

TITLE OF INVENTION: Articulated connection joint between structural elements of a support centring of an excavation

Field of the invention

The present invention relates to the field of excavations, in particular tunnels constructed with an underground excavation.

The invention has been developed with particular regard to a connection joint which is improved for articulated connection between elements of a support centring of such an excavation.

Technological background

For supporting excavations, such as, for example, road or rail tunnels, it is known to use consolidation arches known as centrings. In particular, a centring usually comprises a plurality of shaped structural elements which are made of steel and which are mutually connected in a vaulted configuration. Such elements are constituted by open profiles with an H-shaped, HEB, HEM, IPE, INP, C-shaped or double T-shaped cross-section. In some cases, the elements can be tubular. In the majority of cases, the structural elements of a centring are connected to each other in the region of the excavation to be consolidated after having been shaped in the carpentry workshop. However, there exist centring solutions which provide for the articulated connection of the structural elements. A particular support centring of the tubular type with structural elements which are joined by articulated connection joints is described in EP 2354447. Examples of articulated connection joints

between the structural elements of a centring are described in WO 2015/186029 and WO 2022/254325.

The known articulated connection joints are effective but because they are generally made in the carpentry workshop by means of cut metal sheets which are welded to each other, they are expensive and take time to construct. Furthermore, the joints constructed in this manner have possible faults in terms of resistance because welds which are not carried out in a workmanlike manner could place at risk not only the tightness of the joint, but the tightness of the entire centring.

Statement of invention

An object of the present invention is to improve the articulated connection joints for centrings used in excavations, making them faster and therefore economical to manufacture. Another object of the invention is to provide an articulated connection joint which is convenient and secure to use so as to minimize the risks of failure of the joint and the centring itself.

In order to achieve the above-mentioned objectives, the invention relates to an articulated connection joint between structural elements of a support centring of an excavation, having the features indicated in the appended claims.

According to a first aspect, there is described an articulated connection joint between structural elements of a support centring of an excavation. The joint may comprise two joint portions which can be joined in an articulated manner by means of an articulation pin. The articulation between the two joint portions allows the mutual rotation

thereof so that they can change from an open configuration to a closed configuration of the joint. The two joint portions may each comprise a base wall and at least two side walls which are preferably parallel and preferably extend transversely from the respective base wall. There can be provided in the joint blocking members which allow it to be blocked irreversibly when the joint is brought into the closed configuration. The two joint portions are made from a metal material by casting. In this manner, there is obtained a strong joint without sharp edges and therefore without any force concentration points with the result that the resistance thereof is greatly improved with respect to articulation joints for centrings of the known type.

To this end, according to a particular aspect, each base wall of the articulation joint is connected to the respective side walls without any sharp edges. According to another particular aspect, each side wall may comprise a thickening in a zone where there is formed a hole for the passage of a blocking member. In this case, each thickening may also be connected to the respective side wall without any sharp edges.

According to another particular aspect, one of the two joint portions may be formed so as to comprise a member portion which is connected to the base wall and to the side walls. A through-hole may be formed in this member portion for the passage of the above-mentioned articulation pin. The member portion may also be connected without any sharp edges to the base wall and to the side walls of the joint portion.

According to another particular aspect, the blocking members may comprise two opposite pins which are received so as to

slide in respective holes which are formed in the side walls of one of the two joint portions. These opposite pins can be subjected to the thrust of a spring which, in the closed and blocked configuration of the joint, can urge the opposite pins into respective holes which are formed in the side walls of the other joint portion so as to bring about the irreversible blocking of the joint in the closed position thereof.

According to another particular aspect, the joint may comprise two temporary stops which are mounted on the joint portion which carries the opposite pins. The two temporary stops can retain the pins counter to the action of the spring in the open configuration of the joint. The temporary stops can be removed by an action thereof counter to the side walls of the other joint portion during the manoeuvre for closing the joint.

Brief description of the drawings

Additional features and advantages will become evident from the following detailed description of a preferred embodiment with reference to the appended drawings which are provided merely by way of non-limiting example and in which:

- Figure 1 is a perspective view which illustrates an articulated connection joint which is positioned between structural elements of a support centring of an excavation, in a state shown with a broken line;
- Figure 2 is a cross-sectioned view of the articulated connection joint in accordance with a plane denoted II-II in Figure 1;
- Figure 3 is a perspective view of a first portion of the joint of Figure 1; and

- Figure 4 is a perspective view of a second portion of the joint of Figure 1.

Detailed description

In the following embodiments, there are described features which allow the invention to be carried out. The features described can be combined with each other in various manners and are not necessarily limited to the precise embodiment to which the drawings and the relevant description refer. In other words, a person skilled in the art in the sector who reads the following description will know how to obtain the information items which are useful for knowing the way to carry out one or more of the features described by combining it with one or more of the other features described without the particular formulation of the description, the paragraphs, phrases or drawings constituting a limitation on the possibility of isolating one or more of the features described and illustrated in order to combine them with one or more of any of the other features described and illustrated.

Now with reference to Figure 1, a joint 1 is used for the articulated connection of two structural elements A, B of a support centring C of an excavation. In Figure 1, the joint 1 is illustrated in the closed and blocked condition which defines a structural continuity of the two structural elements A, B which makes them fixedly joined in order to form the centring C. Before this configuration is reached, the joint 1 is provided in the open state so that the two structural elements A, B of the centring C can be folded for prior storage and the installation then of the centring in the excavation, for example, by means of automatic or semi-

automatic positioning and installation systems and means, for example, described in WO 2024/017867 A1.

The joint 1 comprises two joint portions 2, 3 which are joined to each other in an articulated manner by a pin 4 which has a head 5 at one end thereof and which is blocked in position by a peg or cotter pin 6 at the opposite end 7.

The first joint portion 2 which can also be seen individually in Figure 3 has a monolithic metal structure which is formed by casting without any sharp edges. The joint portion 2 has a base wall 8 which is substantially planar and which is intended to be connected by means of welding or another mechanical connection to the structural element A of the centring C. There extend from the base wall 8 as a cast single member two side walls 9, 10 in which there are formed two respective holes 11 for the passage of the pin 4. There are formed in the side walls 9, 10 two additional opposite holes 12 which are formed in the region of two respective thickenings 13 of the side walls 9, 10 which are intended to receive the blocking pins 15, 16 which are carried by the second joint portion 3, as will become clearer below. The side walls 9, 10 are joined at the side opposite the pin 4 by a transverse wall 18 which is also joined to the base wall 8 as a cast single member. The first portion 2 generally forms a type of box, in which the second joint portion 3 is received in the closed configuration.

The joint portion 3 which can also be seen individually in Figure 4 has a metal structure with a base wall 20 which is substantially planar and which is intended to be connected by means of welding or another mechanical connection to the structural element B of the centring C. There projects from

the base wall 20 a monolithic member which is formed by casting and does not have any sharp edges, with a central portion 22 in which a through-hole 24 for receiving the central portion of the pin 4 is formed. The central portion 22 is flanked by two side walls 26, 27 which are joined by a transverse wall 28 which is located at the opposite side with respect to the through-hole 24. Two thickenings 30 are provided on the side walls 26, 27 near the transverse wall 28. There are formed in the thickenings 30 two coaxial holes 32 in which the blocking pins 15, 16 are inserted in a sliding manner. There is interposed between the blocking pins 15, 16 a spring 34 which presses the pins outwards. The blocking pins are provided with abutment edges 36 which prevent the pins from leaving the holes 32 under the action of the spring 34. There are formed at the edges of the base wall 20 two notches 38 which allow, when the joint 1 is closed, the discharge of two stop bars 40 which retain the blocking pins 15, 16 in the coaxial holes 32 while the joint 1 is open. In this condition, illustrated in Figure 4, the stop bars 40 are fixed temporarily to the side walls 26, 27, for example, by means of a few weld spots, in such a manner that, when the joint 1 is closed, they are struck by the side walls 9, 10 of the first joint portion 2 which break the temporary fixing and bring about the discharge of the stop bars 40 from the notches 38 while the blocking pins 15, 16 are released in order to be inserted in the holes 12 of the first joint portion 2, as can be seen in Figure 2.

The production of the two portions 2, 3 of the joint 1 is brought about by casting so as to obtain components without any sharp edges, particularly in the transition zones between the base walls and the side walls. The thickenings are also connected so as to prevent concentration of

stresses. The joint 1 does not have welded components with the exception of the potential weld spots which temporarily retain the bars 40 and which therefore project expressly in order to fail so as to release the blocking pins which, in the closed configuration of the joint 1, block it irreversibly by engaging with the holes 12 in the first joint portion 2 under the thrusting action of the spring 34.

Naturally, the principle of the invention remaining the same, the forms of embodiment and details of construction may be varied widely with respect to those described and illustrated without thereby departing from the scope of the present invention.

Patent claims

[Claim 1] An articulated connection joint between structural elements of a support centring of an excavation, comprising two joint portions (2, 3) which are joined in an articulated manner by means of an articulation pin (4) which allows the mutual rotation of the two joint portions (2, 3) from an open configuration to a closed configuration, the two joint portions each comprising a base wall (8; 20) and at least two side walls (9, 10; 26, 27) which extend from the respective base wall (8; 20), there being provided in the joint (1) blocking members (12, 15, 16, 34) in order to block it irreversibly in the closed configuration, the two joint portions (2, 3) being made from a metal material by casting.

[Claim 2] A connection joint according to claim 1, wherein at least each base wall (8; 20) is connected to the respective side walls (9, 10; 26, 27) without any sharp edges.

[Claim 3] A connection joint according to claim 1 or claim 2, wherein each side wall (9, 10; 26, 27) comprises a thickening (13; 30) in a zone where there is formed a hole (12; 32) for the passage of a blocking member (15, 16), each thickening being connected to the respective side wall (9, 10; 26, 27) without any sharp edges.

[Claim 4] A connection joint according to any one of the preceding claims, wherein a joint portion (3) comprises a member portion (22) which is connected to the base wall (20) and to the side walls (26, 27), a through-hole (24) being formed in the member portion (22) for the passage of the

articulation pin (4), the member portion (22) being connected without any sharp edges to the base wall (20) and to the side walls (26, 27).

[Claim 5] A connection joint according to any one of the preceding claims, wherein the blocking members comprise two opposite pins (15, 16) which are received so as to slide in holes (32) which are formed in the side walls (26, 27) of a first portion (3) of the two joint portions, the opposite pins being subjected to the thrust of a spring (34) which, in the closed, blocked configuration of the joint, urges the pins (15, 16) into holes (12) which are formed in the side walls (9, 10) of the other second portion (2) of the two joint portions.

[Claim 6] A connection joint according to claim 5, comprising two temporary stops (40) which are mounted on the first joint portion (3) and which retain the pins (15, 16) counter to the action of the spring (34) in the open configuration of the joint, the temporary stops being removable by an action counter to the side walls (9, 10) of the second joint portion (2) during the manoeuvre for closing the joint.