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EP-A- 0 075 671
EP-A- 0 076 597
EP-A- 0 081 388
CH-A- 495 468
DE-A- 2 362 338
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"Festbrücke (S-Brücke)", May 1981, Krupp Industrie- und Stahlbau

"Bedienungsanleitung Festbrücke (S-Brücke)", April 1980, Krupp Industrie- und Stahlbau

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Description

This invention relates to a trestle for use in constructing a modular bridge assembly.

In military operations, it is desirable, if not essential, to have a capability for allowing heavy ground equipment, such as tanks, to cross difficulties in terrain. Such difficulties may include gaps formed by ditches, canals and rivers. Although the construction of a bridge for light vehicles is comparatively straight forward, providing a bridge which is capable of supporting a tank is of considerably greater difficulty.

EP-A-0081388 discloses a modular bridge comprising at least one intermediate bridge module and two end bridge modules, each of the bridge modules comprising two longitudinal main girder structures and an intermediate deck having a deck surface, the main girder structures being foldably connected one along each side of the deck and being foldable from an operative position in which the main girder structures offer extensions of the deck surface on either side of the deck for use to a closed position in which the main girder structures are folded beneath the deck, the main girder structures of the end bridge modules being longitudinally tapered in depth when seen from a side of the module in its operative position, the main girder structures of the intermediate module(s) not being so tapered, wherein each of the end bridge modules and the intermediate bridge module(s), are connected to form a bridge.

EP-A-0081388 discloses the construction of such bridge by putting up a building frame, having upwardly facing rollers, on the first bank of the span to be crossed. A preliminary beam is assembled on the frame and pushed outwards towards the bank. The bridge assembly is assembled progressively on the frame, behind the preliminary beam, with the beam being attached to the leading module. The preliminary beam has at its outer end a jacking unit with support rollers so that, when the jacking unit reaches the far bank of the span, it may rest on it and allow the assembly of beam and bridge to roll across the span, the bridge assembly is then lowered onto the bank and the beam withdrawn back through the bridge assembly. This procedure is illustrated in Figures 23A to 23F of EP-A-0081388.

EP-A-0075671 discloses a demountable non-opening bridge comprising discrete channel-section modules and an H-section launching girder, wherein modules comprise a central part and two wing parts, the wing parts comprise box-section track girders, the two wing parts are downwardly hinging below the central part for transportation, in the laying of the bridge the launching girders are assembled and made first, whereafter the various modules are coupled together and pushed over the launching girder and the launching girder remains in the bridge as a bearing element.

EP-A-0075671 discloses the construction of such a bridge by the joint use of a laying vehicle having a cantilever arm and a four-tonne crane. The laying vehicle moves to the bank of the span to be crossed with a launching girder ramp (or end) member already in position on guide rollers of the cantilever arm. The cantilever arm comprises a pinion to advance the ramp member over the span by means of a co-operating rack. The crane delivers launching girder inner sections which are coupled up and advanced. Once the launching girder has reached the required length, a second launching girder ramp (end) member is coupled up. The cantilever arm of the laying vehicle is lowered so that the launching girder is then supported by its own hydraulically deployable feet. A ramp (end) bridge module is now lifted by the crane onto the launching girder. Inner (intermediate) bridge modules are coupled up and drawn over the launching girder by means of a block and tackle and reversing roller. The final module is a further ramp (end) module. The hydraulic feet are then retracted. This construction sequence is as illustrated in Figure 6 of EP-A-0075671.

EP-A-0075671 also discloses the use of a single layer vehicle combining the capabilities of the laying vehicle and crane described above. It is equipped both with a cantilever arm and with a four-tonne crane.

Finally, CH-A-495468 discloses another method of constructing a modular bridge across a span. Once again, a crane or a specialised vehicle is required to lay the bridge, and to provide a counter-balancing weight on the dome bank side of the launching trestle, to prevent the bridge and launching nose from toppling over as the launching proceeds.

The present invention enables the construction of a modular bridge across a span without the requirement for specialist vehicles. Furthermore, it is desirable for bridges of this type to be capable of being built quickly, even at night, by few men.

A trestle having those features set out in the pre-characterising portion of Claim 1 is disclosed in EP-A-0 081 388.

According to the present invention there is provided a trestle characterised by those features set out in the characterising portion of Claim 1.

The trestle preferably has one or more rollers for supporting the launching rail, the rollers desirably being drivable to move the launching rail over the beam of the first trestle. The trestle also preferably comprises one or more rollers for supporting the bridge modules.

The launching rail is preferably of inverted-T shaped configuration. This configuration allows the effective use of lateral guide means, for the launching rail, to be positioned on the trestle. The lateral guide means for the launching rail may comprise retractable pinch wheels. Because of the use of a trestle it is a simple matter also to provide lateral guide means for the bridge modules, which may comprise one or more vertically mounted guide rollers. In addition, the trestle may comprise means for selectively restraining the launching rail during construction: the selective restraining means desirably comprise retractable hooks.

A second trestle may be placed on the home bank to take a proportion of the load of the modules. The second trestle will desirably be of similar construction to the first trestle, except that it is not necessary for it to be provided with retaining means such as hooks or means for moving the rail over the beam, such as powered rollers.

Each bridge module is preferably substantially described in EP-A-0081388 in that it comprises two longitudinal main girder structures and an intermediate deck having a deck surface, the main girder structures being foldably connected one along each side of the deck and being foldable between an operative position in which the main girder structures offer extensions of the deck surface on either side of the deck for use and a closed position in which the main girder structures are folded beneath the deck.

A bridge formed of such modules will normally comprise two end modules, in each of which the main girder structures are longitudinally tapered in depth when seen from the side of the module and at least one intermediate module in which the main girder structures are not so tapered.

For a better understanding of the present invention, and to show how it may be put into effect, reference will now be made by way of example to the accompanying drawings, in which:-

Figure 1A, 1B and 1C show side elevation, plan and end view of an assembled bridge;

Figure 1D shows an enlarged section of D-D of Figure 1A; and

Figure 1E shows a side elevation view of an alternative configuration of the end of a bridge;

Figure 2 shows a perspective view of a first trestle for use in constructing a bridge; and

Figure 3 shows a perspective view of a second trestle for use in constructing a bridge.

Figures 1A to 1E given an overall view of a bridge 131 after construction, suitable for use with the trestles of the present invention. The bridge comprises three intermediate bridge modules 31 and two end bridge modules 75. These can clearly be seen in the side and plan views of Figures 1A and 1B. Underneath the deck of the bridge 131 can be seen (in dotted lines in Figure 1B) a launching rail 133, which is itself formed of intermediate modules 1 and end modules 13. A bracing frame 115 can be seen in position in Figure 1D.

Figures 1A and 1B show how the bridge 131 would be configured when spanning a gap between substantially level banks. Both bridge and modules are fully articulated. On the other hand, in Figure 1E, the end module 75 is not articulated. This reduces the ramp slope at the end of the bridge and renders it more suitable for use on a sloping bank.

Figure 2 shows a trestle 135 comprising a first embodiment of the present invention. The trestle 135 comprises a pair of upright guide posts 137 and 139 of rectangular section, between which is movably and lockably mounted a support beam 141. The support beam 141 is constructed of two support beam members 143 and 145, interconnected by a number of spacers 147.

Each guide post 137 or 139 is mounted on a respective base plate 153 or 155. Sloping tie rods or braces 150 and 152 are pivotally attached at their upper ends each to a respective one of the guide posts 137 and 139 and at their lower ends each to a respective one of the base plates 153 and 155. The length of each of the tie rods 150 and 152 can be adjusted in a similar fashion to a turnbuckle, as will be described later, with reference to Figure 3.

The support beam 141 moves and is locked with respect to the guide posts 137 and 139 by means of hydraulic piston and cylinder arrangements 159 and 161, one associated with each guide post. Hydraulic fluid for the piston and cylinder arrangements 159 and 161 are supplied from a trestle hydraulic power pack supply (not shown).

Between the members 143 and 145 of the support beam 141 are mounted a variety of rollers. Two of them, 163 and 165, are launching rail support rollers powered by the trestle hydraulic power pack supply. They are flanged and have a surface with a high coefficient of friction so that they can drive the launching rail 133 shown in discontinuous lines in Figure 2 in the direction of the arrow 167, which is the direction of launching the launching rail 133, and eventually, the bridge 131. The launching rail support rollers 163 and 165 are centrally disposed along the support beam 141. Above each of the launching rail support rollers 163 and 165 is a respective retractable pinch wheel 167 or 169 mounted, like the launching rail support rollers, for rotation about a horizontal axis. The rotatable pinch wheels 167 and 169 bear upon the upper surfaces of flanges on each of the launching rail modules. When the retractable pinch wheels 167 and 169 are deployed, as shown in Figure 2, they ensure that the launching rail support rollers

163 and 165 properly grip the launching rail 133 when driving it. The pinch wheels 167 and 169 can be retracted by hydraulic piston and cylinder arrangements 171 and 173, respectively.

Either side of the launching rail support rollers is a pair of bridge support rollers 175 and 177. They are again mounted for horizontal rotation. The pairs of bridge support rollers 175 and 177 support the lower surfaces of the main girder structures of the bridge 131, but are not powered. They are therefore passive, low-friction supports. Lateral guide rollers 179, mounted for vertical non-powered rotation, are position one either side of the path of the main girder structures of the bridge 131 during launching.

Two hydraulically retractable launching rail hooks 181 are mounted on the support beam 141 and extend in a downstream direction (as far as the direction of launch is concerned). They terminate in upwardly curved hooked portions. The hooks can pivot about horizontal axes to bring them out of and into engagement with protrusions of a tapered end module of the launching rail 133.

A second trestle 183 is shown in Figure 3. Two of these second trestles 183 are used in the preferred method of construction. The second trestle 183 is broadly similar to the first trestle 135 except that (a) the second trestle 183 does not have to be of such heavy construction as the first trestle 135 because, in use, it does not have to withstand such heavy loading, and (b) the only interaction between the second trestle 183 and the launching girder 133 is such that the launching girder 133 is supported by non-powered rollers.

The second trestle 183 comprises a pair of vertical guide posts 185 and 187 which movably and lockably support a support beam 189 composed of two parallel girders 191 and 193 between which extend spacing members 195. Each of the guide posts 185 and 187 terminates at its lower end on a respective base plate 201, 203.

Either side of the centre of the length of the support beam 189 is a flanged roller 207 or 209, both of which act as launching rail support rollers. Pairs of bridge support rollers 211 and 213 are provided, as for the first trestle, as are lateral guide rollers 215, which are rotatable about a vertical axis and which limit lateral movement of the bridge modules 131 during construction of the bridge. Again, the vertical movement of the support beam 189 towards and away from the ground is provided by a pair of hydraulic piston and cylinder arrangements 217 and 219, each mounted on a respective guide post 185 or 187.

Sloping tie rods or braces 198 and 200 pivotally attached at their upper ends each to a respective one of the guide posts 185 and 187 and at their lower ends each to a respective one of the baseplates 201 and 203. The length of each of the tie rods 198 and 200 can be adjusted in a similar fashion to a turnbuckle. This is achieved, as illustrated by way of example for the tie rod 198, by each tie rod (198 in this case) comprising an upper tie rod end 198A and a lower tie rod end 198B, which are formed at the ends that are not pivotally attached to the guide post 185 or the base plate 201 with left and right hand screw threads, respectively. (Which has the left thread and which had the right does not matter, as long as there is one of each). The threaded ends of the upper and lower tie rod ends 198A and 198B both engage female-threaded ends of a central tube 198C, which carries a handwheel 198D. The central tube 198C lies along the central axis of the handwheel 198D. By turning the handwheel 198D, the length of the tie rod 198 can be increased or decreased in order to keep the guide post near vertical. The same principle applies to the second embodiment of the first trestle 135 shown in Figure 2

The use of such a levelling mens, which comprises a tie rod of adjustable length extending between and pivotally attached to a guide post and a base plate, has the following two advantages. First, need for coordinating the adjustment of the two adjusting screws used in other types of trestle is avoided. Secondly, the support beam 189 can be lowered further than is the case in other types of trestle. This is significant when jacking down the home bank end of the bridge, because the minimum height to which the roller beam can be lowered determines the amount of upward articulation required on the tapered end ramps of the bridge in order to lower the launching rail to the ground. The articulation provided on the bridge end ramp can therefore be significantly reduced by using this trestle.

To construct a bridge by the preferred method it is particularly appropriate to use two hydraulic power packs. One would be positioned on the bridge under construction and would be used for articulating the bridge end modules by means of the piston and cylinder arrangements. The other power pack would be located on the home bank and would be for raising and lowering the support beams 141 and 189 of the first and second trestles 135 and 183 and also for powering the friction drive rollers 163 and 165 of the first trestle, for moving the retractable pinch wheels 167 and 169 into and out of position and for moving the launching rail hooks 181 into and out of position.

Each portable hydraulic power pack can be powered by an air-cooled diesel engine of about 7.5 kiloWatts (10 horsepower) driving a variable displacement pump working at a pressure of 20.6 MN/m^2 (300 psi). The engine would be provided with hand or inertia start to obviate the need for

batteries. Spare power units could be provided as a precaution against breakdown. In addition, an emergency hand pump could be provided to enable the bridge to be jacked down in the event of power failure. Recovery, however, would hardly be feasible with a manual pump, due to the height to which the bridge has to be jacked.

Claims

1. A trestle suitable for use in constructing a modular bridge assembly, comprising a bridge and a launching rail, across a span, the trestle comprising a support beam (141) mounted to one or more guide posts (137, 139), each guide post being mounted on a base plate, means (163, 165) for supporting a bridge launching rail on the beam (141) in such a way that the rail can move over the beam, means (175, 177) for supporting a bridge module on the beam in such a way that the bridge module can move over the beam, the support beam (141) being lockably movable on the or each guide post (137, 139), towards and away from the ground on which the trestle is located; characterised by an adjustable tie rod (150, 198) extending between and pivotally attached to a guide post and a respective base plate for effecting adjustment of the angle between the or each guide post (137, 139) and the ground.

2. A trestle as claimed in Claim 1 comprising at least two guide posts (137, 139) for holding the support beam (141).

3. A trestle as claimed in Claim 1 or Claim 2 in which the means for supporting the bridge launching rail comprise one or more drive rollers (163, 165).

4. A trestle as claimed in Claim 1 or Claim 2 or Claim 3 in which the means for supporting the bridge module comprise one or more rollers (175, 177).

5. A trestle as claimed in any one of the preceding claims including retractable pinch rollers (167, 169) for guiding the launching rail.

Patentansprüche

1. Stützbock zum Zusammenbau eines aus Elementen zusammengesetzten Brückenbausatzes, der eine Brücke und eine Vorschubstange aufweist, wobei der Stützbock einen Stützbalken (141), der an einem oder mehreren, jeweils auf einer Grundplatte montierten Führungspfeilern (137,139) befestigt ist, eine Stützvorrichtung (163,165) zum Abstützen einer Brückenvorschubstange auf dem Stützbalken (141), so daß sich die Vorschubstange über dem Balken bewegen kann, und eine Stützvorrichtung (175,177) zum Abstützen eines Brückenelements, so daß sich das Brükkenelement über den den Stützbalken bewegen kann, aufweist, und wobei der Stützbalken (141) an dem oder den Führungspfeilern (137,139) feststellbar ist und in Richtung auf die Unterlage, auf die der Stützbock gesetzt ist, und in die dazu entgegengesetzte Richtung bewegt werden kann, **gekennzeichnet durch** eine einstellbare Zugstange (150,198), die sich zwischen einem Führungspfeiler und einer jeweiligen Grundplatte erstreckt und an ihnen schwenkbar befestigt ist, zur Bewirkung einer Einstellung des Winkels zwischen dem oder den Führungspfeilern (137,139) und der Unterlage.

2. Stützbock nach Anspruch 1, gekennzeichnet durch mindestens zwei Führungspfeiler (137,139) zur Halterung des Stützbalkens (141).

3. Stützbock nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Stützvorrichtung zum Abstützen der Brückenvorschubstange eine oder mehrere Antriebsrollen (163,165) aufweist.

4. Stützbock nach Anspruch 1,2 oder 3, dadurch gekennzeichnet, daß die Stützvorrichtung zum Abstützen des Brückenelements eine oder mehrere Rollen (175,177) aufweist.

5. Stützbock nach einem der vorhergehenden Ansprüche, gekennzeichnet durch zurückschiebbare Klemmrollen (167,169) zur Führung der Vorschubstange.

Revendications

1. Chevalet utilisable dans la construction d'un assemblage de pont modulaire comprenant un pont et un rail de lancement, sur une travée, le chevalet comprenant une poutre support (141) montée sur un ou plusieurs postes de guidage (137, 139), chaque poste de guidage étant monté sur une plaque de base, un moyen (163, 165) pour supporter un rail de lancement du pont sur la poutre (141) de telle sorte que le rail puisse se déplacer au-dessus de la poutre, un moyen (175, 177) pour supporter un module de pont sur la poutre de telle sorte que le module de pont puisse se déplacer au-dessus de la poutre, la poutre support (141) étant déplaçable tout en pouvant être verrouil-

lée sur le poste de guidage ou sur chaque poste de guidage (137, 139), de façon à se rapprocher et s'éloigner du sol sur lequel le chevalet est situé : caractérisé par un tirant réglable (150, 198) qui s'étend entre un poste de guidage et une plaque de base respective et qui lui est fixé de façon pivotante pour effectuer un réglage de l'angle que fait le poste de guidage ou chaque poste de guidage (137, 139) avec le sol.

2. Chevalet selon la revendication 1, comprenant au moins deux postes de guidage (137, 139) pour supporter la poutre support (141).

3. Chevalet selon la revendication 1 ou 2, dans lequel le moyen pour supporter le rail de lancement du pont comprend un ou plusieurs galets d'entraînement (163, 165).

4. Chevalet selon la revendication 1, 2 ou 3, dans lequel le moyen pour supporter le module de pont comprend un ou plusieurs galets (175, 177).

5. Chevalet selon l'une quelconque des revendications précédentes, incluant des galets de pincement rétractables (167, 169) pour guider le rail de lancement.

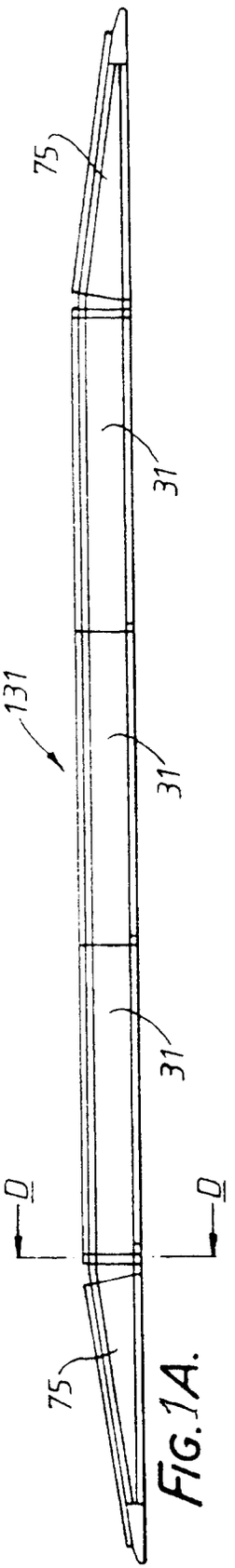


FIG.1A.

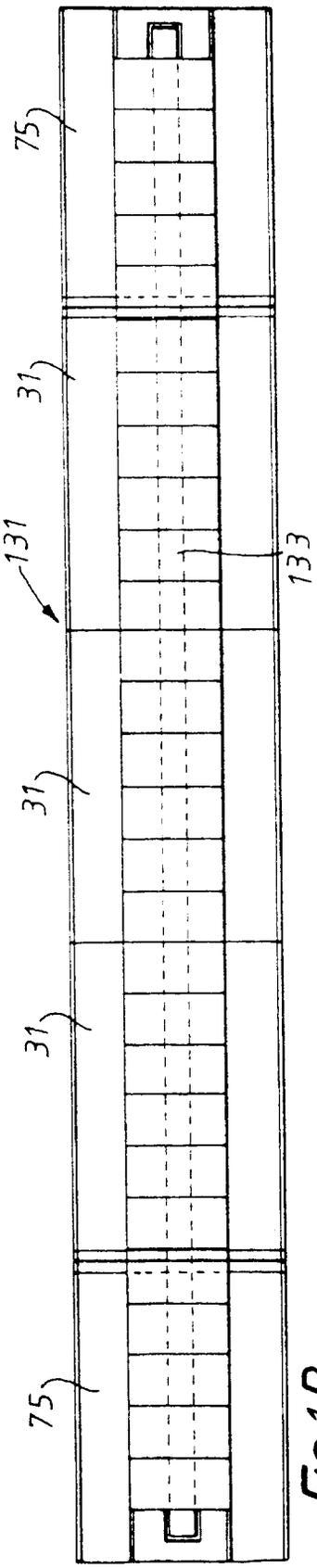


FIG.1B.

FIG.1C.

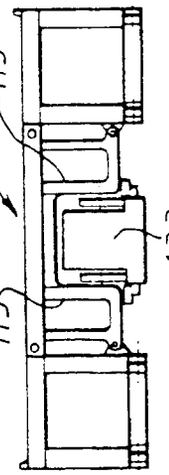


FIG.1D.

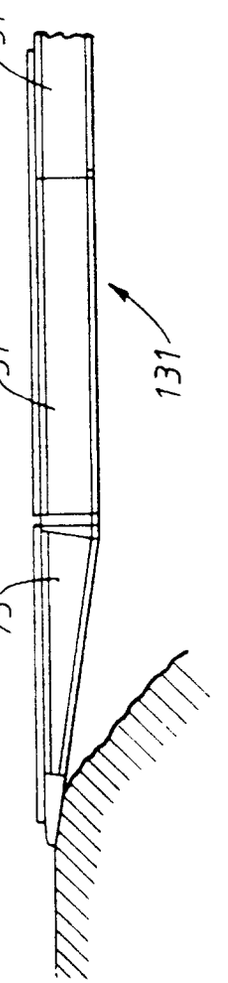
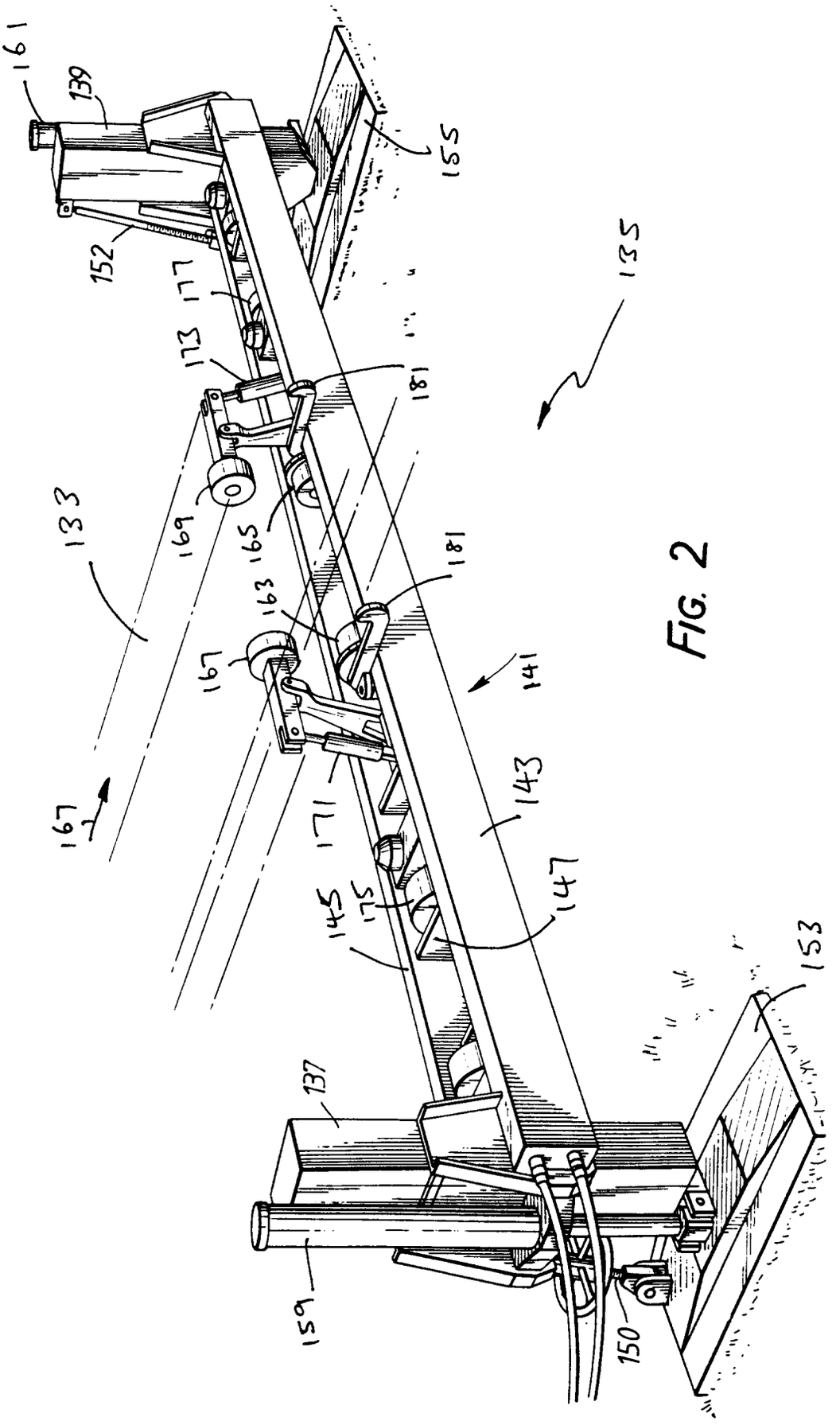


FIG.1E.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177
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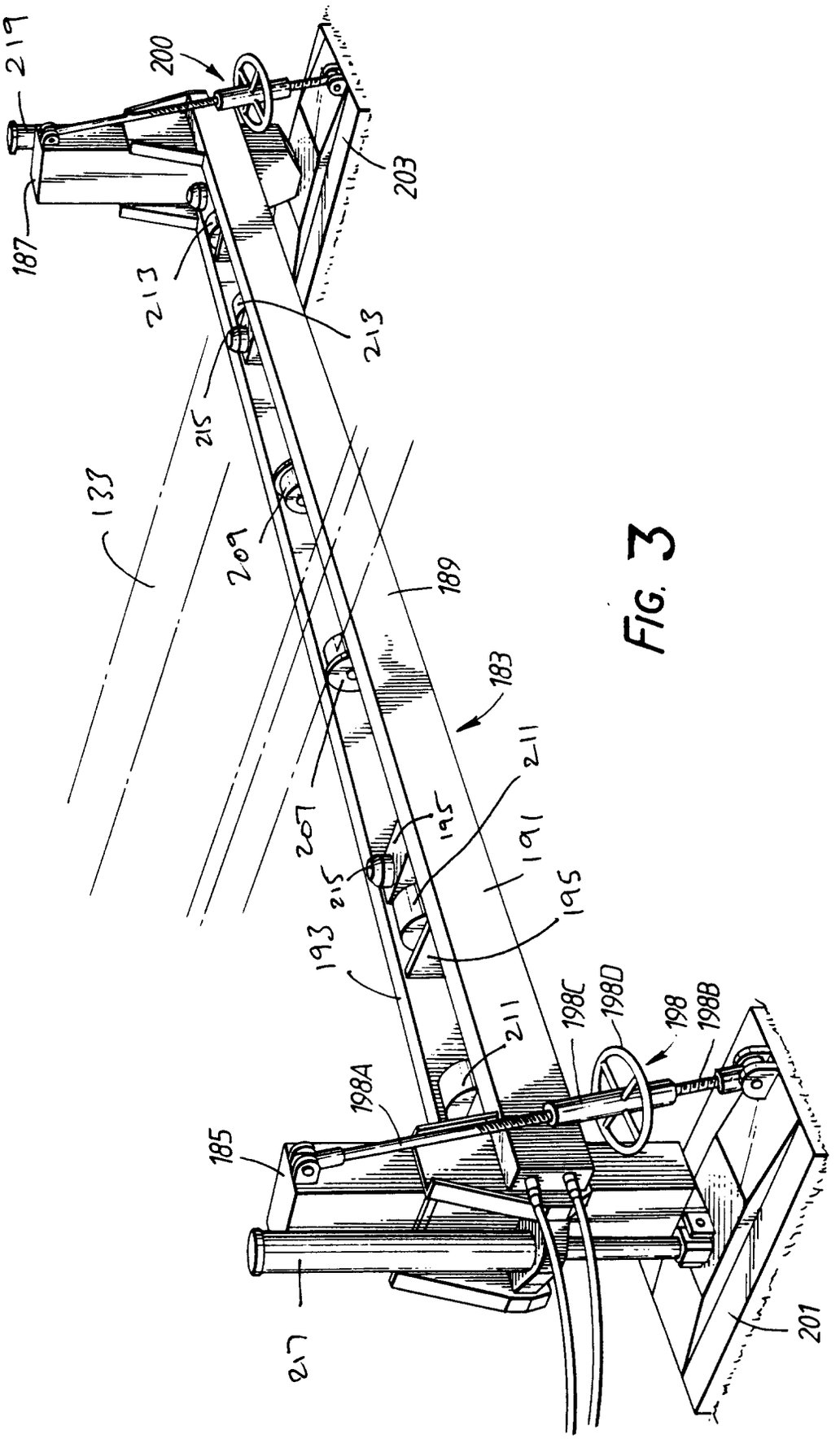
150

FIG. 2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198C
198D
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198B
198A
185
217
201

FIG. 3