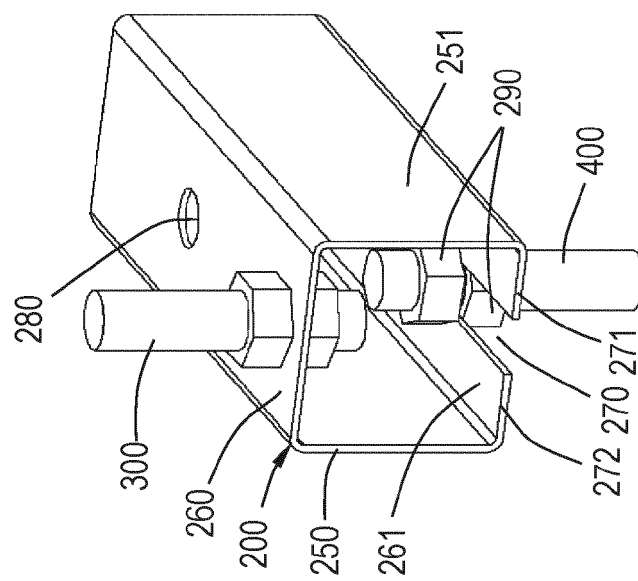


Fig. 5A

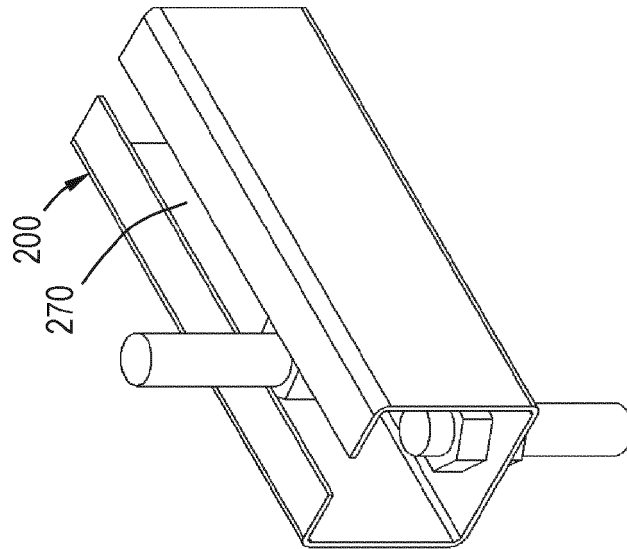


Fig. 5B

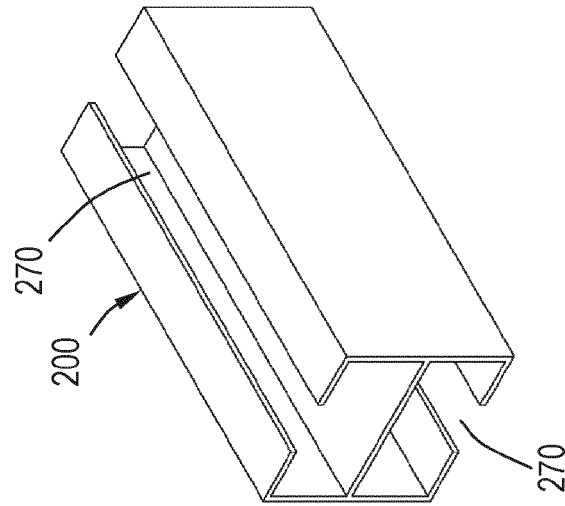


Fig. 5C



EUROPEAN SEARCH REPORT

 Application Number
 EP 20 15 7254

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			E04B
Place of search		Date of completion of the search	Examiner
The Hague		29 May 2020	Righetti, Roberto
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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29-05-2020

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