

The present invention relates to a system on a road vehicle such as a truck for the transport of at least one bridging element intended for the crossing of a ditch and for the laying down of the bridging element
5 over the ditch from the vehicle.

One knows from EP-A-0,374,019 a system permitting in particular to lay down a bridging element with a short length or a greater length after assembly of two bridging elements having short lengths from a vehicle.
10 This known system however involves the use of a great number of handling jacks of which the points of pivotal connection to the vehicle undergo relatively substantial forces during the lifting of a bridging element and the pivoting of a forward portion of the structure
15 supporting the bridging element. In addition this known system does not allow an effective taking up of the forces due to the overhang of the bridging element at the moment of its laying down upon the ditch to be crossed especially in the case where the bridging
20 element has a great length. At last the known system has a structure and an operation which are relatively complex.

EP-A-0,362,065 describes a system comprising the characteristics set forth in the preamble of claim 1.
25 This known system exhibits the same inconveniences as those of the system of the document EP-A-0,374,019 in particular as to the taking up of the overhang forces of the bridging element.

The present invention has as its object to remove
30 the hereabove inconveniences of the known systems by proposing a system such as defined in the preamble of claim 1 and which is characterized in that it comprises a main beam supporting the tilting plate and mounted onto the chassis of the vehicle in a manner displaceable
35 in translatory motion along the longitudinal axis of the vehicle to a position of extension from the vehicle increasing the lever arm of the taking up of the forces

resulting from the cantilever positions of the bridging element and of the launching beam.

Preferably the main beam is supported by a corset beam fastened to the chassis of the vehicle and is
5 positively driven in a guided fashion in translatory motion on the corset beam.

The bridging element is bilaterally guided in relation to the launching beam during its controlled displacements by a guiding unit with rolling rollers and
10 corresponding guide rails moving on the rollers.

Preferably the guide rails are fastened to the bridging element and the rolling rollers are fastened to the launching beam.

The means for driving the bridging element on the
15 launching beam comprise an electric motor made fast to the launching beam and two parallel toothed side racks made fast to the bridging element with which are meshing two drive pinions, respectively, driven by the rotary shaft of the electric motor.

20 Both aforesaid toothed racks are fastened directly onto both guide rails, respectively, each one having a cross-section shaped as a lying U.

The means for driving the launching beam comprise an electric motor fastened underneath the tilting plate, a
25 toothed rack longitudinally fastened below the launching beam and a drive gear driven by the rotary shaft of the motor and meshing with the toothed rack.

Preferably the launching beam is assembled to the tilting plate by a dovetail-shaped guiding whereas the
30 main beam is assembled to the corset beam also by a dovetail-shaped guiding.

The means for driving the main beam comprise an electric motor made fast to the corset beam, a toothed rack longitudinally fastened underneath the main beam
35 and a drive gear driven by the rotary shaft of the motor and meshing with the toothed rack.

The means for the orientation of the tilting plate comprise on the one hand at least one element for

retaining the tilting plate at some distance from the tilting axis of the plate and a member for operating the retaining element and which may be actuated either for pulling the retaining element and causing the tilting plate to pivot in the counter-clockwise direction or for releasing the retaining element so as to allow the bridging element - launching beam - tilting plate assembly to freely pivot about the tilting axis in the clockwise direction and on the other hand a counter-plate device pivoting about the tilting axis of the tilting plate and exerting a thrust force underneath the tilting plate to keep the latter in particular in an approximately horizontal position of supporting the bridging element.

The counter-plate device comprises two arms pivoting about the aforesaid tilting axis and two operating members acting upon both ends, respectively, of the operating arms for pushing them below the tilting plate.

Preferably the bridging element comprises two parallel substantially parallelepipedic twin box members defining two upper treadways and two outrigger ramps pivotally mounted onto both ends, respectively, of each box member about a transverse pivot axis and controlled in such a manner that each outrigger ramp assumes either a position folded back onto the box member and of continuity of the latter or an extended position in extension of the box member permitting vehicles to accede to the treadways and to leave them softly once the bridging element is laid down above the ditch to be crossed.

Both outrigger end ramps located on a same side of both box members, respectively, of the bridging element are simultaneously operated by a control device comprising a motor driving two coaxial shafts extending transversely of the launching beam while extending through both side walls, respectively, of the latter, a jack with a double rod made fast to the launching beam which may drive both shafts slidably mounted between an

inoperative retracted position and a positive operative position for driving both operating forks pivotally mounted onto the outer sides, respectively, of both box members of the bridging element about an axis near the pivot axis of the outrigger ramps and each one in engagement with an external axis made fast to the corresponding outrigger ramp, the forks assuming a lying position in the extended position of the outrigger ramps and a raised position approximately perpendicular to the treadways in the swung-back position of the outrigger ramps.

Both aforesaid shafts have each one at their end a square drive stub engaging in the operative position a rotary socket of complementary shape extending through the internal wall or side of one box member and mounted endwise of a rotary shaft disposed transversely within the box member and driving the pivot axis of the corresponding fork through the medium of a transmission with sprocket wheels and belts or chains disposed endwise of the box member.

The guide rails are fastened to the mutually confronting internal walls or sides, respectively, of both box members of the bridging element in such a manner that the launching beam be disposed between both box members of the bridging element and the end outrigger ramps comprise guide rails fastened to the internal walls of the outrigger ramps and caused to be in extension of the guide rails of the box members when they are in the extended position.

The system in addition comprises another bridging element or lower bridging element onto which is resting in the transport position the aforesaid bridging element or upper bridging element and which may be either laid down over another ditch after laying down the upper bridging element or coupled and mechanically locked to the upper bridging element in extension of the latter to form one bridging element of great length which is then laid down over a corresponding ditch to be spanned.

The lower bridging element rests at its rear end near the cabin of the vehicle upon a stationary support structure with slide skids made fast to the corset beam and at its front end upon a device for lifting the lower
5 bridging element fastened to the corset beam and comprising a portion forming a lifting arm pivoting about a stationary pin transverse to the corset beam, which arm-like portion comprises at least one roll for the bearing of the lower bridging element.

10 The aforesaid lifting device is operated in such a manner that the arm portion lifts the front end of the lower bridging element when the upper bridging element is in an overhanging position on the launching beam and inclined by the same angle as that of the lower bridging
15 element through orientation of the tilting plate in order that the lower bridging element be in alignment with the upper bridging element which is then displaced on the launching beam towards the lower bridging element to be coupled and mechanically locked itself thereto,
20 the launching beam being then righted by the tilting plate in an approximately horizontal position in which the end outrigger ramps of the big bridging element are extended and the big bridging element is then displaced on the launching beam into an overhanging position at
25 which the tilting plate is driven in the clockwise direction for laying the big bridging element down.

For laying the lower bridging element down upon the aforesaid other ditch, the launching beam is brought into the overhanging position, the lifting device is
30 controlled so that the arm portion raises the front end of the lower bridging element, the tilting plate is oriented in order that the launching beam and the lower bridging element be aligned, the launching beam is brought back into the transport position for engaging
35 its rolling rollers with the guide rails of the lower bridging element, the main beam is moved into the position of extension while carrying along therewith the lower bridging element supported by the launching beam,

which is then righted by the tilting plate to an approximately horizontal position, the end outrigger ramps of the lower bridging element are extended and the bridging element is brought in the overhanging position on the launching beam, and the tilting plate is driven in the clockwise direction for laying the lower bridging element down over the other ditch.

The launching beam comprises at least two pairs of rolling rollers, viz. a rear pair and a front pair and the front pair of rollers is mounted onto a bogie device permitting an angular excursion of the rollers during the retraction of the launching beam from the associated bridging element laid down over the ditch or when taking again up the bridging element.

Advantageously the bogie device comprises approaching studs facilitating the positioning of the rolling rollers within the guide rails of the bridging element in particular during the taking up of the bridging element from the ground.

The invention will be better understood and further objects, characteristics, details and advantages thereof will appear more clearly in the course of the explanatory description which will follow, made with reference to the attached diagrammatic drawings given by way of example only illustrating one embodiment of the invention and in which :

Figure 1 shows the system according to the invention comprising a truck and the device for laying down at least one bridging element over a ditch to be crossed.

Figure 2 is a top view according to the arrow II of figure 1.

Figure 3 is a view in section along the line III-III of figure 2.

Figure 4 is a view in section along the line IV-IV of figure 2.

Figure 5 is a view in section along the line V-V of figure 2.

Figure 6 is a view in section along the line VI-VI of figure 2.

Figure 7 diagrammatically shows a bridging element with parts partly broken away.

5 Figure 8 is a top view according to the arrow VIII of figure 7.

Figure 9 is a partial perspective view with parts broken away of the end of the bridging element according to the arrow IX of figure 7 with the end outrigger ramps
10 in extended position.

Figure 10 is a view identical with that of figure 9 with the end outrigger ramps swung back.

Figure 11 is an enlarged view of the circled portion at XI of figure 10.

15 Figure 12 is a top view with parts broken away of a launching beam.

Figure 13 is a side view according to the arrow XIII of figure 12.

Figure 14 is an enlarged view of the circled portion
20 at XIV of figure 13.

Figure 15 is a view in section along the line XV-XV of figure 14.

Figure 16 is a view in section along the line XVI-XVI of figure 12.

25 Figure 17 is a view in section along the line XVII-XVII of figure 12.

Figure 18 is an enlarged view according to the arrow XVIII of figure 13.

Figure 19 is a view in section along the line XIX-XIX of figure 12.
30

Figure 20 is a perspective bottom view of a plate - counter-plate assembly.

Figure 21 is a view in section along the line XXI-XXI of figure 20.

35 Figure 22 shows in a perspective view a main beam of the system of the invention.

Figure 23 is a top view according to the arrow XXIII of figure 22.

Figure 24 is an enlarged view in section along the line XXIV-XXIV of figure 22.

Figure 25 shows as a perspective view a corset beam of the system of the invention.

5 Figure 26 is a view in section along the line XXVI-XXVI of figure 25.

Figure 27 is a perspective view of a device for lifting a lower bridging element of the system of the invention.

10 Figure 28 is a perspective view of a structure for supporting the lower bridging element.

Figure 29 shows as a perspective view a lateral stabilization foot of the truck during the laying down of a bridging element.

15 Figure 30 shows in a perspective view an anti-tipping base associated with an anti-tipping foot of the vehicle backwards of the latter.

Figures 31(A) to 31(O) show the different phases for assembling two bridging elements of short length to form
20 a bridging element of great length and for laying the latter down over a ditch.

Figures 32(A) to 32(H) show the different phases for laying down an upper bridging element.

Figures 33(A) to 33(N) show the different phases for
25 laying down the lower bridging element.

Referring to figures 1 to 30, the reference numeral 1 designates a truck permitting to transport two bridging elements, namely an upper bridging element 2 and a lower bridging element 3 resting upon each other
30 towards at least one ditch to be crossed by for example military vehicles.

The truck 1 comprises a cabin 4 extended by a longitudinal chassis 5 supporting the system for laying down the bridging elements 2, 3.

35 According to the invention, this system comprises a corset beam 6 with a rigid structure and with a U-shaped cross-section covering the chassis 5 while being made fast thereto by any suitable means such as fastening

screws (not shown) extending through the side walls of the beam 6 at places symbolically designated at 7 on figure 25. An electrical motor 8 is fastened with the assistance of fastening bolts 9 underneath the upper junction wall of the side walls of the beam 6 and formed of trussed barks 10. The motor 8 drives through its rotary shaft a drive pinion 11 protected from the outside by a casing 12 fastened underneath the upper wall 10.

10 The system moreover comprises a main beam 13 slidably mounted onto the corset beam 6 along the longitudinal axis of the chassis 5 by a dovetail assembly the tenon 14 of which is machined on the upper wall 10 of the beam 6 and the mortise 15 is machined below the main beam 13. At the bottom of the mortise 15 longitudinally extends a toothed rack 16 arranged along the longitudinal axis of the chassis 5 and underneath and with which meshes the drive pinion 11. The main beam 13 consists of a U-shaped strong structure stiffened by transverse reinforcing bars 17. A preferably hydraulic jack 18 is fastened at the bottom of the main beam 13 along the longitudinal axis thereof by fastening lugs 19 made fast to the body of the jack 18 the rod 20 of which has its end pivotally connected about a transverse axis of a head-like part 21 for the fastening of two parallel chains or cables 22 extending along the beam 13 and the functions of which will be explained subsequently. The part 21 is bilaterally guided along the longitudinal axis of the beam 13 by guide angle bars 23 made fast for example as by welding to the side walls of the beam 13. The beam 13 supports towards its front portion opposite to the cabin 2 of the truck 1 a shaft 24 arranged transversely between both side walls of the beam 13 and journaled with its ends in bronze bushes 25 made fast to sleeves 26 forming supporting bearings fastened through the side walls of the beam 13. The sleeves 26 are closed externally by covers 27. Two pulleys 28 are fastened onto the rotary shaft 24 and serve as pulleys

for guiding both chains or cables 22, respectively, approximately by 90° upwards. The front end of the beam 13 is formed of two parallel plates 13a with a raised bottom with respect to the bottom joining the side walls of the beam 13 and reinforced by two transverse dihedral plates 29. Both plates 13a terminate in two plates 13b approximately vertically perpendicular to the plates 13a and supporting a transverse pivot pin 30 as this will be described herebelow.

10 The system moreover comprises a plate 31 tiltable about the pivot pin 30 under the control of the jack 18 and of the chains or cables 22, of which those ends, which are opposite to that fastened to the part 21 are fastened by two anchoring points shaped as a double yoke 15 32 below the plate 31 and located at some distance from the pivot pin 30. The latter is made fast with its two ends to the plates 13b for supporting the beam 13 in two fastening bushes 33, respectively, made fast to the plates 13b. The plate 31 pivots about the central 20 portion of the pin 30 through the medium of side bronze bushes 34 made fast to the pin 30 coaxially to the latter. With the plate 31 is associated a counter-plate device 35 which comprises two parallel arms 36 pivoting about the pin 30 through the medium of two bronze bushes 25 37 made fast to the pin 30 and arranged between both bushes 34 while being adjacent thereto. Both arms 36 have their ends opposite to the pin 30 pivotally connected by yokes 38 to both ends, respectively, of two rods 39 of two jacks 40 for operating the counter-plate 30 device 35 and which act upon both ends, respectively, of the arms 36 for pushing them against and below the tilting plate 31. The bodies of the jacks 40 are fastened to the external faces of both plates 13a of the beam 13 for example through the medium of fastening 35 plates secured to these external faces at places symbolically designated by the reference numeral 41. A jack 42 has its body fastened in a pivoting manner to the pin 30 at its central portion between the bushes 37

through the medium of a ball joint R and has its jack rod 43 connected in a pivoting manner to an anti-tipping base 44 through the medium of a clevis 45 made fast to the base 44. The base 44 moreover comprises two other
 5 clevises 46 to which are fastened in a pivoting manner two rods 47, respectively, of side jacks 48 for operating the anti-tipping foot strut constituted by the jack 42 and the base 44 and the jacks bodies of which are fastened in a pivoted manner by fastening plates 49
 10 to the external faces of the side walls of the beam 13. The jacks 48 thus permit the pivoting of the anti-tipping foot strut between an inoperative position stowed within the beam 13 underneath the raised bottom between the plates 13a and a vertical operative position
 15 wherein the rod 43 of the jack 42 presses the anti-tipping base 44 upon the ground, the pivoting of the jack 42 taking place in the vertical middle plane of the beam 13. The tilting plate 31 is thus oriented on the one hand by the jack 18 pulling on the chains 22 or
 20 releasing same for taking up maximum forces when the bridging element or elements 2, 3 are overhanging with the launching beam 50 which will be described later in the outward moved position and on the other hand by both jacks 40 of the device 35 when the forces are reversed
 25 (for example when the launching beam 50 is in the stored position) and in this case these forces as well as the motions of the plate 31 are limited. The fact that the tilting plate 31 and the central jack 42 of the anti-tipping foot strut be mounted onto the same pin of
 30 rotation 30 ensures a good diffusion of the forces during the phase of launching of the bridging elements 2, 3.

The launching beam 50 consists of a strong preferably parallelepipedic box-shaped structure and may
 35 be displaced in translatory motion in a guided fashion on the tilting plate 31. For that purpose the beam 50 is assembled to the tilting plate 3 by a dovetail the tenon 51 of which is machined on the plate 31 and the mortise

52 of which is machined underneath the bottom wall of the launching beam 50. A toothed rack 53 is fastened below this bottom wall along the longitudinal axis of the beam 50. An electrical motor 54 is fastened below the tilting plate 31 and has its rotary shaft driving a drive pinion 55 protected from the outside by a protective casing 56 and extending through the plate 31 to mesh with the toothed rack 53. The control of the motor 54 thus permits to displace the launching beam 50 in relation to the plate 31 along the longitudinal axis of the chassis 5 of the truck 1.

The beam 50 comprises two rear pairs of external side guide or riding rollers 57 with both rollers 57 of each pair being disposed coaxially on either side of the beam 50. Each roller 57 is mounted for free rotation onto a supporting axle 58 made fast at right angles to the corresponding side wall of the beam 50. An anti-friction bronze bush 59 is interposed between the roller 57 and the axle 58. The roller 57 moreover is retained in position on the axle 58 by two opposite shoulders 60 of the latter. The beam 50 further comprises two other front pairs of external side guide or riding rollers 61 with the both rollers 61 of each pair disposed coaxially on either side of the beam 50. Both rollers 61 of the foremost pair are each one rotatably mounted on a supporting axle 62 through the medium of an anti-friction bronze bush 63, the axle 62 being made fast to a side plate 64 at right angles to the latter. Likewise both rollers 61 of the other pair are supported in rotatable manner on two axles 62, respectively, made fast to both side plates 64 which moreover are each one pivotally mounted in relation to the corresponding side wall of the beam 50 by a pin 65 made fast to the plate 64 and extending through the side wall of the beam 50. Each pin 65 is freely rotatably mounted in a bronze bush 66 made fast to the side wall of the beam 50 and is retained in this wall by a collar flange 67 endwise of the pin 65. The plates 64 may thus swing in relation to

the side walls of the beam 50 by the pins 65 so as to constitute a device forming a bogie permitting an angular motion of the front pairs of rollers 61 during the final phase of laying down of the bridging elements 2, 3 or during the taking up of the latter from the ground. Each side plate 64 is moreover fitted at its front end with a transverse external stud 68 intended to facilitate the positioning of the rollers 61 in guide rails during the initial phases of taking up of the bridging elements from the ground. Moreover the end of the plate 64 has a bevel cut as this appears from figure 14. It should be noted that the beam 50 also has its end having a bevel cut in order to avoid any interference of the beam 50 with the ground after laying down a bridging element of short or long span.

The launching beam 50 also comprises an electric motor 69 intended to drive in translatory motion a bridging element in relation to the beam 50. The motor 69 is accommodated in the beam 50 and has two opposite coaxial output shafts 69a extending through both side walls, respectively, of the beam 50 and carrying each one a drive gear 70. The motor 69 is fastened to the top wall of the beam 50 by fastening lugs 71. Both side drive gears 70 are meshing with two toothed racks 72, respectively, disposed in symmetrical relation to the longitudinal axis of the chassis 5 of the truck 1 and made fast to one bridging element 2, 3.

The beam 50 also comprises a device 73 for operating outrigger end ramps 74 of the bridging element 2, 3 which will be described in detail later and which comprise two opposite coaxial pins 75 displaceable along an axis orthogonal to the longitudinal axis of the chassis 5 of the truck 1 by a jack 76 with two rods 77 both ends of which are coupled to two side arms 78, respectively, made fast to the pins 75 at right angles thereto. The shafts 75 comprise each one a splined portion 51a accommodated in an internally splined sleeve 79 supported in a rotatable manner in a case 30 fastened

underneath the top wall of the beam 50. The splined portion of each shaft 75 is extended by a drive portion 81 extending through the corresponding side wall of the beam 50 and terminating into a square drive end 82, the connection of one arm 78 to the shaft 75 lying substantially in the portion of junction between the splined portion 75a and the drive portion 81. A pinion with a spur toothing 83 is fastened onto the middle portion of the sleeve 79 in perpendicular relation to the latter and meshes with another lower pinion with a spur toothing 84 made fast to a shaft 85 supported in a rotatable fashion in the lower portion of the casing 80 in parallel relation to the sleeve 79. The shaft 85 supports at its two ends two sprocket wheels 86, respectively, driven by two chains or drive belts 87 reeved over two drive side gears 88, respectively, made fast to an output shaft of a drive motor 89 fastened underneath the top wall of the beam 50. The motor 89 thus permits to rotatably drive the sleeve 79 and therefore the shafts 75 which then assume the operative position shown in dotted lines on figure 19 where the square ends 82 are accommodated within two holes, respectively, with a shape complementary of two sleeves 90 mounted each one for rotation in the bridging element 2, 3. The displacement of the shafts 75 between a retracted inoperative position on figure 19 and the operative position is of course permitted owing to the splined portions 75a below the control of the jack 76.

Both bridging elements 2, 3 have identical structures and are thus formed each one of two parallelepipedic boxes 91 coupled by a bracing plate 92 in aligned flush relationship with the top walls of the boxes 91 which form trackways for the rolling of vehicles. The track for the rolling of each box 91 is extended at its end by a downwards rolling track at each end of which is pivotally connected about a transverse shaft an outrigger ramp 74 the top wall of which is in extension of the downward track in the extended position

of the outrigger ramp. The outrigger access ramps 74 are thus shaped to facilitate the access of vehicles onto the rolling tracks when in the extended position or to allow the vehicles to smoothly leave the rolling tracks.

- 5 Each outrigger ramp 74 may be swung back and locked onto the corresponding downward track of the box so as to ensure the continuity of the box 91.

- To cause each access outrigger ramp 74 to pivot from a folded-back position to an extended position and
- 10 reversely the operating device 73 is completed as follows. A shaft 93 is rotatably supported by a yoke 94 fastened in the corresponding box 91 at the bottom of the latter. The shaft 93 extends transversely in the box 91 in extension of the sleeve 90 which extends through
- 15 the internal side wall of the box 91. The shaft 93 comprises as being made fast thereto a pinion 95 driving through the medium of a chain or of a toothed belt C1 another pinion 96 made fast to a shaft 97 parallel to the shaft 93 and rotatably supported on a yoke 98 also
- 20 fastened to the bottom of the box 91. A third pinion 99 is fastened onto the rotary shaft 97 and drives through the medium of a chain or of a toothed belt C2 extending in the box forming the downward rolling track substantially over the whole length thereof, a fourth
- 25 pinion 100 made fast to a rotary shaft 101 parallel to the shaft 93 and located rearwards of the pivot shaft of the corresponding access outrigger ramp 74 if one considers figure 9. The shaft 101 is rotatably supported in a supporting bearing 102 through the medium for
- 30 example of ball bearings extending from the external side wall of the box 91 inwards of the latter. The shaft 101 terminates in an outward projecting square end 101a engaging a mating square hole formed through an outer fork 103 between the fingers 104 of which is engaged a
- 35 pin or stud 105 made fast to the external face of the external side wall of the outrigger ramp 74. The shaft 105 is arranged at some distance from the pivot pin of the corresponding outrigger ramp 74 so as to be

constantly retained in engagement between the fingers 104 of the fork 103 whatever the folded-back or extended position of the outrigger ramp 74 might be. The pinions 95, 96, 97 and 100 form a gear reduction permitting the extension or the folding back of each outrigger ramp 74 with relatively weak forces. In the extended position of an outrigger ramp 74, the corresponding fork 103 assumes a substantially elongated or aligned position whereas in the folded-back position of the outrigger ramp 74, the fork 103 assumes a position approximately perpendicular to the track for the rolling of the box 91 and for retaining the corresponding outrigger ramp 74 in the swung-back position.

Each bridging element 2, 3 as from the beginning of the phase of launching the latter is supported by the launching beam 50 through the rolling rollers 57 and 61 on which are moving two guide rails 106 each one with an elongated U-shaped cross-section, made fast to both mutually confronting internal side walls, respectively, of the twin boxes 91. Both guide rails 106 are disposed in symmetrical relation to the vertical middle plane of a bridging element. The boxes 91 of each bridging element are thus disposed on either side of the launching beam 50 for being displaced in translatory motion throughout the length of the latter without interference. The toothed racks 72 are preferably fastened directly onto both guide rails 106, respectively. The outrigger end ramps 74 also comprise guide rails 107 fastened to both mutually confronting internal side walls of both outrigger ramps located on a same side, onto which are directly fastened toothed racks 108, the rails 107 having their ends bevelled in order to facilitate the engagement and the disengagement of the rolling rollers 57, 61 with and from these rails. When the outrigger ramps 74 are extended, the rails 107 are lying in extension of the rails 106 so as to obtain a continuous rail throughout the length of the bridging element. When the outrigger ramps are swung back the

rails 107 do not hinder the passage of the launching beam 50.

As already mentioned previously, both bridging elements 2 and 3 may be mechanically coupled and locked
5 endwise to form one bridging element of greater length.

An embodiment of a device for coupling and locking two bridging elements end-to-end has already been described in the European patent application EP-A-0,407,274 filed in the name of the applicant. Thus
10 the locking device ensuring the coupling end-to-end of both bridging elements is constituted by the same locking device intended to rigidly fasten each outrigger ramp of one bridging element for example 2 in the extended position and comprises a lock unit consisting
15 of first aligned transverse locking pins 109 made fast to the front face 74a of an outrigger ramp 74 in the folded-back position and of hooks 110 for locking the pins 109 made fast to the front face 91a of the box 91 (see figure 10), the locking pins 109 and hooks 110
20 projecting from a same side of the front faces 74a and 91a. When the outrigger ramps 74 are brought into the extended position by their respective operating devices 73, the pins 109 automatically engage the locking hooks 110 the unlocking of which may be effected manually by
25 actuating an unlocking lever 111 simultaneously controlling the hooks 110. The coupling and the locking of two bridging elements are effected when the outrigger ramps 74 are in the folded-back position. In order that the coupling and the locking of the bridging element 2
30 to the bridging element 3 may be carried out, it is of course necessary that the front face 74a of each outrigger element 74 of the bridging element 3 comprises the locking hooks 110 which are engaged by the locking pins 109 of the bridging element 2 whereas the front
35 face 91a of each box 91 of the bridging element 3 comprises locking pins 109 engaging the locking hooks 110 of the front face 91a of the box 91 of the bridging element 2.

In the transport position the lower bridging element 3 rests in the vicinity of its rear end near the cabin 4 of the truck 1 upon a stationary supporting structure 112 formed of lattice frames 113 defining a horizontal supporting platform fastened on two inverted L-shaped parallel supporting angle bars 114 fastened as by welding or bolting to the side walls of the corset beam 6 at the places designated at 115. The platform for supporting the structure 112 comprises a number in the present case four stationary sliding skids 116 extending in parallel relationship along the longitudinal axis of the chassis 5 of the truck 1 and allowing the lower bridging element 3 to slide during its translatory motion with respect to the supporting structure 112. Stops 117 made fast to the structure 112 are provided at the level of the ends of the sliding skids 116, respectively, in order to prevent the lower bridging element 3 from hitting the cabin 4 of the truck 1 when the front part of the bridging element 3 is lifted.

The front end of the lower bridging element 3 rests upon a lifting device 118 comprising two supporting plates 119 approximately in the shape of an inverted T, fastened with their heads to the side walls, respectively, of the corset beam 6 at the places one of which is designated at 120. The ends of the legs of the supporting plates 119 support a shaft 121 disposed transversely of the longitudinal axis of the chassis 5 and serving as a pivot for a part forming a lifting arm 122 in the shape of a plate shaped as an approximately isosceles triangle with lattice frames the base of which comprises two yokes 123 for supporting two spaced transverse rolls 124, respectively, upon which the lower bridging element 3 is caused to bear. The pivoting of the lifting arm-like part 122 is operated by two side jacks 125 the rods of which are connected in a pivoting manner underneath the portion 122 and the bodies are fastened to both side walls of the corset beam 6 through the medium of fastening plates 126 made fast to places

one of which carries the reference numeral 127 on figure 25.

Figures 4 and 5 show the places of the supporting plates 119 and of the control jacks 125 such that the main beam 13 may displace itself in translatory motion without being hindered by or interfering with any other element of the system.

Two feet 127 for the lateral stabilization of the truck 1 are fastened in a pivoting manner about a vertical axis of two side walls of the corset beam 6 through the medium of two fastening plates 128, respectively, made fast to the corset wall 6 at places one of which is shown at 129 on figure 25. Each foot 127 comprises a L-shaped part 130 the big leg of which carries at its end opposite to the leg pivotally connected to the plate 128, a vertical jack 131 the rod 132 of which is fastened in a pivoting manner about a horizontal axis to a base member 133 caused to bear upon the ground. The connection of the rod 132 to the base member 133 is effected by a clevis 134.

The principle of laying down a bridging element which already appears in part from the hereabove description of the system will be described in detail with reference to figures 31(A)-(O) wherein the laid down bridging element results from the assembly end-to-end of the upper and lower bridging elements 2 and 3.

The truck 1 carries both bridging elements to the place where the ditch B to be crossed is located and moves backwards to approach the latter to a place shown on figure 31(A). During the transport the lower bridging element 3 rests upon the supporting structure 112 and the lifting device 122 whereas the upper bridging element 2 still in engagement with the launching beam 50 rests upon the lower bridging element 3 owing to the release of the pressure in the hydraulic jacks 18, 40 orienting the tilting plate 31, it being well understood that during the launching phase, the putting under pressure of the jacks 40 slightly lifts the upper

bridging element 2 which then fully rests upon the launching beam 50 and thus is no longer in contact with the lower bridging element 3.

Once the truck 1 presents itself with its back directed towards the ditch B and locates itself at the right distance from the edge of the latter, the lateral stabilization feet 127 are put in position and the main beam 13 is displaced in relation to the corset beam 6 towards the ditch B by energizing the motor 8 which rotatably drives the drive pinion 11 meshing with the toothed rack 16. During its translatory motion the main beam 13 carries along therewith the upper bridging element 2 resting upon the launching beam 50 as this appears from figure 31(B). The beam 13 then assumes a position of extension from the chassis 5 increasing the lever arm for taking up the forces resulting from the subsequent cantilever positions of the bridging element and of the launching beam 50.

The anti-tipping foot is put in place in the vertical position by successively feeding the hydraulic jacks 48 and 49 as this is shown on figure 31(C).

The upper bridging element 2 is driven in translatory motion on the launching beam 50 in a guided manner by the guide rails 106 moving on the riding rollers 57, 61 by energizing the electric motor 69 driving the drive gears 70 in engagement with the toothed racks 72. Figure 31(D) shows the bridging element 2 displaced to a position wherein its rear end is substantially plumb with the rear end of the launching beam 50.

The launching beam 50 is then displaced with respect to the tilting plate 31 towards the ditch B by energizing the motor 51 which drives the drive pinion 55 in engagement with the toothed rack 53 of the beam 50. This displacement is effected to the cantilever launching position of the beam 50 shown on figure 31(E) which also shows that the front outrigger ramps 74 of the bridging element 2 have been extended by at first

feeding the jack 76 which moves transversely in opposite directions both shafts 75 the square end portions of which engage the sleeves 90 and then by energizing the electric motor 89 which rotatably drives both shafts 75
 5 simultaneously so that both transmissions with chains or belts C1, C2 tilt both forks 103 from the vertical position to the lying position.

The jack 18 is then fed so as to pull on the chains or cables 22 in a direction causing the tilting plate 31
 10 to pivot in the counter-clockwise direction about the pivot pin 30. The tilting of the plate 31 orients the bridging element 2 as shown on figure 31 (F). The jacks 125 of the device 118 are also fed to cause the part forming the lifting arm 122 to pivot in the counter-
 15 clockwise direction and thus to lift the front portion of the lower bridging element 3 to a position where the latter is located in extension of the inclined upper bridging element 2.

The electric motor 69 is energized so that the drive
 20 gears 70 move the upper bridging element 2 in relation to the beam 50 towards the cabin 4 of the truck 1. This displacement permits the coupling and the locking of the bridging element 2 to the bridging element 3 by the engagement of the pins for locking the bridging element
 25 2 to the bridging element 3 by the engagement of the locking pins 110 of the bridging element 3 and of the locking pins 109 of the bridging element 3 with the locking hooks 110 of the bridging element 2. This configuration is shown on figure 31(G).

30 The big bridging element T thus formed is then displaced on the launching beam 50 towards the bridge B to a position wherein the transverse middle plane of the bridging element D is approximately coinciding with that of the beam 50 as this appears from figure 31(H).

35 The beam 50 - and-bridging element T assembly is brought to a substantially horizontal position as shown on figure 31(I) by tilting the plate 31 in the clockwise direction with the assistance of the jack 18 the rod 20

of which is moved out to a corresponding position for releasing the retaining chains or cables 22.

The rear outrigger ramps 74 of the bridging element T and in fact two of the lower bridging element 3 are
 5 extended and the bridging element T is moved with respect to the launching beam 50 to an overhanging stroke-end position as this is shown on figure 31(J).

The plate 31 is then tilted in the clockwise direction by means of the jack 18 and of the chains or
 10 cables 22 until the cantilever end of the bridging element T is caused to bear upon that edge of the ditch B which is opposite to that towards the truck 1 as this is shown on figure 31(K).

The launching beam 50 is then slightly displaced on
 15 the plate 31 towards the cabin 4 of the truck 1 so as disengage both pairs of rolling rollers 57 from the guide rails 107 as this appears from figure 31(L).

The launching beam 50 is fully tilted downwards in the clockwise direction by tilting the plate 31 with the
 20 assistance of the jack 18 and of the chains or cables 22 in order to bring the end of the bridging element T in contact upon that edge of the ditch B which is located towards the truck as this is shown on figure 31(M).

The anti-tipping foot 42, 43 is then folded back
 25 into a position stowed in the main beam 13 which is brought back to the stored transport position on the corset beam 6, which has the effect to disengage the pairs of rollers 61 of the beam 50 from the guide rails 107 of the bridging element T as this is shown on figure
 30 31(N).

The bridging element 50 is then brought back to a horizontal position by tilting the plate 31 in the counter-clockwise direction and is displaced on the
 plate 31 towards the cabin 4 of the truck 1 to be
 35 located in the transport position shown on figure 31(O).

The bridging element T is thus laid down over the ditch B to allow vehicles such as tanks, military trucks and other motorized appliances to cross the ditch B.

Figures 32(A) to 32(H) show the different phases permitting the laying down of the upper bridging element 2 only over the ditch B. The principle of laying down this bridging element is identical with the one described with reference to figures 31(A)-(O) ; the phases (A) to (D) have not been illustrated again on figure 31. Of course the phases of assembling both upper and lower bridging elements 2 and 3 have been omitted. It is therefore not necessary to describe in detail the phases shown on figures 32(A)-(H) which are understood by themselves.

Figures 33(A)-(N) show the principle of laying down the lower bridging element 3 upon a second ditch B after the upper element 2 has been laid down previously over a first ditch B or over the second ditch to permit the crossing of the latter for a greater number of vehicles.

Once the truck 1 has been positioned in relation to the ditch B and the lateral stabilization feet 127 have been put in place, the launching beam 50 is displaced to a launching position overhanging with respect to the main beam 13 as this is shown on figure 33(A). The beam 50 and the lower bridging element 3 are aligned by tilting the plate 31 in the counter-clockwise direction by means of the jack 18 and of the retaining cables or chains 22 and by lifting the front part of the bridging element 3 with the lifting device 118. The launching beam 50 is then moved on the tilting plate 31 towards the cabin 4 of the truck 1 and therefore towards the stored position thereby having the effect to put the rolling rollers 57, 61 of the beam 50 in engagement with the guide rails 106, 107 of the bridging element 3 (see figures 33(B), (C)).

The main beam 13 is displaced in relation to the corset beam 6 towards the ditch B by carrying along therewith the bridging element 3 supported by the launching beam 50 as this is shown on figure 33(D).

Figure 33(E) shows the putting in place of the anti-tipping foot 42, 43 whereas figure 33(F) shows the beam

50-and-bridging element 3 assembly in the horizontal position righted with the assistance of the plate 31 operated by the jack 18 and the chains or cables 22.

5 The beam 50-and-bridging element 3 assembly is displaced in translatory motion on the plate 31 towards the ditch B to a cantilever launching position as this is shown on figure 31(G).

10 The different phases successively shown on figures 33(H) to 33(N) are identical with those depicted on figures 32(B) to 32(H) and have therefore not to be described.

15 Of course the taking up again of the bridging elements with a short or great length from the ground is effected according to the different phases considered when starting from figure 31(O) to figure 31(A), from figure 32(H) to figure 32(A) or from figure 33(N) to figure 33(A).

20 The system according to the invention described hereinabove has a relatively simple structure and operation in comparison with the system described in EP-O,374,019 in the name of the applicant. Moreover to the extent where the corset beam 6 supports the whole of the system for the transport of the bridging elements and for the laying down thereof, it is the only element
25 to be adapted onto a truck to permit to mount this assembly upon another truck having an identical structure. This peculiarity thus allows to easily fit all the standard trucks usable to carry out the transport and the laying down of bridging elements. It
30 is furthermore to be noted that the different electrical motors used in the system of the invention may be replaced with hydraulic motors or any other suitable motor type.



CLAIMS

1. System on a road vehicle such as a truck (1) for the transport of at least one bridging element (2 ; 3) intended for the crossing of a ditch (B) and for the laying down of the bridging element (2 ; 3) over the ditch (B) from the vehicle (1), comprising a beam (50) for supporting and launching the bridging element (2 ; 3), disposed approximately along the longitudinal axis of the vehicle (1), displaceable in relation to the vehicle along this axis between an inoperative position on the vehicle and a launching position in a cantilever relation to the vehicle (1) in which the bridging element (2 ; 3) is positively driven according to a translatory motion in a guided manner on the launching beam (50) also in a cantilever position in relation to the launching beam (50) which in these cantilever positions may pivot about a stationary horizontal axis (30) until the bridging element (2 ; 3) is caused to bear at first with its cantilever end upon that edge of the ditch (B) which is opposite to that located towards the vehicle (1) and then with its end opposite to the ditch edge towards the vehicle (1), the launching beam (50) being then disengaged from the bridging element (2 ; 3) which is thus laid down upon the ditch (B), the launching beam (50) being supported by an orientable plate (31) tilting about the stationary axis (30) and being thus positively driven in a guided manner in a translatory motion on the tilting plate (31), characterized in that it comprises a main beam (13) supporting the tilting plate (31) and mounted onto the chassis (5) of the vehicle (1) in a manner displaceable in translatory motion along the longitudinal axis of the vehicle (1) to a position of extension from the



vehicle increasing the lever arm taking up the forces resulting from the cantilever positions of the bridging element (2 ; 3) and of the launching beam (50).

2. System according to claim 1, characterized in that
5 the main beam (13) is supported by a corset beam (6) fastened to the chassis (5) of the vehicle (1) and is positively driven in a guided fashion in translatory motion on the corset beam (6).

3. System according to claim 1 or 2, characterized in
10 that the bridging element (2 ; 3) is bilaterally guided in relation to the launching beam (50) during its controlled displacements by a guiding unit with rolling rollers (57, 61) and corresponding guide rails (106, 107) moving on the rollers.

4. System according to claim 3, characterized in that
15 the aforesaid guide rails (106, 107) are fastened to the bridging element (2 ; 3) and the rolling rollers (57, 61) are fastened to the launching beam (50).

5. System according to one of the foregoing claims,
20 characterized in that the means for driving the bridging element (2 ; 3) on the launching beam (50) comprise an electric motor (69) made fast to the launching beam (50) and two parallel toothed side racks (72, 108) made fast to the bridging element (2 ; 3)
25 with which are meshing two drive pinions (70), respectively, driven by the rotary shaft of the electric motor (69).

6. System according to claim 5, characterized in that
30 both aforesaid toothed racks (72, 108) are fastened directly onto both aforesaid guide rails (106, 107), respectively, each one having a cross-section shaped as a lying U.



7. System according to one of the foregoing claims, characterized in that the means for driving the launching beam (50) comprise an electric motor (54) fastened underneath the tilting plate (31), a toothed
5 rack (53) longitudinally fastened below the launching beam (50) and a drive gear (55) driven by the rotary shaft of the motor (54) and meshing with the toothed rack (53).

8. System according to one of claims 2 to 5, characterized in that the launching beam (50) is assembled to the tilting plate (31) by a dovetail-shaped guiding (51, 52) whereas the main beam (13) is assembled to the corset beam (6) also by a dovetail-shaped guiding (14, 15).

9. System according to one of claims 2 to 8, characterized in that the means for driving the main beam (13) comprise an electric motor (8) made fast to the corset beam (6), a toothed rack (16) longitudinally fastened underneath the main beam (13) and a drive gear
20 (11) driven by the rotary shaft of the motor (8) and meshing with the toothed rack (16).

10. System according to one of the foregoing claims, characterized in that the means for the orientation of the tilting plate (31) comprise on the one hand at
25 least one element (22) for retaining the plate (31) such as a wire or chain fastened below the tilting plate (31) at some distance from the tilting axis (30) of the plate (31) and a member (18) for operating the retaining element and which may be actuated either for
30 pulling the retaining element (22) and causing the tilting plate (31) to pivot in the counter-clockwise direction or for releasing the retaining element (22) so as to allow the bridging element (2 ;3) - launching beam (50) - tilting plate (31) assembly to freely pivot



about the tilting axis (30) in the clockwise direction and on the other hand a counter-plate device (35) pivoting about the tilting axis (30) of the tilting plate (31) and exerting a thrust force underneath the
5 tilting plate (31) to keep the latter in particular in an approximately horizontal position of supporting the bridging element (2 ; 3).

11. System according to claim 10, characterized in that the counter-plate device (35) comprises two arms (36)
10 pivoting about the aforesaid tilting axis (30) and two operating members (40) acting upon both ends, respectively, of the arms (36) for pushing them below the tilting plate (31).

12. System according to claim 10, characterized in that
15 the aforesaid control member (18) is a hydraulic jack the body of which is fastened to the main beam (13) and the rod (20) of which is connected to the retaining element (22), which extends longitudinally of the main beam (13) and is returned to the tilting plate (31) by
20 a guide pulley (28).

13. System according to claim 11, characterized in that both aforesaid operating members are hydraulic jacks (40) the bodies of which are fastened to the main beam (13) and the rods of which are connected to the
25 aforesaid operating arms (36).

14. System according to one of the foregoing claims, characterized in that the bridging element (2 ; 3) comprises two parallel substantially parallelepipedic twin box members (91) defining two upper treadways and
30 two outrigger ramps (74) pivotally mounted onto both ends, respectively, of each box member (91) about a transverse pivot axis and controlled in such a manner that each outrigger ramp (74) assumes either a position



folded back onto the box member (91) and of continuity of the latter or an extended position in extension of the box member (91) permitting vehicles to accede to the treadways and to leave them softly once the
5 bridging element (2 ; 3) is laid down above the ditch (B) to be crossed.

15. System according to claim 14, characterized in that both outrigger ramps (74) located on a same side of two box members, respectively, of the bridging element (2 ;
10 3) are simultaneously operated by a control device comprising a motor (89) driving two coaxial shafts (75) extending transversely of the launching beam (50) while extending through both side walls, respectively, of the latter, a jack (76) with a double rod made fast to the
15 launching beam (50) which may drive both shafts (75) slidably mounted between an inoperative retracted position and a positive operative position for driving both operating forks (103) pivotally mounted onto the outer sides, respectively, of both box members (91)
20 about an axis near the pivot axis of the outrigger ramps (74) and each one in engagement with an external axis (105) made fast to the corresponding outrigger ramp (74), the forks (103) assuming a lying position in the extended position of the outrigger ramps (74) and a
25 raised position approximately perpendicular to the treadways in the swung-back position of the outrigger ramps (74).

16. System according to claim 15, characterized in that both aforesaid shafts (75) have each one at their end a
30 square drive stub (82) engaging in the operative position a rotary socket of complementary shape (90) extending through the internal wall or side of one box member (91) and mounted endwise of a rotary shaft (93) disposed transversely within the box member (91) and



driving the pivot axis of the corresponding fork (103) through the medium of a transmission with sprocket wheels (91, 96, 99, 100) and belts or chains (C1, C2) disposed endwise of the box member (91).

5 17. System according to claims 3 and 4 and to one of
the foregoing claims, characterized in that the
aforesaid guide rails (106) are fastened to the
mutually confronting internal walls or sides,
respectively, of both box members (91) of the bridging
10 element (2 ; 3) in such a manner that the launching
beam (50) be disposed between both box members (91) and
in that the end outrigger ramps (74) comprise guide
rails (107) fastened to the internal walls thereof and
arranged in extension of the guide rails (106) of the
15 box members (91) when they are in the extended
position.

18. System according to claim 17, characterized in that
the guide rails (107) of the outrigger ramps (74) have
their ends bevelled to facilitate the engagement or the
20 disengagement of the rolling rollers (57, 61) with or
from the rails.

19. System according to one of the foregoing claims,
characterized in that it comprises another bridging
element (3) or lower bridging element onto which is
25 resting in the transport position the aforesaid
bridging element (2) or upper bridging element and
which may be either laid down over a ditch after laying
down the upper bridging element or coupled and
mechanically locked to the upper bridging element (2)
30 in extension of the latter to form one bridging element
of great length (T) which is then laid down over a
corresponding ditch to be spanned.



20. System according to claim 19, characterized in that the lower bridging element (3) rests at its rear end near the cabin (4) of the vehicle (1) upon a stationary support structure (112) with slide skids (116) made
5 fast to the corset beam (6) and at its front end upon a device (118) for lifting the lower bridging element (3) fastened to the corset beam (6) and comprising a portion forming a lifting arm (122) pivoting about a stationary pin (121) transverse to the corset beam (6),
10 which portion (122) comprises at least one roll (124) for the bearing of the lower bridging element (3).

21. System according to claim 20, characterized in that the lifting device (118) is operated in such a manner that the arm portion (122) lifts the front end of the
15 lower bridging element (3) when the upper bridging element (2) is in an overhanging position on the launching beam (50) inclined by the same angle as that of the lower bridging element (3) through actuation of the tilting plate (31) in order that the lower bridging
20 element (3) be in alignment with the upper bridging element (2) which is then displaced on the launching beam (50) towards the lower bridging element (3) to be coupled and mechanically locked thereto, in that the launching beam (50) is then rightened by the tilting
25 plate (31) in an approximately horizontal position in which end outrigger ramps (74) of the big bridging element (T) are extended and the big bridging element (T) is then displaced on the launching beam (50) into an overhanging position at which the tilting plate (31)
30 is driven in the clockwise direction for laying the big bridging element (T) down.

22. System according to claims 19 and 20, characterized in that to only lay down the lower bridging element (3), the launching beam (50) is brought into the



overhanging position ; the lifting device (118) is controlled so that the arm portion (122) raises the front end of the lower bridging element (3) ; the tilting plate (31) is oriented in order that the launching beam (50) and the lower bridging element (3) be aligned ; the launching beam (50) is brought back into the transport position for engaging its rolling rollers (57, 61) with guide rails (106, 107) of the lower bridging element (3) ; the main beam (13) is displaced into the position of extension while carrying along therewith the lower bridging element (3) supported by the launching beam (50), which is then rightened by the tilting plate (31) to an approximately horizontal position ; end outrigger ramps (74) of the lower bridging element (3) are extended and the bridging element is brought in the overhanging position on the launching beam (50) ; and the tilting plate (31) is driven in the clockwise direction for laying the lower bridging element (3) down over the corresponding ditch (B).

23. System according to one of the foregoing claims, characterized in that the launching beam (50) comprises at least two pairs of rolling rollers, a rear pair (57) and a front pair (61) and the front pair of rollers (61) is mounted onto a bogie device (64) permitting an angular excursion of the rollers (61) during the retraction of the launching beam (50) from the associated bridging element laid down over the ditch or when again taking up the bridging element.

24. System according to claim 23, characterized in that the aforesaid bogie device comprises approaching studs (68) facilitating the positioning of the rolling rollers (61) within the guide rails of the bridging



element (2 ; 3) in particular during the taking up of the bridging element from the ground.

25. System according to one of the foregoing claims, characterized in that it comprises an anti-tipping foot (42, 43) pivoting about the aforesaid pivot axis (30) made fast to the main beam (13) and caused to bear telescopically on the ground by a pivoted anti-tipping base (44), the anti-tipping foot being retractable into the main beam (13) in inoperative stowing position.
- 10 26. System according to one of the foregoing claims, characterized in that it comprises two feet (127) for the lateral stabilization fastened in a pivoting manner to the main beam (13).