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The present invention relates to a rail for accommodating cable loops for connecting prefabricated components, consisting of a rail with a U-shaped profile having a base plate and two angled side plates, with apertures in the base plate of the U-shaped profile for feeding-through cable loops and with a surface structure which improves the grip in the prefabricated component and is in the form of protruding and/or receding wall portions in the base plate and/or on the side walls of the U-shaped profile.

In order to clarify the distinction from side walls of other components, the side walls of the rails which are U-shaped in cross section will be referred to hereinafter as "side plates", without this term being intended to define a specific geometry.

A corresponding rail is for example known from WO 2007/031128.

The prefabricated components, in particular precast concrete walls and supports are frequently equipped with what are known as cable loops for rapid and precise connection to one another along their end and side faces, above all along their vertical extension. For this purpose, there are inserted into a formwork, with the aid of which the prefabricated component is manufactured, in addition to a conventional steel reinforcement, for example along the rim faces or end faces of the concrete parts to be cast, also steel loops consisting of steel cable portions which are joined together to form a loop and the joined-together ends of which protrude over a certain distance (for example 15 to 50 cm) into the interior of the precast concrete part, while the loop formed by this steel cable portion protrudes from a face or end side of the precast concrete part. This end face is generally structured in the form of a groove extending in the longitudinal direction of the end face, wherein the cable loop emanates from a base of the groove and may if appropriate extend a certain distance further beyond the free rim of the precast concrete part. An opposing component, which has, for its part, a corresponding groove in an end face or side face and cable loops protruding therefrom, is joined together with the former component so as to be flush along the end faces or groove openings having the cable loops, the protruding ends of the cable loops of one part engaging with the groove-like recess in the opposing part and the cable loops of both joined-together components overlapping one another. An additional reinforcement is then inserted into the grooves or between the grooves of the mutually facing end faces, parallel to the end faces of the prefabricated parts, and in the process reaches at the same time through the cable loops of both components which are in this way secured. Subsequently, both grooves are filled up with a casting compound or a casting mortar, so that the two prefabricated parts are then securely connected to one another, the cable loops and the reinforcing rod extending through the cable loops forming, as well as the mortar connection, an additional reinforcement which extends beyond both components and ensures a secure grip between these two components.

Without additional auxiliary means, correctly positioning the cable loops in a manner such that they can fulfil the purpose described hereinbefore is a laborious process. For this reason, what are known as cable loop boxes or else cable-loop rails have been developed, which consist of a U-shaped profile, the base plate of which has apertures for feeding-through cable loops, these cable loops generally being held by a plastics material part which is clamped into an aperture, so that the free ends of the steel cable forming the loop protrude on the back of the U-shaped profile substantially perpendicularly to the base plate, while on the front of the rail, which is U-shaped in profile, the cable loop extends roughly at right angles from the base plate of the U-shaped profile. Rails of this type or else correspondingly shorter boxes accommodating only one or two cable loops are introduced and fixed into a corresponding formwork along the end faces of a prefabricated component still to be manufactured. Subsequently, concrete or a corresponding casting compound is introduced into the formwork and fills out the space defined by the formwork, with the exception of the interior of the U-shaped profile rail or corresponding cable loop boxes, a corresponding profile rail being, after the hardening of the concrete or the casting compound along the base plates and along the side plates, sheathed with concrete and defining with its open side the groove to be provided in the end face of the precast concrete part. In this case, the base plates and side plates of the U-shaped profile rails generally also have protruding and/or receding surface portions which are intended to improve the grip of the rail in the concrete.

In order to improve handling of rails or cable loop boxes of this type, the cable loops are, prior to fastening in the formwork and also during concreting or else during the subsequent transportation of the finished parts, folded inward through approximately 90° into the groove defined by the profile rail and fixed in this position, so that they do not protrude beyond the free rims or the opening of the U-shaped profile. If appropriate, it is also possible to provide for this purpose a plate which covers the open side of the U-shaped profile, is clamped onto the open U-shaped profile and can be fastened, for example, directly to an inside of the formwork.

Rails of this type are usually made of zinc-coated steel sheet or possibly (above all in the form of relatively short cable loop boxes) of plastics material. However, inherently, these materials have only relatively poor adhesion to concrete.

This is the case despite the provision of the above-mentioned surface structures which usually consist of knob or scale-like wall portions which are pressed inward or outward and can be embodied above all in the side plates, but also in the base plate of the U-shaped profile. Although these embossments in the form of protrusions from or indentations in the side walls and/or the base plate increase resistance to longitudinal displacements of the rail in the precast concrete part, the forces which are as a result to be introduced into the concrete via the rail are still relatively low. This results, for example, in the fact that, in the case of forces acting in the longitudinal direction of the end faces of the prefabricated components, these forces cannot be transferred very effectively from one prefabricated component to the other, so that when relatively low force limit values, which may also be referred to as "transverse force bearing capacity parallel to the joint", are exceeded, the rail loses the secure adhesion either to the concrete of the associated prefabricated component or to the casting mortar filling out the opposing grooves and the joint between the prefabricated components. This leads to undesirable cracks in the joint region between the prefabricated components; this restricts usability, although the cable loops still ensure that the components are held securely together.

Although the cable loops help to improve the transverse force bearing capacity, it is only possible to compensate for the lack of grip of the rails on the concrete or the casting mortar to a limited extent by increasing the number and density of the cable loops (more cable loops at shorter distances); this also makes the rails and the system as a whole more expensive.

From DE 10 2004 043 454 A1, a storage device for reinforcing rods is known comprising a bottom part and a cover part, which comprises openings for the reinforcing rods in the wall of the cover. For detachably fixing the bottom part and the cover part, a number of plug connections is provided, wherein each plug connection comprises a plug opening and a latch plate as connecting component, the free end of which can be passed through the plug opening and which can be deformed in order to achieve a form fit, and wherein each connecting component at the bottom part the other connecting component are provided at the cover part.

WO 2007/031128 A1 shows a connecting device for a closed linkage connection absorbing shear forces between concrete components, in particular concrete pre-fabricated components. The device comprises an elongated protective box for insertion into an end face of the components, which comprises a bottom and at least two side walls, extending into a longitudinal direction of the bottom, at least one flexible reinforcement loop element, which can be received in the protective box and which can be actuated therefrom, wherein the bottom comprises a bottom profiling having alternating groups of bottom projections and bottom recesses in the longitudinal direction, wherein each group comprises at least one bottom projection or at least one bottom recess, respectively.

Said document also discloses all technical features of the subject-matter of the preamble of claim 1.

German utility model document DE 297 23 990 U1 relates to a device for connecting precast concrete components, consisting of at least one cable loop, which is anchored with one end in the precast concrete component while the other loop-like end thereof cooperates with a holding part inserted into the end face of the precast concrete component, in order to elastically fold the cable loop by a right angle during manufacturing of the precast concrete components and to release the cable loop for the connection, wherein the holding part is designed as an elongated metal box being substantially uniform in cross-section. The bottom of the box comprises one or more openings for the cable loop, wherein the side walls of the metal box are obtained by folding in order to give the metal box a U-form in cross-section and wherein the end covers are obtained by bending.

The German utility model shows a device for insertion into a casing for a concrete part having a box-like storage element made of metal which can be locked by a cover, wherein at least the side walls and the bottom are profiled and are made of a one-piece blank.

Considering this prior art, it is the object of the present invention to provide a rail of the type mentioned at the outset in such a way that it is suitable for accommodating relatively high loads, i.e., for a given number of cable loops, relatively high forces can be introduced into the prefabricated components in question via the cable loops and via the rail holding the cable loops, and above all the transverse force bearing capacity is improved, so that the connection in question can accommodate relatively high static loads even without increasing the number of cable loops.

This object is achieved in that there is provided, at least in the base plate of the U-shaped profile, in addition to the apertures for the cable loops, at least one cavity which is open on one side and the cross-sectional surface area of which, measured in the plane of the base plate, is at least 4 cm^2 and the minimum length, width and depth dimensions of which are each at least 1 cm, wherein the at least one cavity is formed by an opening in the base plate and a hollow body which is open at its underside and otherwise closed and is inserted to fit into the opening provided in the base plate. Cavities of this type wholly or partly replace the conventionally provided surface structure or they are provided in addition to a surface structure of this type. There are therefore now provided, instead of a large number of relatively small protruding and receding wall portions, such as were conventionally provided on corresponding rails, cavities which have a relatively large cross section and above all a relatively great depth on the base plate of the rail and, during casting of the rail with concrete, are filled out by concrete or are left out, so that the concrete forms, at least along the respective base of the groove, solid cams or cavities which have a cross-sectional area of at least 4 cm^2 and a depth of at least 1 cm, engage with the cavities of the rail or are filled out by casting mortar in the rail, thus reach through the base plate of the rail and prevent displacement of the rail in the longitudinal direction or detachment of the rail from the concrete much better than the known surface structures formed by deforming or punching of the rail side walls and base plates.

Expediently, the cavities are, viewed from above, rectangular and have according to one embodiment of the invention minimum dimensions of 2 x 3 cm^2, in other embodiments of 4 x 3 cm^2 and in one embodiment approximately 10 x 3 cm^2 or else 10 x 5 cm^2, the dimension specified first in each case being measured in the longitudinal direction of the rail and the second dimension being measured in the transverse direction of the rail.

As corresponding cavities cannot be formed or can be formed only at considerable cost, solely by corresponding shaping in one piece, by embossing the rail, the respective cavities are formed by an opening in the base plate and a hollow body which is open at its underside and otherwise closed and is inserted to fit into the opening provided in the base plate.

The open side of the hollow body then coincides more or less with the opening in the base plate and the hollow body extends, moreover, into the U-shaped profile of the rail (or out of said profile). The hollow body can for example be a substantially right parallelepiped plastics material box optionally having along its opening edge a small flange resting in the assembled state on the edge of the corresponding opening in the base plate. According to an embodiment, locking elements, which interlock behind the edge of the base plate opening, can fix the hollow body to the edge of the base plate opening.

Also conceivable in this case are hybrid forms in which, for example, a part of the side walls of the hollow body is formed by punched-out material of the base plate that is bent over toward one side, so that a part to be inserted need now merely to supplement the pre-existing wall portions to form a corresponding hollow body open only on one side.

In order to maintain, when casting the rail with the corresponding precast concrete part, the cams at a desired shape and size, an embodiment of the invention provides for the cavity to have side walls extending from its edge on the base plate into the interior of the rail and a bottom which is closed toward the inside of the rail. These side walls and the bottom then define precisely the geometric structure of a concrete cam engaging with the base plate of the rail. As mentioned hereinbefore, the depth dimension of a cam of this type should be at least 10 mm so that accordingly the height, measured perpendicularly to the rims of the cavity, should also be at least approximately 10 mm and is according to an embodiment at least 20 mm.

According to another embodiment of the invention, the cavity which is open on one side can however also be provided on the base plate or the side plates of the U-shaped profile in such a way that its side walls extend outward from the base plate (or the side walls). In this case there are formed, when connecting adjacent precast concrete parts, cams which are made of casting mortar, reach through the base plate of the rails, extend into the base of the groove (or the walls of the groove) at the end face or side face of a precast concrete part and in this way also increase the transverse force bearing capacity by improving the rail/prefabricated component assembly as in the above-described embodiment. Although this embodiment is subject substantially to the same functional principle as a rail with inwardly protruding side walls of the cavity or cavities and is therefore to be included within the scope of protection of the present invention, it is less preferable owing to a correspondingly higher consumption of expensive casting mortar. In addition, these variants of the invention are somewhat more awkward and less practical in use, because the hollow bodies protrude outward from the base plate of the rail. The preferred variant with inwardly protruding walls or cavities will therefore be described for the most part hereinafter, although the respective variant with outwardly directed walls is in this case to be conceptually included in a similar manner.

According to an embodiment of the invention, a plurality of cavities are provided in the base plate of the rail at distances from one another, wherein, again, according to a particular embodiment of the invention, the overall cross-sectional area of the cavities or the cams resulting therefrom forms at least 5 %, or better at least 10 % of the total surface area of the base plate and is preferably up to about one third of the surface area of the base plate.

In this case, adjacent cavities, between which a respective cable loop is arranged, have at least a distance from one another that corresponds to the length of the portion of the cable loop that protrudes from the base plate and is preferably at least 10 % greater than this length. The cable loop can then be, as it passes through the base plate, in addition to cavities, folded over into a position in which the plane defined by the cable loop lies parallel to the base plate, so that the cable loop is completely accommodated between the side walls and does not protrude from the open upper side of the rail. This position of the cable loop is generally maintained in the formwork and also during transportation of the plates, provided that the cable loops are not required in order, for example, to suspend the plates therefrom and to transport them and provided that they are not yet used for connecting to adjacent prefabricated components.

The cavities according to the invention are therefore set far enough apart from one another that sufficient space for folding in or angling the cable loop between the adjacent cavities is present at those locations where a cable loop is present between two cavities. According to an embodiment, the clear distance between adjacent cavities, between which a cable loop is arranged, is at least twice the length of the cavities as measured in this direction.

However, in an alternative embodiment, in which the side plates of the U-shaped profile are much taller than the depth of the cavities, in accordance with the height, measured from the open side, of the side walls of the cavities, the cable loops and the cable loop holders could also be configured in such a way that the cable loops are folded down onto the upper side of closely adjacent cavities and held in this position, as in this embodiment sufficient space for accommodating the cable loops is also present above the bottom of the cavities that is positioned inside the U-shaped profile, without said cable loops protruding beyond the edge of the U-shaped profile. In this case, the cavities could therefore be arranged at a lesser distance from one another and from the cable loops and take up, for example, in total one third or more of the total length of the rail.

However, overall, it is preferable if the cavities form, based on the total length of the device, in total less than half the length of the base plate and encompass, based on the surface area of the base plate, at most one third of the base plate.

An advantageous ratio of holding cams or cavities to the remaining base area of the rail is obtained if the total cross-sectional area of all the cavities at the base of a rail is between 15 % and 25 % of the overall base area of the base plate (including the recess).

According to one embodiment, the side walls of the cavity can extend perpendicularly to the base plate; however, according to another embodiment, they can also enclose an angle to the base plate that can be, measured in each case in the same direction, between 60° and 120°. In particular, opposing side walls of the recess can in this case have an opposite inclination to the base plate, meaning that the angle, measured in one direction, that a side wall encloses with the base plate is less than 90°, while the corresponding angle of the opposing side is greater than 90°. This provides the cavities and the cams formed therefrom in a complementary manner with selectively a trapezoidal or dovetail cross section. Depending on whether corresponding precast concrete slabs or walls are cast with a horizontally or with a vertically oriented rail, it is expedient to configure, in a rectangular recess, two walls opposing one another in the vertical direction in such a way that they define in section a trapezoidal profile, while the two walls arranged perpendicularly thereto are inclined relative to one another in such a way that they form a dovetail profile, i.e. that the walls of the cavities effectively form undercuts. The walls defining the dovetail profile are in this case those which are oriented substantially vertically during the casting of a corresponding plate, while the walls defining the trapezoidal profile have horizontally running rims and are arranged vertically one above another. This prevents the formation in the cavities, during casting of corresponding concrete slabs, of air bubbles in the undercuts, which would then not be filled out with concrete.

Otherwise, corresponding inclined side walls can of course also be combined with side walls perpendicular to the base plate or else opposing side walls can also be inclined toward the same side, so that a parallelogram profile is formed or else the angles of inclination can each be both greater or both less than 90°, but different from one another. However, undercuts should at all times be formed in such a way that during the casting of a concrete slab they are not defined by the side wall, which is then in each case positioned on top, of a recess in order to avoid the formation of air bubbles in the undercut.

Furthermore, it goes without saying that corresponding cavities, such as were described for the base plate, could also be formed in the side plates of a U-shaped profile rail.

Generally, it is expedient to avoid in the cavities sharp corners and transitions and to round off the corner regions between the side walls somewhat. Nor do the cavities necessarily have to be rectangular in their embodiment; on the contrary, they can be embodied as any desired polygons or else be circular or elliptical in their embodiment. Even in cross-sectional shapes of this type, it is possible to generate undercuts by way of appropriate inclination of the side walls and overall to incline the side walls in such a way that, in any case, a portion which is positioned on top during casting does not define any undercut in order to avoid the formation of air bubbles.

A further advantage of the relatively large cavities in the rails of the present invention also consists in the fact that relatively coarse-grained, and thus more economical, aggregates can be used both for the concrete and for the casting mortar, as the concrete or mortar can even then still fill out the large-volume cavities without difficulty; this would be problematic in the case of smaller structures.

According to an embodiment of the invention, provision is furthermore made for the rail to have a plurality of cavities distributed over the length of the rail, the rail being embodied asymmetrically with respect to the distances, measured at the two ends of the rail, of the cavities.

If, therefore, the clear distances of the cavities from one end of the rail, starting in the cavity closest to this end up to the cavity furthest away from the end in question, form a series of values x_1, x_2, ... x_n, then a corresponding series of values y_1, y_2, ... y_n, measured from the other end, of the clear distances of the cavities differs in all the pairs of values x_i, y_i (wherein i = 1...n).

In this case, the clear distances of the cavities from one of the ends of the rail should differ from the corresponding clear distances, which are positioned closest in terms of distance, of the cavities from the other end of the rail preferably by an amount corresponding at least to the length of the cavities, measured in the longitudinal direction of the rail.

This means that, when two rails are installed in an inverted manner in the longitudinal direction, the cavities have different positions, offset by the respective differential amount, with respect to the respective prefabricated component.

In this sense, the present invention also includes a combination of two rails of this type for connecting two adjacent prefabricated components, in which the mutually opposing rails of adjacent prefabricated components are arranged in their longitudinal orientation so as to be rotated relative to one another through 180°, so that the cavities of the opposing rails are arranged offset from one another. It has surprisingly been found that the prefabricated components connected to one another in this way have a greatly improved transverse force bearing capacity parallel to the joint compared to when the cavities of the rails, and thus corresponding holding cams, are arranged precisely opposing one another on both sides of the joint, such as would be the case in rails which are symmetrical in the longitudinal direction or in a symmetrical, non-offset arrangement of the holding cams on the opposing sides of the connecting joint. Expediently, according to a variant, the reciprocal offset of the cavities of the mutually opposing pairs of rails is precisely as great as half the pitch of the cavities along one of the rails. Thus, a cavity of one rail is positioned precisely at the centre between two cavities of the other, opposing rail, the cavities preferably being set uniformly apart from one another along a rail.

It goes without saying that the present invention also includes combinations of rails or interconnected prefabricated components in which the rails do have cavities arranged symmetrically with respect to their longitudinal direction, but are arranged in a correspondingly offset manner at the end sides of the connected prefabricated components, wherein they are for this purpose embodied so as to be somewhat shorter than the associated end sides of the prefabricated components or are shortened accordingly.

In all these combinations of two rails, preference is given to a variant of the invention in which the rails are nevertheless embodied substantially symmetrically with respect to the distances of the points of passage of the cable loops from the respective ends of the rail. In other words, while the concrete cams are arranged offset from one another in the longitudinal direction of the rail at the base of the two opposing rails, the (folded-out) opposing cable loops should nevertheless each be positioned at the same level in pairs. This is ensured by the substantially symmetrical embodiment of the distances of the points of passage of the cable loops on the base plate of the rails from the ends of the rails, wherein it is sufficient if this symmetry is adhered to with a tolerance of 1 to 3 cm, as the folded-out, directly opposing cable loops can then, in view of their flexibility, still be positioned in direct proximity and tensile forces can be transmitted directly and reciprocally to one another via the inserted reinforcing bar and the concrete composite.

The invention also provides a combination of two rails for connecting two adjacent prefabricated components, in which the side plates of one rail have a height, measured perpendicularly to the base plate, which is at least twice the height of the side walls of the other rail.

According to an embodiment, in a combination of this type of two rails, the side plates of one rail are to have a height of at least 50 mm and the side plates of the other rail are to have a height of at most 30 mm.

In particular, the present invention also includes precast concrete parts which are manufactured using the rails and combinations of rails such as are defined in the claims.

Further advantages, features and possible applications of the present invention will become clear from the following description of a preferred embodiment and the figures pertaining thereto, in which:

Figure 1 is a perspective view of the open side of a portion of a profile rail with a cable loop and box-shaped cavities in the base plate;

Figure 2 is a perspective view of a profile rail portion from the side of the base plate;

Figure 3 is a cross section through a first embodiment of a profile rail;

Figure 4 is a cross section through a second embodiment of a profile rail;

Figure 5 is a longitudinal section through precast concrete slab parts with cast-in profile rails according to Figures 3 and 4; and

Figure 6 is a horizontal cross section through two interconnected precast concrete parts with corresponding profile rails;

Figure 7 shows various combinations of cross sections of the cavities in two mutually perpendicular directions;

Figure 8 shows a rail (illustrated discontinuously) which is arranged on a prefabricated component and has asymmetrical clear distances of the cavities toward the two ends of the rail; and

Figure 9 shows two prefabricated components, the joint of which is formed with the aid of two rails having cavities distributed asymmetrically in the longitudinal direction and, in addition, side plates of different height but symmetrically arranged points of passage of the cable loops.

Figure 1 shows a rail which is denoted in its entirety by reference numeral 10, has a substantially U-shaped profile (as may be seen more clearly in Figure 3) and consists of a base plate 11 and two side plates 12a, 12b which are angled substantially at right angles thereto. The base plate 11 has, on the one hand, apertures for accommodating cable loops 7, corresponding holding parts 15 for the cable loops 7, which are generally made of plastics material, being inserted into the apertures and substantially filling them out. The cable loops are formed by short steel cable portions 8 which are doubled up and securely connected to one another at their free ends via a corresponding sleeve, these free ends extending, after the casting of the rail 10 with a concrete slab, into the interior of the concrete slab and the cable loops 7 protruding from a lateral end face of the concrete slab. Also provided, in addition to the apertures, which are concealed by the inserted holding elements 15, are cavities 1 in the form of depressions or cavities in the base plate 11 that extend from the underside of the profile rail into the interior of the U-shaped profile. These cavities are formed by a corresponding, substantially rectangular opening in the base plate 11 and, on the other hand, by a plastics material box which is open at the underside and otherwise substantially right parallelepiped and consists of side walls 2, 3, 4, 5 and a bottom 6, thus producing a right parallelepiped body which is closed at five sides and is positioned with its open side substantially in the plane of the base plate 11 and thus forms a cavity 1 protruding into the interior of the U-shaped profile rail 10.

Figure 2 is, again, a likewise perspective rear view from the underside of the bottom 11 of the rail 10 which has already been shown in perspective in Figure 1. Again, Figure 2 shows the base plate 11 and a side wall 12a of the rail, the holding element 15 for the cable loops 7 and the cavity 1 with the bottom 6 and visible side walls 2, 3, the side walls 4, 5 being concealed on account of the perspective view.

In addition, it is also possible to see on the side wall 3 additional holding elements 31 which are arranged in such a way that they interlock behind the rim of the opening in the base plate 11 that accommodates the plastics material box and thus secure this plastics material box to the rail, wherein the edge of the plastics material box can have, for example, a small flange 32 resting tight against the underside of the base plate 11.

Figure 3 shows, again, the rail 10 in cross section or in an end-side view corresponding to Figure 1 or Figure 2 from below. Figure 3 also shows, again, the recess 1 which is formed by a substantially right parallelepiped plastics material box and has side walls 2, 3, 5 (and also a non-visible side wall 4 opposing the side wall 2) and a bottom 6. This illustration also shows the small flange on the plastics material box which defines the cavity 1 and, on the outside of the side walls 3, 5, barbs or spring elements 31 which are close to the edge 32 of the flange and interlock behind the edge of the opening in the base plate and thus fix this plastics material box securely and in a substantially tight manner in the opening in the base plate 11. It may in addition be seen that the side plates 12a, 12b of the U-shaped profile 10 also have an additional profiling or bulging which ensures a better grip of the rail in the end face of a concrete slab.

Figure 4 is a cross section or else an end view, similar to Figure 3, of a second variant of a profile rail 20. This profile rail 20 differs from the profile rail 10 substantially only in terms of the much taller side plates 22a, 22b which define a much deeper U-shaped profile than the side plates 12a, 12b of the U-shaped profile 10. In addition, in the exemplary embodiment illustrated here, these side plates are also provided with protrusions 23 and a receding portion 24 which are likewise intended to serve to improve the grip of the profile rail 20 in a precast concrete part or an end face of the precast concrete part. In addition, in this case, the side plates 22a, 22b are angled in relation to the base plate 21 by an angle differing from 90°, so that the groove formed by this profile rail 20 in the end face of a concrete slab has a slightly trapezoidal cross section, the width of which increases slightly from the base toward the opening.

All the remaining details, i.e. in particular the individual features of the cable loop holder 15 of the cable portion 8 and the cable loop 7 and also the cavity 1, are identical to the details which have already been described with reference to Figures 1 to 3. Nevertheless, owing to the greater depth of the U-shaped profile 20, a large part of the cable loop 7 is still positioned within this U-shaped profile, whereas in the exemplary embodiment according to Figure 3 this cable loop 7 is positioned for the most part outside the U-shaped profile 10.

Figures 5 and 6 show the corresponding profile rails 10, 20 in the fitted state, thus also making clear the purpose of the U-shaped profiles 10 and 20 respectively, which have different depths. Figure 5 shows two precast concrete parts in the form of slabs 40, 50 which are connected to one another along a joint 45. This longitudinal section shows that the end portions of the steel cable 8, which are securely connected to one another by suitable end sleeves, extend far into the concrete slabs 40, 50 and are cast therewith. A dot-dash line indicates the position of a reinforcing bar 46 extending through the reciprocally covering cable loops 7 which are, again, folded down from the U-shaped profile rails 10 and 20 respectively and cover one another, as may be seen above all in the enlarged illustration in the top right of Figure 5.

In the illustrated exemplary embodiment, the two profile rails 10, 20 each have five cable loops at substantially the same positions measured in the longitudinal direction of the rails.

Prior to use, i.e. before the two concrete walls 40, 50 are connected, the cable loops 7 are generally folded into the profile rails and are held in the folded-in position within the U-shaped profile by the correspondingly embodied holding elements 15 which may be seen, with regard to this configuration, particularly clearly in Figure 1. For use, i.e. for connecting two mutually adjoining precast concrete parts via the joint 45, these cable loops 7 are folded out from the profile rails 10 and 20 respectively, which are cast with the concrete walls 40, 50, and then enter the position which is illustrated in Figure 5 and also in Figure 6 and in which the cable loops 7 of opposing profile rails 10 and 20 overlap one another.

It may also be seen that cavities 1, which have already been described in detail with reference to Figures 1 to 4, are arranged at regular distances between the cable loops and the corresponding cable loop holders 15 in the base plates 11, 21 of the profile rails 10 and 20 respectively. In the state illustrated in Figure 5 and in Figure 6, in which the profile rails 10 and 20 respectively have been cast with corresponding precast concrete parts 40, 50, concrete material from which the elements 40, 50 are made extends of course into the cavities 1 and forms in this way a plurality of (in the specific case five) holding cams arranged at regular distances between the cable loops 7.

The plan view of Figure 6 clearly shows the manner in which the U-shaped profiles 10 and 20 respectively define, in the end faces of precast concrete parts, grooves in which the cable loops 7 can be at least partly accommodated firstly in the folded-in state and later, for connecting the two prefabricated parts 40, 50, also in the folded-out state. In this case, one of the U-shaped profiles, that is to say the U-shaped profile 20, is deliberately embodied so as to be much deeper than the U-shaped profile 10, because it is in this way possible to give the folded-out cable loops 7, at a given size, appropriate space between the end faces of the precast concrete parts 40, 50.

In this case, both rails 10 and 20 respectively are also deliberately embodied so as to have different depths, because the base plate 11 of the rails 10 must, in the case of certain precast concrete parts, in particular in supports, maintain a sufficiently great distance from the inner reinforcing elements of these prefabricated parts which, however, are on the other hand arranged, again, relatively close to the surface of the concrete or the end face facing the prefabricated part 50, so that it is not possible in the case of certain precast concrete parts, such as in particular in certain supports, to insert the deeper U-shaped profiles 20. However, on the other hand, the cable loops have, for reasons of practical handleability, a minimum length of the order of magnitude of 70 mm so that, in the folded-out state, they would not fit into an opposing groove having a lesser depth of, for example, only 20 mm if the remaining joint 45 between the furthest protruding rims of the end faces or grooves is not to exceed a certain maximum dimension of, for example, likewise 20 mm.

However, the combination of a flat U-shaped profile 10 with a deep U-shaped profile 20 then also allows a sufficient distance from reinforcing elements, for example on the side of a support by attaching a flat rail 10 and attaching a deep rail 20 to the end face of a concrete slab and nevertheless a relatively narrow joint 45 and a volume which is overall relatively low and is to be filled out with the (generally relatively expensive) casting compound for connecting corresponding precast concrete parts, this volume being defined substantially by the volume of the two U-shaped profiles 10, 20 and the joint 45 remaining on account of the distance of the precast concrete parts 40, 50. At the same time, this volume or the distance of the opposing base plates 11, 21 of the opposing rails offers 10, 20 sufficient space for the complete folding-out of cable loops 7 having a length which can be up to the amount of the sum of the depths of the two rails plus the width of the remaining joint 45.

In this case, a further positive side effect also resides in the relatively large-volume cavities 1 at the base of the U-shaped profiles 10 and 20 respectively, as the cavities, for their part, reduce the size of the volume to be filled out by casting compound or casting mortar when they protrude into the interior of the rail.

In the illustrated embodiments, the base areas of the cavities 1 preferably form between 10 % and 35 % of the surface area of the base plates 11, 21, based on the total surface areas of the base plates 11, 21.

Figure 7 shows a few more possible cross-sectional shapes of the cavities 1 with partly undercut side walls 3, 5 and 2, 4 respectively.

In all these cases, provision is made for the concrete cam formed by the cavity 1 to widen in cross section into the U-shaped profile, at least in a cross-sectional direction of the concrete slab. Figure 7 is, right at the top, a plan view onto a cavity or a corresponding concrete cam forming in a cavity of this type. Two cross-sectional lines A and B are also represented. Various combinations of cross sections "A" and "B" are illustrated in the partial images therebelow, the longitudinal cross section "A" being illustrated in somewhat shortened form for reasons of space.

As may be seen, the concrete cams resulting from corresponding cavities have, in at least one cross-sectional direction, a cross section widening outward from the slab; in practice, this leads to a larger breakout wedge in the concrete and thus to an increased transverse force bearing capacity of the rails and cable loops secured indirectly via these cams. However, in all the cross section combinations, an undercut is avoided along at least one side wall, the rail with its cavities being arranged at all times in such a way that a wall of the cavities that is positioned in each case on top is at all times one of the side walls which do not define an undercut.

Figure 8 shows schematically along an end side of a prefabricated component or a prefabricated wall 40 a rail 20 with its two asymmetrical ends, the central portion of the rail and the wall 40 being omitted by a break. The special feature of the rail according to Figure 8 consists in the fact that the clear distances x_1 to x_n, measured from an end of the rail 20 up to the respective cavities 1, differ from corresponding distances y_1 to y_n which would be measured from the opposite end of the rail, again starting at the cavity closest to this end up to the most remote cavity. In other words, the rail is embodied asymmetrically with respect to the clear distances of the cavities 1 from the ends of the rail.

The purpose of this measure may be seen from Figure 9 which represents a connecting region between adjacent prefabricated components 40, 50, on the end sides of which corresponding rails 10, 20 with cable loops 5 are arranged. In this case, one rail 10 is rotated relative to the other rail 20 through 180° about a horizontal axis lying in the plane of the paper, i.e. the end corresponding to the lower end of the rail 20 shown on the left is arranged at the top in the rail 10 shown on the right. This has the consequence that the concrete cams of the prefabricated components that are formed as a result of the concrete penetrating the cavities 1 are arranged on one side of the connecting joint so as to be offset in relation to the cams formed on the opposing side, while the points at which the cable loops issue are still located at the same level.

In addition, Figure 9 also shows a variant which is independent of this reciprocal offsetting of the cams and in which the side walls of one rail are much lower than the side walls of the other rail. In other words, while the rail 20 shown on the left can have a side wall height of approx. 70 mm, for example, the rail 10 shown on the right has only a height of approx. 20 mm.

However, the asymmetrical arrangement of the cams with respect to the ends of the respective rails is independent of this different height of both rails. Even similar rails 10, 20 would lead, when rotated accordingly through 180° about a horizontal axis, to the offset arrangement of the opposing cavities 1 and the concrete cams forming therein. On the other hand, the apertures for the cable loops and the corresponding cable loops 5 are arranged roughly symmetrically with respect to the two ends of the rail, so that the cable loops of opposing prefabricated components are positioned relatively close together, as is shown in Figure 9. In the case of high loads, this leads to an advantageous transmission of force directly between the cable loops which each form a tight-knit pair.

The length of the cavities 1 or the cams is in this example about 60 to 80 mm, their width is about 30 to 55 mm and their height is about 20 mm. The distance between the cable loops is about 250 mm; this also corresponds to the pitch of the cavities 1 which have a different distance only from the ends of the respective rail, the difference in the clear distances of the outermost cavities 1 from the ends closest to them of the rail 10 or 20 corresponding roughly to half the pitch, i.e. being about 125 mm or assuming any other value between 100 and 150 mm, for example. It goes without saying that the foregoing dimensions of the individual elements can be implemented independently of one another.

Also with regard to the remaining features, reference is made to the fact that, for the purposes of the original disclosure, all of the features, such as they are revealed to a person skilled in the art from the present description, the drawings and the claims, even if they were specifically described only in relation to certain further features, may be combined both individually and in any desired assemblies with others of the features or groups of features disclosed in the present document, provided that this was not expressly ruled out or technical conditions make such combinations impossible or futile. A comprehensive, explicit account of all of the conceivable combinations of features has not been given in the present document merely for the sake of brevity and readability of the description.

P A T E N T K R A V

1. Skinne til optag af kabelløkker (5) til forbindelse af bygningselementer (40, 50) bestående af en skinne (10) med U-formet profil, som omfatter en grundplade (11) og to vinklede sideplader (12a, 12b; 22a, 22b), med gennembrydninger (9) i grundpladen (11) af U-profilet til gennemføring af kabelløkker (7) og med en overfladestruktur, som forbedrer holdet i bygningselementet, i form af fremstående og/eller tilbagestående vægafsnit i grundpladen (11) og/eller på sidevæggene (12a, 12b; 22a, 22b) af U-profilet, k e n d e t e g n e t ved, at overfladestrukturen mindst i grundpladen (11) af U-profilet ud over gennembrydningerne (9) til kabelløkker (5) også omfatter mindst ét hulrum (1), hvis i planet af grundpladen (11) målte tværsnitsflade andrager mindst 4 cm^2, og hvis minimale længde-, bredde- og dybdemål hver andrager mindst 1 cm, hvor det mindst ene hulrum (1) dannes af en åbning i grundpladen og et på dets underside åbent og i øvrigt lukket hult legeme, som er indsat passende i den i grundpladen tilvejebragte åbning.

2. Skinne ifølge krav 1, k e n d e t e g n e t ved, at hulrummet (1) omfatter sidevægge (2, 3, 4, 5), der udstrækker sig fra dets rand i planet af grundpladen ind i det indvendige af skinnen (10), og en mod indersiden af skinnen (10) lukket bund (6).

3. Skinne ifølge krav 2, k e n d e t e g n e t ved, at væggen (2, 3, 4, 5) med grundpladen (11) af skinnen i en retning i et plan vinkelret på væggen målt vinkel indeslutter mellem 60° og 120°.

4. Skinne ifølge krav 3, k e n d e t e g n e t ved, at mindst en del af væggene af et hulrum i forhold til grundpladen (11) omfatter forskellige hældningsvinkler.

5. Skinne ifølge ét af kravene 1 til 4, k e n d e t e g n e t ved, at hulrummet omfatter afrundede hjørner.

6. Skinne ifølge ét af kravene 1 til 5, k e n d e t e g n e t ved, at hulrummet i grundplanet er cirkelformet eller elliptisk udformet.

7. Skinne ifølge ét af kravene 1 til 6, k e n d e t e g n e t ved, at sidevæggene (12a, 12b; 22a, 22b) af skinnen har en vinkelret på grundpladen (11) målt højde på mellem 20 og 80 mm.

8. Skinne ifølge ét af kravene 1 til 7, k e n d e t e g n e t ved, at U-profilet i tværsnit er trapezformet, hvor den åbne side af profilet danner den længere trapezside.

9. Skinne ifølge ét af kravene 1 til 8, k e n d e t e g n e t ved, at bunden (13) af hulrummene (1) udstrækker sig i afstand fra grundpladen (11) og i det væsentlige parallelt med denne.

10. Skinne ifølge ét af kravene 1 til 9, k e n d e t e g n e t ved, at skinnen omfatter flere hulrum (1), som er fordelte over længden af skinnen, k e n d e t e g n e t ved, at skinnen i forhold til afstanden fra hulrummene (1) til de to ender af skinnen er udformet asymmetrisk.

11. Skinne ifølge krav 10, k e n d e t e g n e t ved, at de frie afstande af hulrummene fra en af skinneenderne adskiller sig fra tilsvarende, afstandsmæssigt nærmest liggende

frie afstande af hulrummene til den anden skinneende med en mængde, som mindst svarer til længden af hulrummene målt i skinnens længderetning.

12. Kombination af to skinner ifølge ét af kravene 10 eller 11 til forbindelse af to til hinanden grænsende bygningselementer, k e n d e t e g n e t ved, at de overfor hinanden liggende skinner af til hinanden grænsende bygningselementer i deres længdeudretning er anbragt drejet med 180° i forhold til hinanden, således at hulrummene (1) af de overfor hinanden liggende skinner er anbragt forskudt i forhold til hinanden.

13. Kombination af to skinner ifølge ét af kravene 10 til 12, k e n d e t e g n e t ved, at skinnerne i forhold til afstandene af passagepunkterne af kabelløkkerne til de respektive ender af skinnerne er udformet i det væsentlige symmetrisk.

14. Fremgangsmåde til at forbinde to til hinanden grænsende betonbygningselementer, som omfatter langs deres forbindelses- eller frontflader forløbende noter, ud af hvilke der rager kabelløkker, som bringes til at overlappe ved at bringe forbindelses- eller frontfladerne sammen og oprette kabelløkkerne, for samtidigt at føre en armeringsstang gennem kabelløkkerne af begge bygningselementerne, som skal forbindes, og efterfølgende at støbe noterne og de tilgrænsende fuger med en støbemasse, k e n d e t e g n e t ved, at der ved anvendelse af skinnerne ifølge ethvert af kravene 1 til 12 ved bunden af noterne dannes knaster af beton eller af støbemasse, hvilke knaster udstrækker sig fra bunden af noterne ind i det indre af noten eller i det under bunden af noten liggende betonmateriale, og har en dybde, henholdsvis højde, på mindst 10 mm og i et til bunden af noten parallelt plan har en tværsnitsflade på mindst 4 cm^2.

15. Fremgangsmåde ifølge krav 14, k e n d e t e g n e t ved, at én af noterne har mindst den dobbelte dybde af de andre noter, hvor skinner ifølge ethvert af kravene 1-12 anvendes, hvor sidepladerne (22a, 22b) af den ene skinne (20) har en vinkelret på grundpladen (21) målt højde, der andrager mindst det dobbelte af højden af sidepladerne (12a, 12b) af den anden skinne (10).

16. Betonbygningselement eller bygningsværk af flere betonbygningselementer, k e n d e t e g n e t ved, at det på mindst én af sine frontsider, sideflader eller forbindelsessteder omfatter en skinne eller en kombination af skinner ifølge ét af de foregående krav 1 til 13.

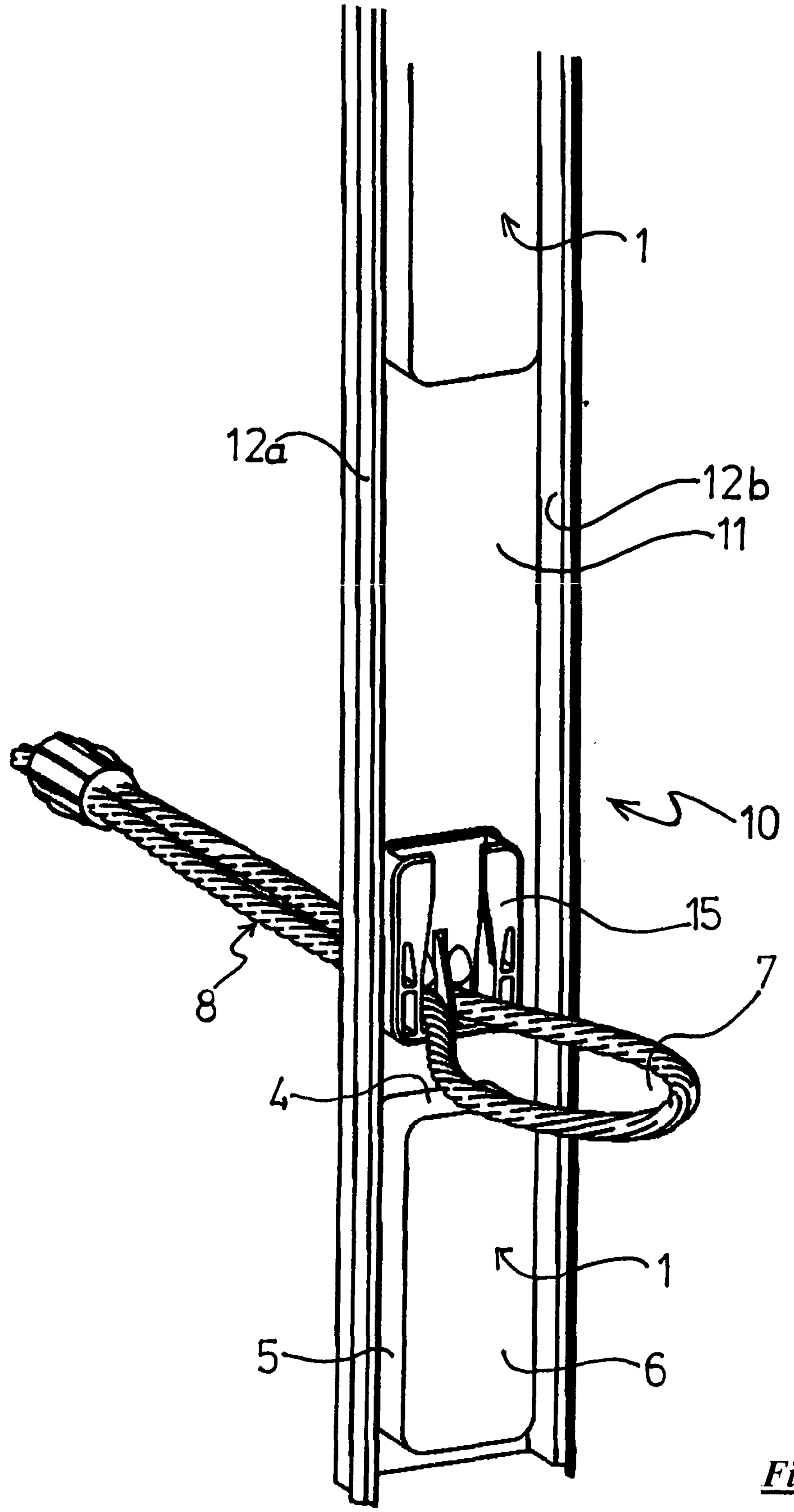

Fig. 1

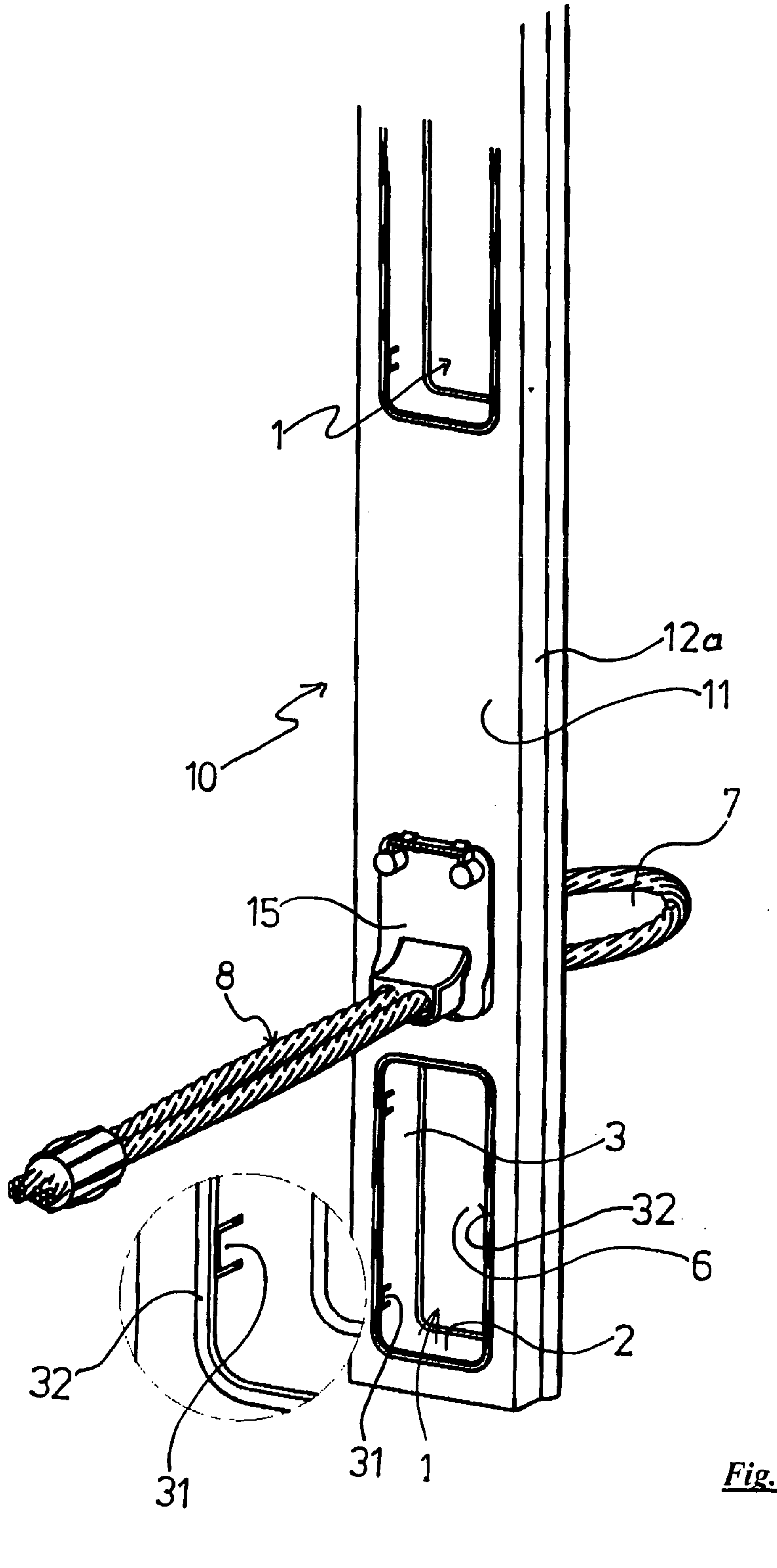

Fig. 2

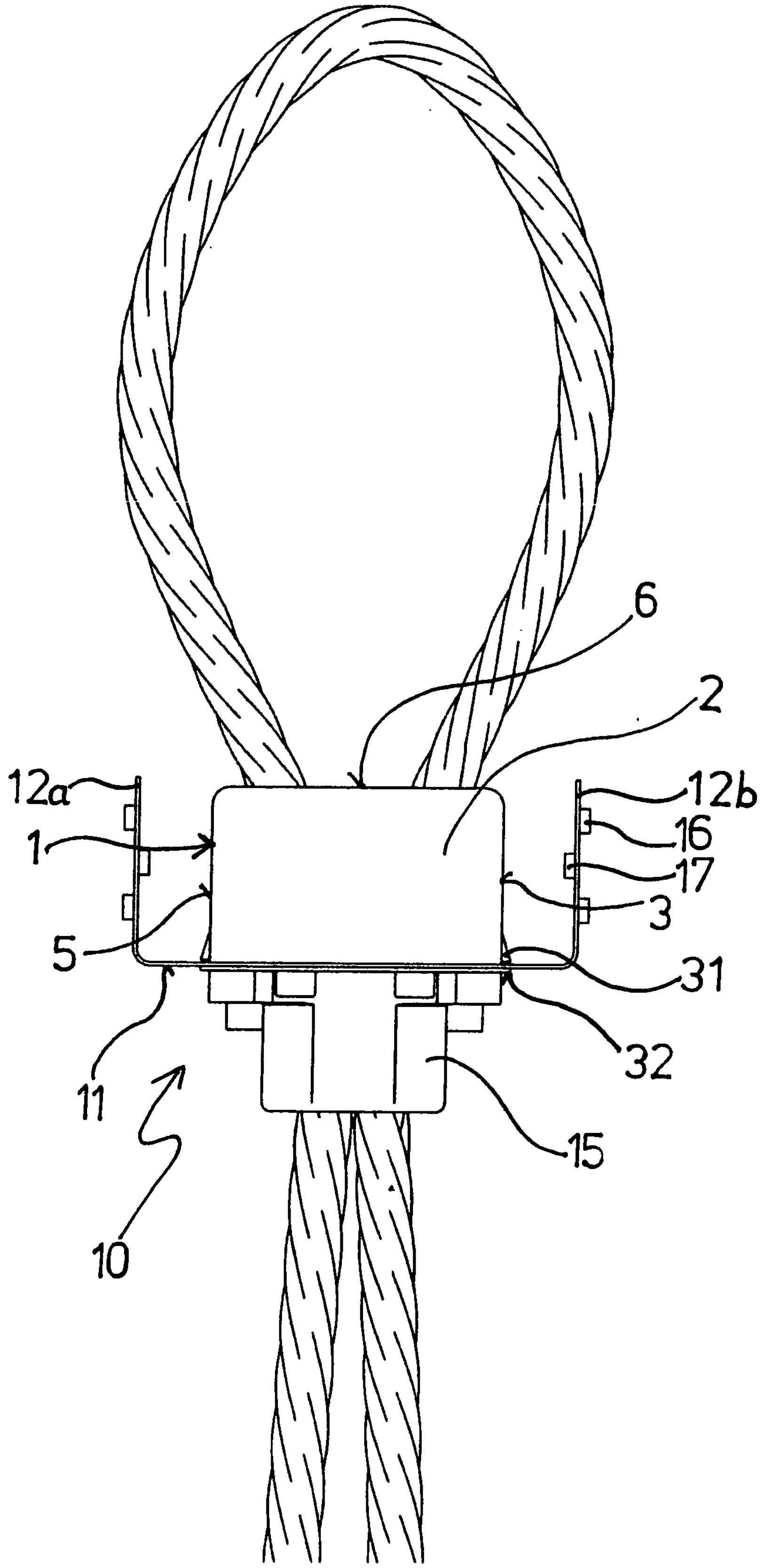

Fig. 3

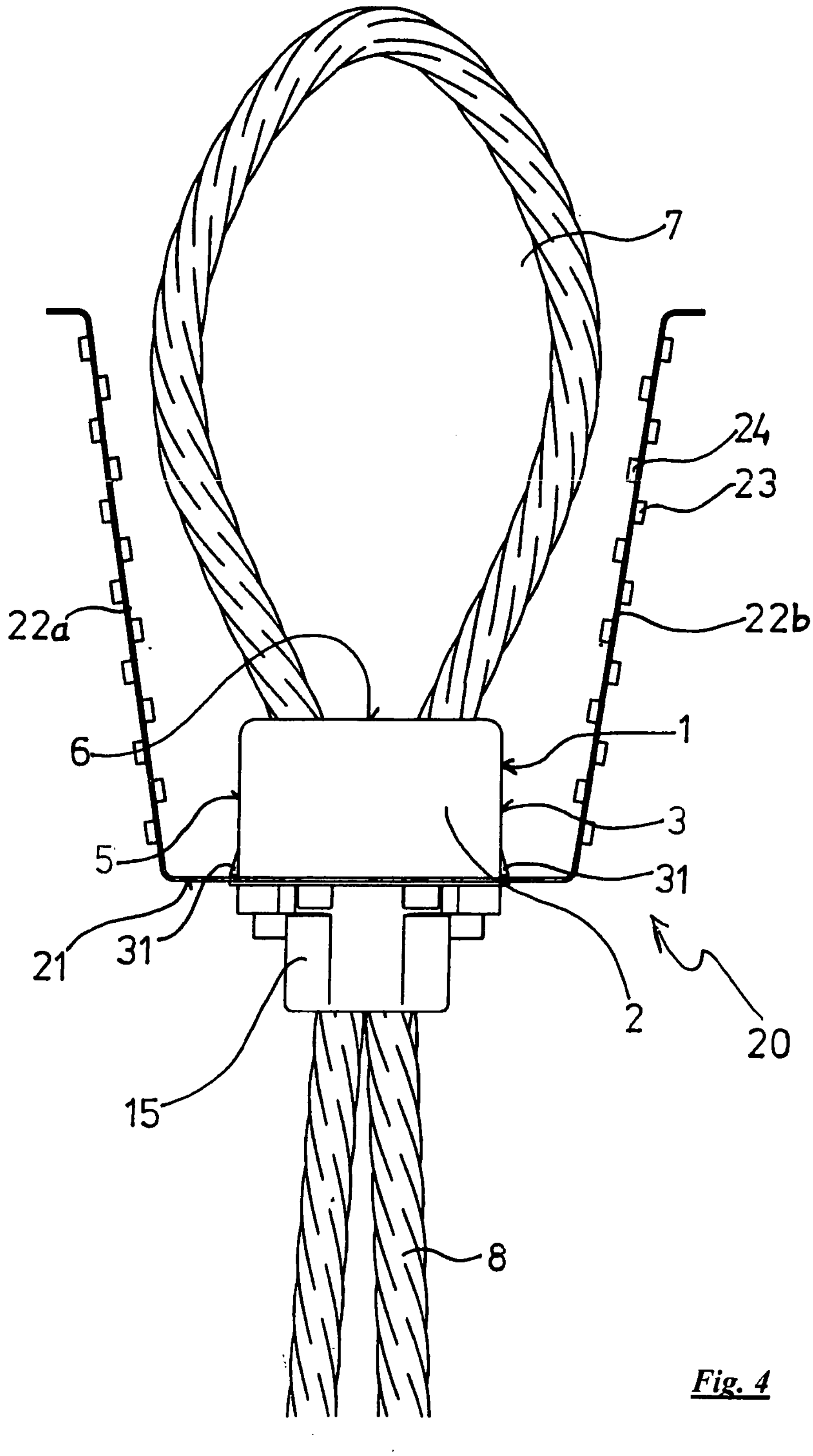

Fig. 4

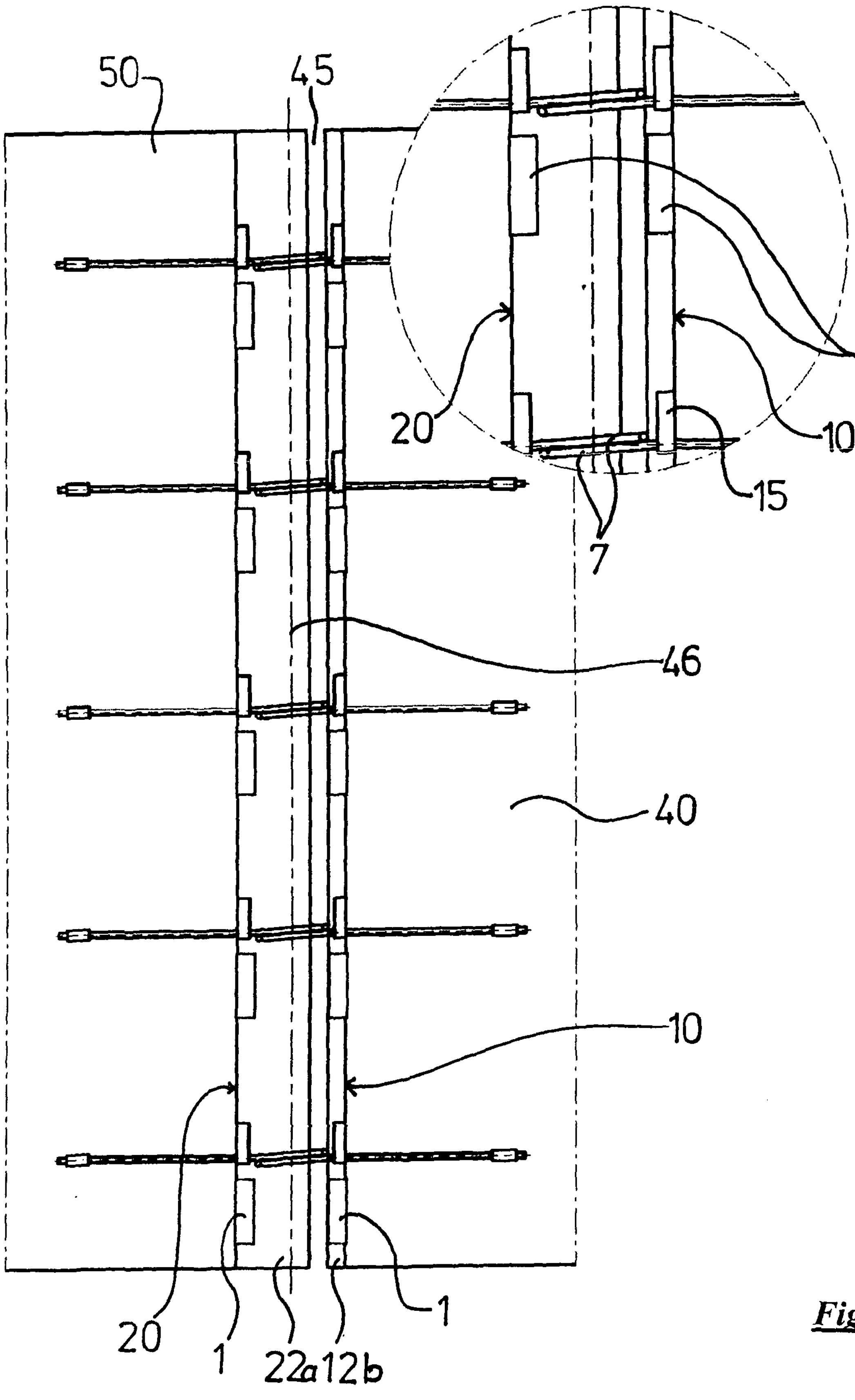

Fig. 5

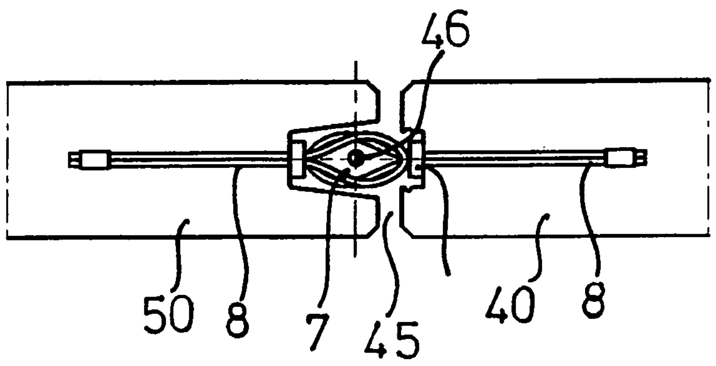

Fig. 6

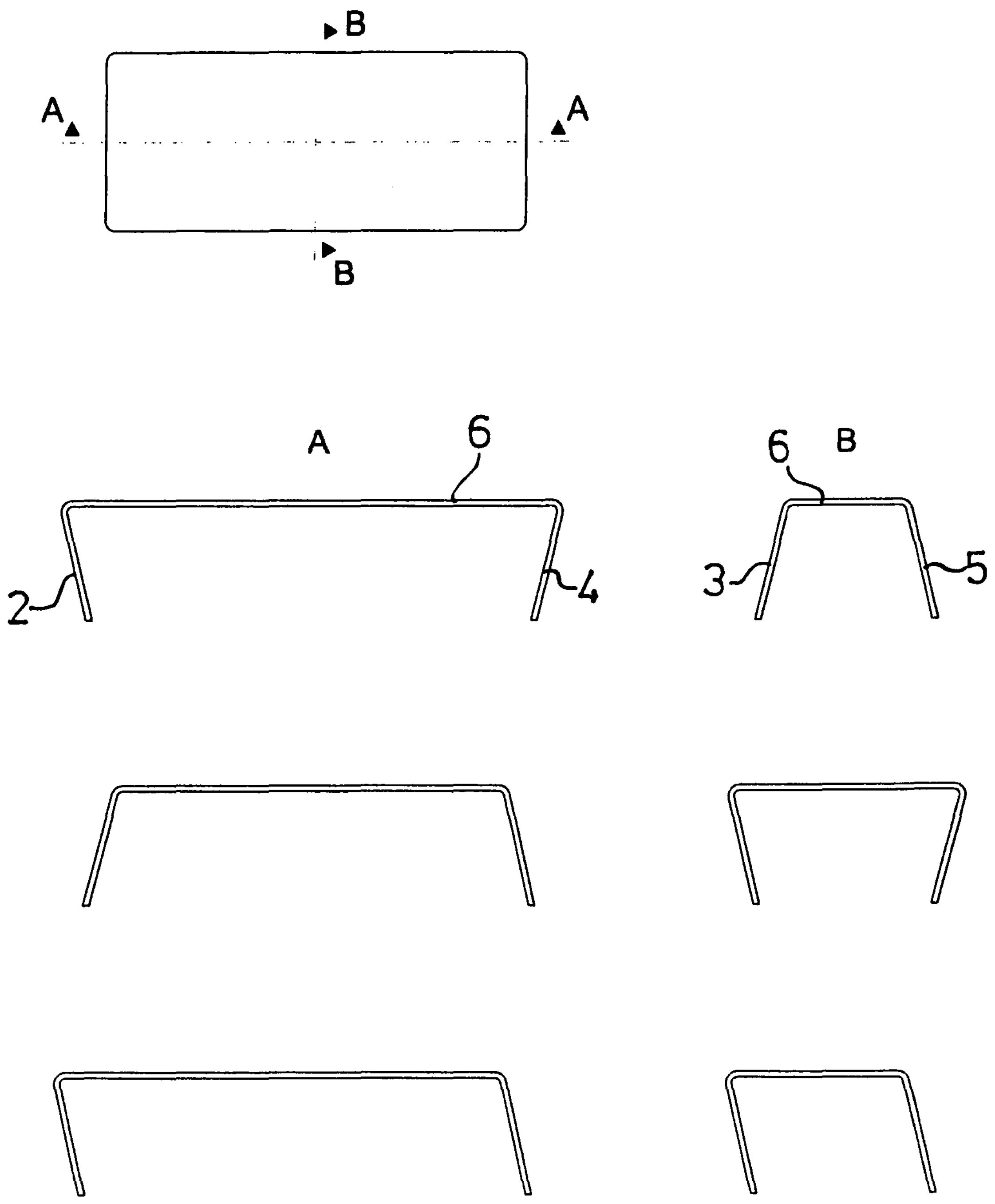

Fig. 7

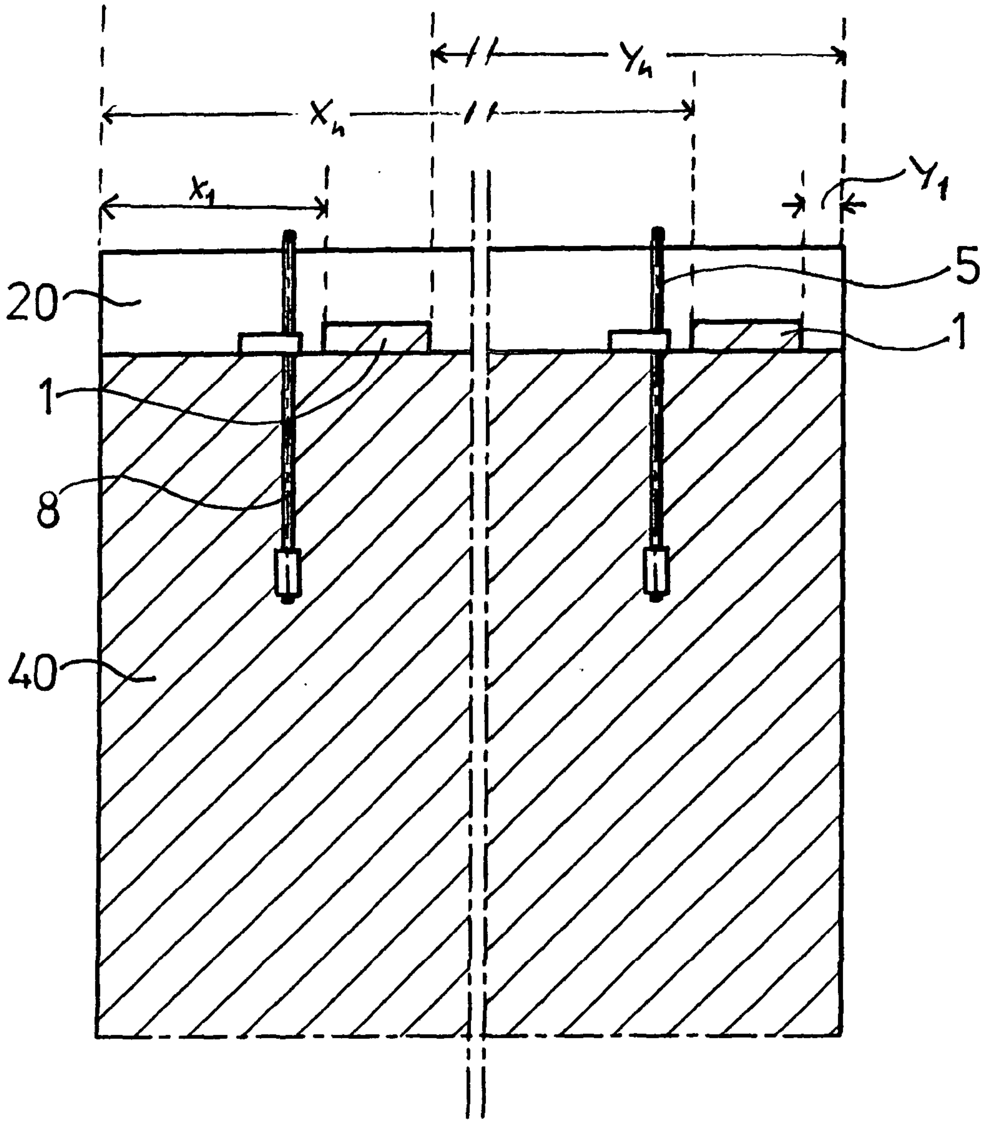

Fig. 8

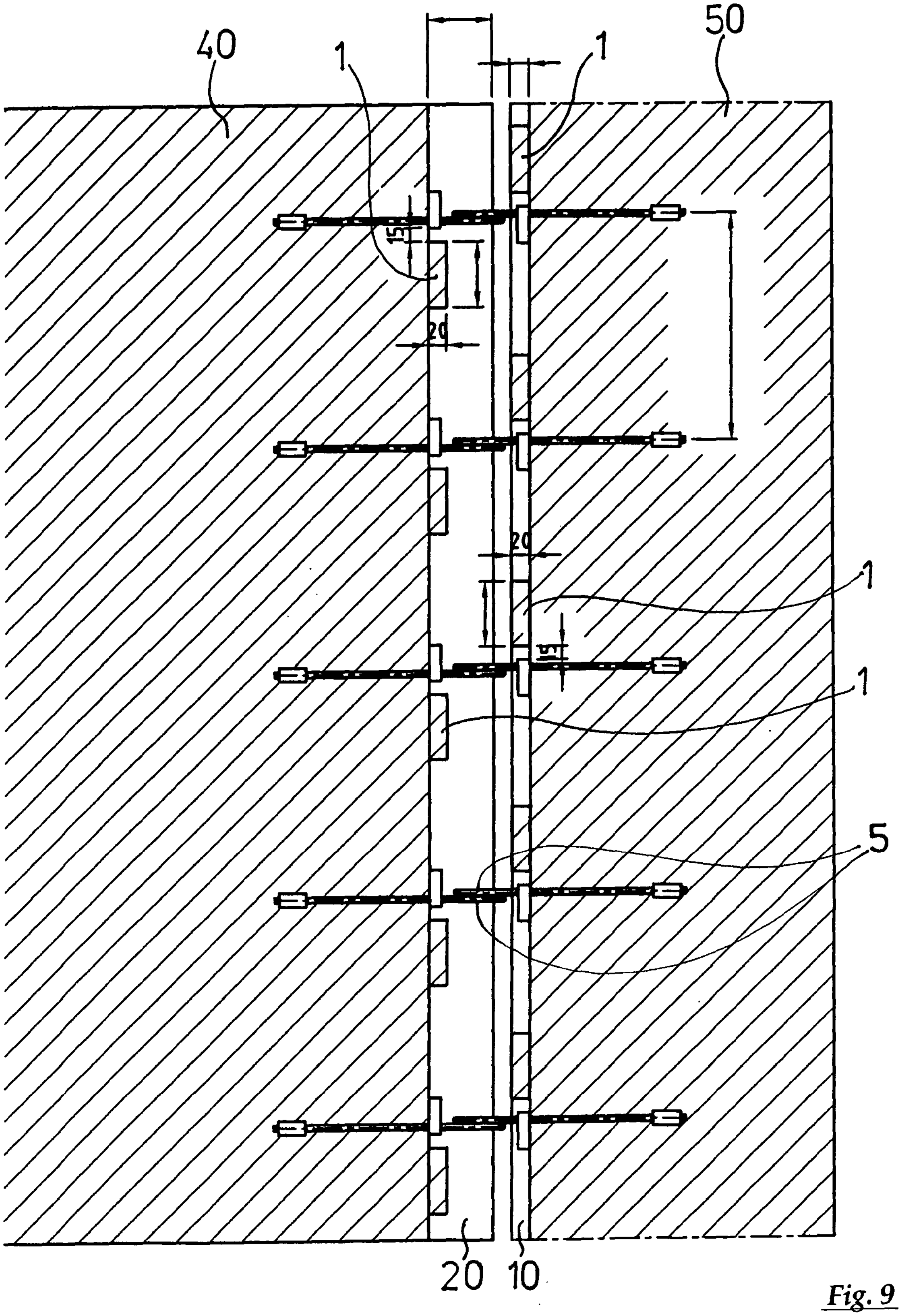

Fig. 9