

Extension element for a movable bridge

The invention relates to an extension element for extending a movable bridge, in the end regions of which
5 drive-on ramps are arranged which run in an inclined manner. A further subject matter of the invention is formed by a movable bridge, in particular a temporary bridge, in the end regions of which drive-on ramps are arranged which run in an inclined manner. Furthermore,
10 the invention relates to a bridge-laying vehicle and to a method for extending a movable bridge.

Movable bridges are used, in particular, in the military field of use as a temporary crossing option
15 for crossing rivers, ditches or similar obstacles, for example in crisis or catastrophe regions.

To this end, the bridges are usually transported to a defined use location by a special bridge-laying vehicle
20 and are also laid over the obstacle to be crossed by way of said bridge-laying vehicle. In order for it to be possible to conform to defined loading dimensions on the bridge-laying vehicle despite the partially enormous bridge lengths, the bridges are often divided
25 in the longitudinal direction into a plurality of bridge segments which are not combined until at the use location to form a longer bridge. For example, scissors type bridges, in which two bridge segments are positioned on one another by way of pivoting, are known
30 in this context. Modular bridges are also known, in which a plurality of bridge segments are displaced against one another and are subsequently positioned next to one another on the end side in a butt joint.

35 In order to facilitate crossing of the bridge, drive-on ramps which run in an inclined manner with respect to the remaining bridge are provided in the end regions. In the case of scissors type bridges, the run-on ramps are usually formed integrally on the ends of the bridge

segments. In the case of modular bridges, the run-on ramps are formed in each case on the outer bridge segments, the bridge segments which lie in between serving merely as extension elements and not having any
5 run-on ramps.

Although bridges of this type have certainly proven themselves, it has been shown to be problematic in certain situations that said bridges always have a
10 fixedly defined maximum length. It can therefore occur that it emerges at the use location that the bridge which is carried by the bridge-laying vehicle is too short for it to be possible to bridge the obstacle to be overcome. In situations of this type, even a few
15 meters can decide whether the obstacle can still be bridged or not.

It is therefore an object of the present invention to provide an apparatus which makes it possible in a
20 simple and inexpensive way to broaden the use spectrum of a movable bridge as required.

According to the invention, said object is achieved in the case of an extension element of the type mentioned
25 at the outset by way of a coupling region for releasable coupling to the end regions of the bridge.

The extension element can be coupled via the coupling region releasably to the end regions of the bridge,
30 with the result that an extension of the bridge can be achieved if required in a structurally simple way and in only a few steps. In this way, a bridge which is initially too short can be extended by several meters, with the result that the obstacle can be bridged
35 completely. As a result, the use spectrum even of bridges which are already in use can be broadened considerably.

One advantageous refinement of the invention provides that the coupling region can be coupled on the end regions in a positively locking manner. By way of a positively locking coupling, a releasable and at the same time reliable connection of the extension element to the bridge can be achieved in a simple way.

It is particularly preferred if the coupling region has a plug-in opening. By way of a plug-in opening, the extension element can be plugged onto the end regions of the bridge in a simple way and a type of releasable plug-in connection to the bridge can thus be established. The plug-in opening can have different shapes and can be open, for example, toward one and/or a plurality of sides. The plug-in opening can form a type of plug-in connection with the end regions of the bridge.

Furthermore, it is advantageous if the extension element has a drive-on ramp which runs in an inclined manner. Via the drive-on ramp, driving of a vehicle onto the extension element and therefore onto the bridge can be facilitated. On its upper side, the drive-on ramp has a roadway. This can consist, for example, of a different material than the other regions of the extension element.

One preferred refinement provides that the drive-on ramp is inclined to a less pronounced extent than the drive-on ramps of the bridge. The overall length of the extension element can be varied via the selection of the gradient of the drive-on ramp of the extension element. Depending on requirements, the gradient can run in a flatter or steeper manner. Here, the greater the extension length becomes, the flatter the configuration of the drive-on ramp. The drive-on ramp preferably has an angle of between 0° and 45° , but particularly preferably has an angle of between 20° and

30° with respect to the horizontal plane of the bridge. As an alternative, the drive-on ramp can also have the same gradient as the drive-on ramps of the bridge, however.

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Furthermore, it is proposed in one structural refinement that the coupling region has a lower coupling arm which extends substantially parallel to the underside of the bridge. In particular, a tensile coupling can be achieved by way of the lower coupling arm. This is because the tensile forces which are produced by a vehicle driving over the bridge can be introduced into the extension element by way of a coupling arm which extends below the bridge.

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One further preferred refinement provides that the coupling region has an upper coupling arm which extends substantially parallel to the upper side of the bridge. The compressive forces which are produced in the bridge can be introduced into the extension element by way of the upper coupling arm.

It is advantageous in this context if the extension element has both an upper and a lower coupling arm. This is because both a tensile and compressive coupling can thus be achieved. The upper and the lower coupling arm preferably end at the same bridge section, in particular at the same level. Furthermore, the coupling arms can extend with a full surface area over the entire width of the extension element or, as an alternative, can extend in the form of individual struts.

In one advantageous refinement, an opposing slope which serves as a drive-over aid is arranged at that end of the upper coupling arm which points toward the bridge middle. Disruptive edges at the transition between the extension element and the bridge are avoided by way of

the opposing slope, which edges might lead to damage of a vehicle tire or the like under some circumstances when crossing. An opposing slope can also particularly preferably be provided on the lower coupling arm.

5 Taking up of the bridge can be simplified by way of the opposing slope which is arranged on the lower coupling arm, since there is no disruptive edge against which the bridge might get caught under some circumstances.

10 It is proposed in a further structural refinement that the drive-on ramp be longer than the upper coupling arm.

Furthermore, one preferred refinement provides that a
15 tensioning element and/or a locking element are/is provided for locking the coupled coupling region. The extension element can be connected fixedly to the bridge by way of the tensioning element and/or the locking element, with the result that the extension
20 element is not detached, for example when a vehicle drives over the bridge.

In the case of a movable bridge of the type mentioned at the outset, said object is achieved by virtue of the
25 fact that the extension element is configured in accordance with one or more of the above-described features. The advantages which have already been explained in conjunction with the extension element result.

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In one advantageous refinement of the bridge, it has two track supports which run substantially in parallel. The track supports can serve as drive-over surfaces for a vehicle which is crossing the bridge. The track
35 supports are particularly preferably arranged spaced apart from one another, which results in a weight-saving design of the bridge element with a

substantially free middle region between the track supports.

Particularly preferably, two or four extension elements
5 can be coupled to the bridge in order to extend the
bridge. This results in a length of the bridge which
can be varied in a mission-specific manner, since no
extension element has to be used in the case of short
obstacles, extension elements can be coupled only on
10 one side of the bridge in the case of obstacles of
medium length, or extension elements can be coupled on
both sides of the bridge in the case of longer
obstacles. For extension purposes, the extension
elements can be coupled to the bridge either track
15 support for track support or in a manner which reaches
over the track supports from one track support to the
other. By way of coupling two or four extension
elements to the bridge, the bridge can be used with
three different lengths depending on the intended use,
20 which results in a considerably broadened use spectrum
in comparison with conventional bridges.

Moreover, it is proposed that the track supports be
connected to one another via transverse supports which
25 run transversely with respect to the track supports.
The transverse supports can extend, in particular,
transversely with respect to the drive-over direction
and can be connected to the track supports, for
example, by way of welding.

30 Furthermore, it is advantageous if the tensioning
element extends between the extension element and the
transverse support. The extension element can be braced
against the bridge in a pressure-resistant manner, with
35 the result that the extension element cannot be
detached unintentionally during crossing. The
transverse carrier and/or the extension element can
have holding devices for fastening the tensioning

element, to which holding devices the ends of the tensioning element can be fastened. The tensioning element can be, for example, a rope, a belt or a chain.

5 In the case of a bridge-laying vehicle of the type mentioned at the outset, the abovementioned object is achieved by virtue of the fact that said bridge-laying vehicle has extension elements and/or a bridge of the above-described type. This likewise results in the advantages which have already been described in
10 conjunction with the extension element and/or the movable bridge.

In the case of a method of the type mentioned at the
15 outset, the abovementioned object is achieved by virtue of the fact that an extension element is coupled releasably to the end regions of the bridge via a coupling region.

20 This also results in the advantages which have already been described in conjunction with the extension element and/or the movable bridge.

It is particularly advantageous in this context if the
25 extension element and/or the movable bridge and/or the bridge-laying vehicle are/is configured in accordance with one or more of the above-described features.

Further details and advantages of the invention are to
30 be explained in the following text with the aid of the exemplary embodiments which are shown in the drawings. In which:

Fig. 1 shows a process sequence for explaining a
35 bridge laying operation,

Fig. 2 shows a diagrammatic side view of a bridge with coupled extension elements,

Fig. 3 shows a plan view of the bridge according to Fig. 2,

5 Fig. 4a shows a perspective view of an extension element according to a first embodiment,

Fig. 4b shows a side view of the extension element according to Fig. 4a with an associated
10 bridge,

Fig. 5a shows a perspective view of an extension element according to a second embodiment,

15 Fig. 5b shows a side view of the extension element according to Fig. 5a with an associated bridge,

Fig. 6a shows a perspective view of a third extension element according to a third embodiment,
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Fig. 6b shows a side view of the extension element according to Fig. 6a with an associated
25 bridge,

Fig. 7 shows a diagrammatic plan view of a bridge with coupled extension elements, and

Fig. 8 shows a diagrammatic plan view of a movable
30 bridge with coupled extension elements.

Movable bridges 1 are used, in particular, in the military field of use as a temporary crossing option for crossing rivers, ditches or similar obstacles 18,
35 for example in crisis or catastrophe regions.

In accordance with the illustration in Fig. 1, the bridges 1 are transported to this end by a bridge-

laying vehicle 17 to a defined use location and are also laid by said bridge-laying vehicle 17 over the obstacle 18 to be crossed. Often, track-driven vehicles are used as bridge-laying vehicle 17, which are also
5 suitable in unpassable terrain for transporting and laying the bridge 1 which often has a quite considerable weight on account of their satisfactory suitability as transport vehicle and their satisfactory cross-country capability. However, the present
10 invention is not restricted to bridge-laying vehicles 17 of this type, but rather can likewise also be used in the case of, for example, wheel-driven bridge-laying vehicles 17.

15 Fig. 1a) shows a bridge-laying vehicle 17 which is constructed on the basis of a tank chassis with a bridge 1 which is stored on it. The bridge 1 is configured in the manner of a scissors type bridge and is situated in a compact transport position for
20 transport. In the transport position, the bridge 1 is transported to a use location by way of the bridge-laying vehicle 17 which is configured as a pioneer tank, and is laid over an obstacle 18 to be crossed, for example a river, a ditch or the like.

25 As can be gathered from the illustration in Fig. 1a), a plurality of extension elements 5 can be carried on the bridge-laying vehicle 17. Said extension elements 5 can be arranged, for example, on the side of the bridge-laying vehicle 17 above the tracks in the region of the
30 track shoulders. As an alternative, it is also possible to arrange them at another location which affords sufficient room and is readily accessible if required. As an alternative, it would also be conceivable to
35 carry the extension elements 5 on an accompanying vehicle or trailer.

In order now to lay a bridge 1, the bridge 1 which is folded together is first of all folded apart via a folding-open mechanism which is not described here in greater detail (cf. Fig. 1b)) until the bridge 1 which
5 is folded open extends with its entire length L_1 above the bridge-laying vehicle 17 in accordance with the illustration in Fig. 1c).

In the military field, the length of the obstacle 18 to
10 be bridged can be determined via suitable reconnaissance measures, for example using satellite data. The length L_1 of the bridge 1 is then known to the operators of the bridge-laying vehicle 17, with the result that a decision can be made, proceeding from the
15 determined length of the obstacle 18, as to whether the length L_1 of the bridge is sufficient, in order to lay the bridge 1 over the obstacle 18.

For the case where the length L_1 of the bridge 1 is not
20 sufficient, as shown in Fig. 1d), extension elements 5 can be taken down from the bridge-laying vehicle 17 depending on requirements and can be plugged onto the drive-on ramps 4, which run in an inclined manner, of the end regions 3 of the bridge 1. After plugging on,
25 the bridge 1 has an overall length L_3 which is several meters greater than the length L_1 . The bridge 1 which is extended in this way can subsequently be laid over the obstacle 18 in a conventional way by the bridge-laying vehicle 17, cf. Fig. 1e).

30 After the bridge 1 has successfully been laid, it can be crossed by vehicles which are also partially very heavy, such as battle tanks and the like. As soon as the bridge 1 is no longer required after a defined use
35 duration, it can be taken up by the bridge-laying vehicle 17. Here, the extension elements 5 are released from the bridge 1 by the operators, are removed from said bridge 1 and are stored securely on the bridge-

laying vehicle 17, after which the loading dimensions which are predetermined for transport can be adhered to.

5 Fig. 2 shows a diagrammatic side view of a bridge 1. The bridge 1 consists of a single bridge element 2, in the end regions 3 of which drive-on ramps 4 are arranged which run in an inclined manner. As an alternative, the bridge 1 can also have a plurality of
10 bridge elements 2 which can be positioned on one another in the manner of a scissors type bridge or a modular bridge.

The bridge 1 has an overall length L_1 . The overall
15 length can be extended to a length L_3 by way of two-sided coupling of extension elements 5. As an alternative, there is also the possibility to select an intermediate length L_2 by way of single-sided coupling.

20 A coupling region 7 which serves for releasable coupling to the end regions 3 of the bridge 1 is provided on the extension element 5. For coupling purposes, the coupling region 7 is connected fixedly to the drive-on ramps 4 of the bridge 1.

25 Fig. 3 shows a diagrammatic plan view of a bridge 1 with coupled extension elements 5. It can be seen using said illustration that the drive-over surface of the bridge 1 is formed from two track supports 13, 14 which
30 run substantially in parallel. The track supports 13, 14 are arranged spaced apart from one another, with the result that a vehicle 17, 20 can drive over them easily and reliably. The track supports 13, 14 are connected to one another transversely with respect to the
35 crossing direction by way of transverse supports 15.

For extension to the length L_2 , two extension elements 5 can be coupled to the bridge 1 on one side track

support for track support. If the bridge 1 is to be extended to the length L3, extension elements 5 are coupled at both ends of the bridge 1, with the result that a total of four extension elements 5 are attached to the bridge 1. In order to extend the bridge 1, the extension elements 5 can be plugged onto the track carriers 13, 14 of the bridge 1 either track support for track support or in a manner which reaches over the track supports.

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Advantageous refinements of the extension element 5 according to the invention are now to be explained using the illustrations in Figs. 4 to 6.

15 A first exemplary embodiment of structurally simple design of an extension element 5 is shown in Figs. 4a and 4b. The extension element 5 can be manufactured from steel, aluminum or composite materials. The extension element 5 has a trapezoidal shape. A coupling region 7 which is provided for releasable coupling to the end regions 3 of the bridge 1 is arranged on the side to be coupled of the extension element 5. Here, the end regions 3 of the bridge 1 have drive-on ramps 4 which run in an inclined manner and are coupled to the coupling region 7.

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The drive-on ramp 6 has a gradient with respect to the underside of the extension element 5 and/or the horizontal plane of the bridge 1, which gradient is inclined to a less pronounced extent than that of the drive-on ramps 4 of the bridge 1. In the exemplary embodiment which is shown in Fig. 4a, the drive-on ramp 6 has, for example, a gradient angle of approximately 30°. As an alternative, said gradient angle can also be selected to be greater or smaller. The overall length of the extension element 5 can be varied by way of the selection of the gradient angle. This is because the flatter the gradient, the longer the extension element

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5. If the gradient angle is selected to be greater, the length of the extension element 5 can be shortened in comparison with the extension element 5 which is shown in Fig. 4a. The advantage is produced that, the flatter the configuration of the drive-on ramp 6, the more easily a vehicle 17, 20 can drive onto the bridge 1. As an alternative, it is also possible, however, that the drive-on ramp 6 and the drive-on ramp 4 have the same gradient depending on the intended use.

As can likewise be gathered from Figs. 4a and 4b, the drive-on ramp 6 and the coupling region 7 are connected to one another via a surface 19 which runs in a flat manner. Said surface 19 lies in the same plane as the upper side of the bridge 1. This results in the advantage that the upper surface 19 terminates flush with the upper side of the bridge 1. No edges are thus produced which, for example, might lead to damage of the tires during the crossing of the vehicle 17, 20.

The underside of the extension element 5 is likewise of flat configuration and runs in a plane with the underside of the bridge 1 and serves as a support of the movable bridge 1.

In order to extend the bridge 1, the extension element 5 can be placed onto the drive-on ramp 4 from above and can be connected to the latter via connecting elements which are not shown in the drawing. For example, positively locking or non-positive connecting elements can be used. Screw elements, plug-in elements or the like are conceivable here.

A second exemplary embodiment of an extension element 5 which is configured as a plug-on module is shown in Figs. 5a and 5b. In said exemplary embodiment, the extension element 5 has in principle a similar shape to the embodiment of the extension element 5 which is

shown in Figs. 4a and 4b. Here, however, a lower coupling arm 8 is additionally provided which extends substantially parallel to the underside of the bridge 1.

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The coupling arm 8 forms a plug-in opening 9 together with the upwardly extending part of the extension element 5. The extension element 5 can be plugged through the plug-in opening 9 onto the end regions 3 of the bridge 1 in the manner of a plug-in connection. A
10 plug-in opening 9 which is configured in this way affords the advantage that a positively locking connection which is effective in a plurality of directions is achieved on the bridge 1.

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A tensile coupling is achieved via the lower coupling arm 8. During crossing of the bridge 1 by a vehicle 17, 20, the bridge 1 is subjected to a tensile load in the lower part. By way of the lower coupling arm 8, the
20 forces which are produced in the bridge 1 can be introduced into the extension element 5 reliably.

According to a third refinement, as shown in Figs. 6a and 6b, in addition to the lower coupling arm 8, the
25 extension element 5 has an upper coupling arm 10 which extends substantially parallel to the upper side of the bridge 1. As a result, a compressive coupling is achieved which introduces the compressive forces which are produced in the upper part of the bridge 1 into the
30 extension element 5.

The coupling arms 8, 10 can be configured as individual struts or as plate-shaped elements which extend over the entire width or parts of the bridge 1. Furthermore,
35 the coupling arms 8, 10 can be connected to the bridge 1, for example, via threaded bolts or locking pins. As a result, additional locking of the extension element 5 on the bridge 1 can be achieved.

Furthermore, an opposing slope 11 which serves as a crossing aid is arranged at that end of the upper coupling arm 10 which points toward the bridge middle.

5 An opposing slope 11 of this type affords the advantage that a vehicle 17, 20 which is driving over the bridge 1 can drive onto the extension element 5 easily, without it being necessary to cross a disruptive edge in the process. Here, the opposing slope 11 terminates
10 flush with the bridge 1. Here, the opposing slope 11 has as flat a gradient as possible, with the result that the impairment of the vehicle 17, 20 by way of the opposing slope 11 is as low as possible.

15 As can be gathered, in particular, from the illustration in Fig. 6b, the ends of the two coupling arms 8, 10 end at the same level and/or bear against the same bridge section. On account of this configuration, the lower coupling arm 8 and the upper
20 coupling arm 10 might be connected to one another and also to the track supports 13, 14 of the bridge 1 via a single connecting element which extends, for example, as a type of bolt from the upper coupling arm 10 through the bridge 1 and the lower coupling arm 8. As a
25 result, additional locking of the extension element 5 on the bridge 1 can be achieved.

The locking of the extension 5 on the bridge 1 is now to be explained in the following text using the
30 illustration in Figs. 7 and 8:

Holding devices 20 are provided on the extension element 5, to which holding devices 20 a tensioning element 12 can be fastened. These can be, for example,
35 eyelets which are welded to the extension element 5. They are arranged on both sides of the extension element 5, with the result that it is possible for an operator of a bridge-laying vehicle 17 to plug each

extension element 5 onto any desired track supports 13, 14, without it being necessary to pay attention to which side of the extension element 5 a holding device 20 is provided on.

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The tensioning element 12 can be hooked into the holding device 20, for example, via a carabiner hook or the like and can then be pulled in the direction of the bridge 1. In order to fasten the tensioning element 12 to the bridge 1, holding devices 20 are likewise arranged on the transverse supports 15 of the bridge 1. Accordingly, the tensioning element 12 can be fastened both to the bridge 1 and to the extension element 5 and can then be tensioned.

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The coupling region 7 can be locked with respect to the drive-on ramps 4 by way of the tensioning of the tensioning element 12, with the result that it can be ensured that the extension element 5 is not released or displaced during laying or crossing of the bridge 1. Tensioning elements 12 can be ropes, chains or the like and can consist of a very wide variety of materials.

As an alternative or in addition, locking elements 16 can be arranged on the extension element 5, for example in the form of tension locks, snap-in locks or the like. They are then closed after the extension element 5 has been plugged on and coupled, with the result that blocking of the extension element 5 with respect to the bridge 1 is likewise achieved by way of this.

By way of the above-described extension element 5, an extension of a bridge 1 at the use location can be performed in a simple and inexpensive way, as a result of which the use spectrum even of bridges which are already in use can be broadened considerably.

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List of Designations

	1	Bridge
	2	Bridge element
5	3	End region
	4	Drive-on ramp
	5	Extension element
	6	Drive-on ramp
	7	Coupling region
10	8	Lower coupling arm
	9	Plug-in opening
	10	Upper coupling arm
	11	Opposing slope
	12	Tensioning element
15	13	Track support
	14	Track support
	15	Transverse support
	16	Locking element
	17	Bridge-laying vehicle
20	18	Obstacle
	19	Flat surface
	20	Holding devices
	21	Vehicle
25	L1	Length of the bridge without extension element
	L2	Length of the bridge with an extension element
	L3	Length of the bridge with two extension elements

Patent Claims

1. An extension element for extending a movable bridge (1), in the end regions (3) of which drive-on
5 ramps (4) are arranged which run in an inclined manner, characterized by a coupling region (7) for releasable coupling to the end regions (3) of the bridge (1).
2. Extension element as claimed in claim 1,
10 characterized in that the coupling region (7) can be coupled on the end regions (3) in a positively locking manner.
3. Extension element as claimed in either of the
15 preceding claims, characterized in that the coupling region (7) has a plug-in opening (9).
4. Extension element as claimed in one of the
20 preceding claims, characterized by a drive-on ramp (6) which runs in an inclined manner.
5. Extension element as claimed in claim 4,
characterized in that the drive-on ramp (6) is inclined
25 to a less pronounced extent than the drive-on ramps (4) of the bridge (1).
6. Extension element as claimed in one of the
preceding claims, characterized in that the coupling
30 region (7) has a lower coupling arm (8) which extends substantially parallel to the underside of the bridge (1).
7. Extension element as claimed in one of the
35 preceding claims, characterized in that the coupling region (7) has an upper coupling arm (10) which extends substantially parallel to the upper side of the bridge (1).

8. Extension element as claimed in claim 7, characterized in that an opposing slope (11) which serves as a drive-over aid is arranged at that end of the upper coupling arm (10) which points toward the
5 bridge middle.

9. Extension element as claimed in one of the preceding claims, characterized in that a tensioning element (12) and/or a locking element (16) are/is
10 provided for locking the coupled coupling region (7).

10. A movable bridge, in particular a temporary bridge, in the end regions (3) of which drive-on ramps (4) are arranged which run in an inclined manner,
15 characterized by an extension element (5) as claimed in one of the preceding claims.

11. Movable bridge as claimed in claim 10, characterized by two track supports (13, 14) which run
20 substantially in parallel.

12. Movable bridge as claimed in claim 11, characterized in that the track supports (13, 14) are connected to one another via transverse supports (15)
25 which run transversely with respect to the track supports (13, 14).

13. Movable bridge as claimed in claim 12, characterized in that the tensioning element (12)
30 extends between the extension element (5) and the transverse support (15).

14. A bridge-laying vehicle for laying a bridge (1), characterized by an extension element (5) as claimed in
35 one of claims 1 to 9 and/or a movable bridge (1) as claimed in one of claims 10 to 13.

15. A method for extending a movable bridge (1), in the end regions (3) of which drive-on ramps (4) are arranged which run in an inclined manner, characterized in that an extension element (5) is coupled releasably to the end regions (3) of the bridge (1) via a coupling region (7).