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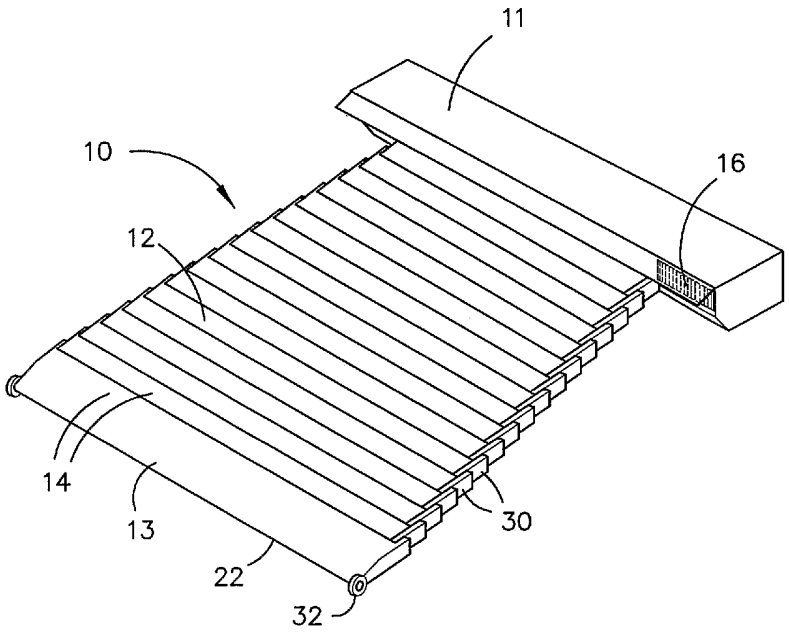

(57) Abstract: A bridging device (10) for providing a bridging surface (12) between two points comprising a stack of interjoined beams (14) housed in a retracted position in a housing (11) mounted at a first point; and a drive system that drives the beams (14) to slide one over the other to telescopically extend out of the housing (11) from the retracted position to an extended position to thereby form a bridging surface (12) to a second point.

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BRIDGING DEVICE

This invention is an automated bridging device capable of extending and retracting to form a temporary bridging surface between two points.

BACKGROUND OF THE INVENTION

Automated access ramps and other bridging devices bridge gaps and provide a pathway for persons or vehicles to cross.

Automatic ramps are very useful in the public and private transport industry. The ramps allow access onto and off trains and road vehicles for both enabled and disabled commuters as well as small vehicles such as bicycles and factor handling vehicles.

Known automatic ramps have several inherent problems. Firstly, in their retracted state they are bulky and require a large area to mount. Some of them are also heavy which is undesirable in terms of speed and fuel efficiency if the retractable ramp is mounted on a transport vehicle. The aerodynamics and weight balance of vehicles can be affected by mounting a ramp structure to the vehicle. Most automated access ramps, due to their size, are economically unviable for retrofitting to existing transport systems. Retrofitting is made more difficult by the various structural constraints associated with mounting the ramps. Additionally, most devices need to be fully extended to perform the function of a ramp and can be unwieldy if the gap to be bridged is small.

WO 99/52738 describes an articulated ramp which is an earlier ramp by the inventors of the present invention. The ramp assembly described therein comprises a plurality of articulated segments forming a ramp body that extends

from a retracted position located below the surface of the vehicle to an extended position where it bridges a gap between the vehicle and a second surface. The housing for the ramp body locates under the vehicle and houses the length of the ramp body in a substantially vertical position. Accordingly, the ramp body must be capable of significant curving through approximately 90° to achieve its final extended position. This articulated ramp assembly is awkward and very bulky, particularly when it is attached below the carriage floor of a train where space below the floor is limited and the aerodynamics and weight balance of the train could be affected by such a structure mounted to the carriages.

Furthermore, the articulated segments forming the ramp body of WO 99/52738 move in a scissor and clamping motion which present safety problems to the operator and the public. This scissor and clamping motion easily runs the risk of rendering the function of the ramp inoperable by the invasion of foreign objects, by accident or sabotage. This could result in disruption to transport schedules and possible physical injury.

The present bridging device addresses these drawbacks and the drawbacks with other known bridging devices.

SUMMARY OF THE INVENTION

In one aspect of the invention there is a bridging device that provides a bridging surface between two points and comprises:

a stack of interjoined beams housed in a retracted position in a housing mounted at a first point; and

a drive system that drives the beams to slide one over the other to telescopically extend out of the housing from the retracted position to an extended position thereby forming a bridging surface to a second point.

Preferably, the beams are of a flat, slat-like form and are supported by end plates located at each end. The beams may have a forward edge that is downturned at an angle. The end plates are each stacked adjacent each other and slidingly engage the end plates on each adjacent side to enable telescopic movement of the bridging device.

The sliding engagement of the end plates is preferably effected by a sliding boss and key slot engagement which limits the extent that adjacent end plates may slide relative to one another. The underside of each end plate is preferably provided with a gear rack that meshes with a drive gear on a drive shaft that is driven by a drive source in the drive system.

Preferably, each end plate meshes with a drive gear dedicated to that end plate. The drive gears corresponding to each end plate are co-axially mounted on the drive shaft and clustered towards both ends of the drive shaft.

The drive shaft is preferably bearing mounted on the housing and is driven by a motor in the drive system, which is also mounted in the housing.

The first plate, which is the leading plate when the stack of beams is extended, is preferably provided with a wheel to allow the leading end of the bridging surface to move with the extending bridge when the leading end contacts the ground.

Each end plate preferably has a lock to lock adjacent plates in the extended position and prevent unintentional retraction.

In one embodiment the lock is a pivoting lever pinned in a recess on the end plate and adjacent the key slot on the same end plate, through which a boss on an adjacent plate protrudes. The lever pivots to protrude into the key slot and obstruct the boss from sliding out of the extended position.

The pivoting lever preferably has two tabs. The corresponding drive gear contacts the first tab as the bridging device is extending thereby moving the lock into a locked position. The drive gear contacts the second tab when moving to retract the bridging device thereby moving the lock into an unlocked position and allowing the end plates to retract back into the housing.

The key slot is preferably angled at a rear end to create a curve to the end plates when extended, therefore giving the bridging device in its extended position a pre-camber for visual appeal and psychological reassurance of its strength.

The housing is preferably an enclosed elongated structure having a front opening through which the beams extend. The opening may be provided with a tilting sprung cover. The sides of the opening may be provided with side shutters to cover the partially exposed opening. When in the extended position the beam located at the opening does not extend across the entire width of the opening.

The housing may be provided with base-mounted springs under the stack of beams to give an upward force to assist the incremental rise of the stack during extension.

The housing may further be provided with an end pull for stabilising the last plates supporting the last beam in the stack, which remains stationary inside the housing. When in the extended position the last plates inherently

tend to tilt upwards. Accordingly, the end pull pulls the leading edge of the last plates downwards.

The end pull preferably comprises a tension spring located horizontally between the last pair of end plates and a tether attached to each end of the spring which extends in opposite directions, and turned through 90° around guide rollers to extend upwards and attach to, or close to, the respective last end plates.

The stack of beams is preferably restrained at the front of the housing in cassette form, only allowing the top beam to progress over catches on top of the restrainer as the stack of beams rises incrementally. The catches are biased by suitable biasing means such as sprung balls or a single leaf spring.

The interjoined beams may be of different lengths so as to create a trapezium shaped surface, or other shaped surface. The beams are preferably supported on top of the end plates but they may be supported underneath the end plates such that the end plates protrude upwards and form a border along the sides of the bridging surface.

The housing may be mounted in a tilting position to vary the angle at which the bridging surface extends. The tilting angle may be automatically or manually controlled to vary. A sensor may be provided to sense the required angle of tilt so that the angle may be adjusted accordingly.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is described further by way of example with reference to the accompanying drawings by which:

Figures 1(a), 1(b) and 1(c) illustrate applications of a bridging device according to the present invention;

Figure 2 is a perspective view of a bridging device according to the present invention in an extended position;

Figures 3(a), 3(b) and 3(c) illustrate the bridging device in a retracted position, a partially extended position and a fully extended position respectively bridging a gap between points of different heights;

Figure 3(d) illustrates the bridging device partially extended between points of the same height;

Figure 4(a) is a perspective view of the bridging device in a retracted position;

Figure 4(b) is a view similar to Figure 4(a) but shows the retracted beams located inside the housing;

Figure 4(c) is a view similar to Figure 4(a) but illustrates the driving mechanism located inside the housing;

Figure 4(d) is a view similar to Figure 4(a) but illustrates various other components located inside the housing;

Figure 5 is a part front view of one end of the extendable beams of the bridging device;

Figure 6 is a side view of Figure 5 viewed from the section A-A;

Figures 7(a), 7(b) and 7(c) illustrate in three sequential steps the mechanics and movement of an end plate as it is driven into the extended position;

Figure 8 illustrates one embodiment of a lock of the bridging device;

Figure 9 is a perspective illustration of the last plates located in the bridging device;

Figure 10 is a side sectional view taken at section B-B of Figure 9;

Figure 11 is a front view of an end of a stack of beams according to another embodiment of the bridging device; and

Figure 12 is a front view of an end of the stack of beams in accordance with yet another embodiment of the bridging device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The Figures illustrate a bridging device 10 that in its preferred use is adapted to be mounted at or under a door opening of a vehicle. Such a vehicle could be a train, tram, bus, taxi, water vehicles such as ferries, or private road vehicles.

The bridging device 10 comprises a housing 11 from which, as illustrated in Figure 2, a bridging surface, or ramp 12, telescopically extends. The ramp 12 is designed to bridge a gap between two points and specifically between the point at which the housing 11 is mounted and a point at the opposite side of the gap. Furthermore, the gap may be between: two spaced surfaces at the same level or surfaces of uneven height. A leading edge 13 of the ramp may be supported on the opposite surface or may remain unsupported, extending in a cantilevered fashion from the housing.

The ramp 12 comprises a stack of interjoined beams 14 that slide out of the housing one over the other to telescopically extend from the retracted position, as illustrated in Figures 3(a) and 6, through the partial extension of Figure 3(b) and to a fully extended position as illustrated in Figure 3(c) where the leading edge 13 is supported on the lower surface on the opposite side of a gap. The extended ramp is stable and capable of holding sufficient loads and withstand the normal loads associated with a crowd of people including wheelchairs, exiting public transport, or the weight of a vehicle traversing a gap.

Figure 3(d) illustrates an alternative situation where the bridging device extends to bridge a small gap between level surfaces. Here the ramp only needs to extend part-way to close the gap without the leading edge of the ramp having to rest on the opposite surface. This can be achieved because the ramp 12 of the bridging device can extend as a cantilever and remain in an extended position entirely unsupported at its leading edge. This is achieved as a result of the structure of interjoining beams which provide strength to the ramp when partially or fully extended. Accordingly, the bridging device 10 can be used as a ramp between uneven surfaces where the leading edge rests on the opposite surface, or used as a bridge between surfaces, typically even surfaces, where the leading edge is not supported but is aligned level with the opposite surface as illustrated in Figure 3(d).

The interjoined beams 14 are made of a strong, stiff material and overlap one another to prevent buckling of the ramp under high loads.

Housing 11 is a rectangular box structure that houses all the main components of the bridging device and is significantly smaller than the housing structures of known bridging devices.

Housing 11 is all enclosed, as illustrated in Figure 4(a), but for an opening 15 on its front face through which the ramp extends. When in the retracted position the opening is closed by hinged cover 16.

Figure 4(b) illustrates the stacked beams 14 in a retracted position inside the housing 11.

Figure 4(c) illustrates the driving mechanism 20 used to drive the beams to automatically extend into a ramp.

Figure 4(d) illustrates sliding shutters 21 which serve to close the exposed portion of opening 15 when the extended ramp does not entirely fill the opening 15. Figure 2, for example, illustrates the ramp in the extended position. Owing to the telescopic nature of the bridging device, the first beam 22 at the leading edge 13 is longer than the last beam 23, with all the beams in-between graduated in length from the first beam 22 to the last beam 23. Consequently there remains a gap in the opening 15 through which particles and objects could enter and damage the device 10. Accordingly, the sliding shutters 21 slide in guides 24 from the side of the housing to the front to close off the opening. The shutters may be driven from the main gear drive via cables and pulleys, thereby synchronizing the shutters' movement with that of the beams. Alternatively, the shutters may be spring loaded to shut as the ramp 12 extends.

Figure 4(d) also illustrates vertical track brackets 25 mounted in the housing 11 that restrain the last beam 23 in the stack stationary inside the housing and form a vertical track inside the housing allowing vertical movement only.

The ramp 12 comprises beams, of a flat slat-like construction, overlapping one another. Each beam 14 is supported at both ends by an elongated end plate 30. In the preferred embodiment the beam is supported perpendicularly to the end plate and on top of the end plate. In the retracted position when all the beams 14 are stacked one on top of the other, the end plates are stacked one adjacent to the other. This arrangement is illustrated in Figures 5 and 6.

Each end plate slidingly engages the end plates on each adjacent side thereby enabling telescopic movement of the bridging device 10. The leading pair of end plates 31

at the leading edge 13 of the ramp and the last pair of end plates 33 in the housing 11 obviously only engage one other end plate. Additionally, the last pair of end plates 33 are fixed to the housing by way of brackets 25.

To make it possible for the beams to extend out onto a continuous level surface, the beams are graduated in length so as to accommodate the end plates 30 (see Figure 5, for example). Hence, the leading edge 13 end of the ramp is wider than the housing end in this embodiment.

The leading pair of plates 31 at the leading end of the ramp are provided with a wheel 32. The wheel 32 is the first point of contact on a surface as the ramp extends to the surface. It enables the ramp to smoothly move along the surface as it extends.

The bridging device 10 may be designed to only extend partway if it is not necessary to execute a full extension or if an obstruction is encountered. In this case sensors are used to prevent contact between the leading end of the ramp and an obstruction.

Figures 7(a) to 7(c) illustrate the mechanics of the end plates 30 that enable each end plate to slide against an adjacent end plate to provide the telescopic extension of the ramp.

Adjacent end plates slidingly engage by a slide boss and slot engagement. The inner face 34 of each end plate 30 has a slot 35. The outer face 36 of each end plate is provided with two bosses 37, or alternatively a single, elongated boss, which engage the slot 35 of an adjacent end plate. The slot has closed ends thereby preventing the bosses from escaping and adjacent plates from detaching. The spacing between the bosses is such that in the extreme positions in the slot 35 the beams 14

supported by the end plates are either stacked one above the other or extended still with some overlap without gaps therebetween.

In another embodiment the tolerance between the key slot and boss may be increased. This results in an extended ramp that drops slightly under gravity, which is useful where the first surface to which the bridging device is mounted is higher than the second surface across a gap. In effect the ramp 'seeks' the opposite second surface as it extends downward.

The beams 14 themselves may have a downturned edge 64 at the front edge, which provides additional strength for lighter weight, larger spans and stiffer construction. This is best seen in Figures 7(a), 7(b) and 7(c). The downturned edge 64 on each beam is angled forward to allow the beams to be stacked substantially vertically. In the extended position the downturned edge 64 of a beam is located underneath the rear edge of the beam in front. Therefore, each beam rests on the beam behind it as shown in Figure 7(c), which increases the strength of the ramp.

A gear rack 40 is located in a recess 41 along the bottom edge of each plate and is flush with the inner face 34 of the plate. The gear rack 40 meshes with a drive gear 42 axially mounted on a drive shaft 43. The gear rack 40 bends upwards at the leading end to allow smooth meshing of the different level racks onto the gears thereby catering for the lead in between each plate due to the difference in stack height. A predetermined rise allows sufficient clearance for adjacent plate racks to mesh with the gears. This rise is preferably about 4mm.

Drive shaft 43 is mounted in the housing on bearings and is driven by driving mechanism 20 that, as illustrated in Figure 4(c), essentially comprises a motor 50, gear box

51 and a flexible or solid drive shaft 52 that drives drive shaft 43. All the components of the drive mechanism are mounted in the housing in the configuration of this particular embodiment.

Each gear rack 40 on each plate engages only with its own corresponding drive gear 42 such that each plate has its own gearing system. Accordingly, and as illustrated in Figure 4(c), the drive shaft 43 supports a number of co-axially mounted drive gears 42 that each correspond to an end plate 30. In this configuration the drive gears 42 are clustered at each end of the drive shaft 43 and operate in pairs to correspond with each pair of end plates 30 mounted to every beam 14. Accordingly, each drive gear 42 on one side of the drive shaft 43 has a corresponding pair located at the other end of the drive shaft.

By virtue of the end plates 30 at each end, the beams 14 sequentially slide over each other to telescopically extend into a ramp. In this embodiment extension begins with the top most beam, which is the first and forward most beam. In the first instance the drive shaft 43 aligns the first pair of drive gears, located at the extreme far ends of the drive shaft 43, with the leading pair of end plates 31 supporting the first beam 22 to extend out of the housing.

Turning back to Figures 7(a) to 7(c) the drive shaft 43 rotates drive gear 42 to engage rack 40 of a first pair of end plates 30a and to drive the end plates, and consequentially the beam 14, in a forward direction. Figure 7(b) illustrates gear 42 moving end plate 30a in a forward direction to reach the position illustrated in Figure 7(c). As gear 42 passes the point illustrated in Figure 7(c), bosses 37 of a second plate 30b (illustrated in ghost lines) located in the slot 35 of the first plate

30a do not allow the first plate 30a to travel any further without pulling the second plate 30b along with it.

The leading end plates 31 are longer than the remaining end plates so that the gear racks on the leading plates can remain engaged with the drive gears while the ramp is in the retracted position. Figure 6 best illustrates this.

At this point the driving force is transferred from the gear rack 40 of the first plate 30a to the adjacent drive gear associated with the second end plate 30b. The second drive gear corresponding to the second end plate 30b is not illustrated in Figures 7(a) to 7(c) but would be located in front of the first drive gear 42 as viewed in those Figures.

The second drive gear would then rotationally engage with the second end plates gear rack (not shown) to drive the second plate 30b forward until the bosses 37 in the third end plate 30c (illustrated in ghost lines) engage with the rear end of the slot of the second end plate.

The driving process thus continues by sequentially transferring the driving force from one drive gear 42 to the next.

The driving mechanism 20 stops when the drive shaft has moved forward the second last end plate. The last end plate is fixed and remains stationery.

To ensure each end plate remains in a forward position relative to the end plate immediately behind it, each end plate is provided with a lock.

Figures 7(a), 7(b), 7(c) and 8 illustrate one embodiment of lock in which the lock is a lever plate 45

pivotingly mounted on inner face 34 with pin 44. Lever 45 is pinned to the inner face 34 of each end plate 30 in a corresponding recess 46. Specifically, the lever 45 is positioned on inner face 34 between slot 35 and gear rack 40 so that pivoting movement of the lever causes it to protrude into slot 35 and interfere with rack 40.

Figures 7(a) and 7(b) illustrate the lever 45 in an unlocked orientation. Figure 7(c) illustrates the lever 45 rotated in a clockwise direction to protrude into slot 35 to thereby confine bosses 37 towards the rear of slot 35 and lock the adjacent plates in an extended position.

Lever 45 is pivoted into the locked position by drive gear 42 rotating along gear rack 40. Lever 45 has two tabs extending downwardly adjacent gear rack 40. These are: lock tab 47 and unlock tab 48.

As drive gear 42 rotates in the direction extending the ramp, the drive gear passes under unlock tab 48, which is shorter than lock tab 47, and contacts lock tab 47. This contact occurs when the slot 35 of the first end plate 30a has moved forward such that bosses 37 of the second end plate 30b reach the rear of slots 35. This is illustrated in Figure 7(c). At this point the contact between the drive gear 42 and lever 45 pivots the lever in a clockwise direction to protrude into slot 35 and prevent bosses 37 moving from the rear of slot 35.

As the drive shaft and drive gears systematically move from one pair of plates to the next, each end plate is locked against the end plate behind it. The result is an extended ramp that can be securely and stably used without the concern that the plates could slide back over each other and the ramp collapse.

When retracting the beams 14 the drive shaft rotates in the opposite direction to systematically retract each beam one by one beginning with driving the second last beam onto the last stationery end plate 33. In the retracting position the drive shaft and drive gears rotate anti-clockwise to travel from the position illustrated in Figure 7(c) to the position illustrated in Figure 7(b) then Figure 7(a). With the lever 45 still in the locked position gear 42 travels under lock tab 47 and rotates to make contact with unlock tab 48. When contact is made lever 45 pivots about pin 44 in an anti-clockwise direction to bring the lever out of the locking position and free bosses 37 to move towards the front of slot 35 as the end plate 30 is pulled back by the driving mechanism 20. Hence, each pair of plates is one by one retracted back into the housing until the plates adopt the retracted stack position illustrated in Figures 5 and 6.

Other embodiments of plate locks may also be used. For example instead of a lever a spring biased pin may be seated in a stepped aperture extending through each end plate. When extension occurs the pin could be forced to extend to behind the plate adjacent to it and prevent the plate from retracting.

The rear of each slot can be bent or curved to induce a pre-camber causing the extended ramp 12 to curve slightly and form a hump giving the structure a sense of stability. In the case of its application as a pedestrian walk way, pedestrians are more likely to view the bridging device 10 as a safe and stable ramp to traverse if the ramp has a slight outward curvature compared with a "sagging" inward curving ramp.

If the bridging device 10 is intended to bridge a gap between two points having relative uneven heights the curve of the extending ramp can be adjusted such that, for

example, the telescopically extending ramp extends horizontally from the housing and curves to meet a surface that is lower than the height of the housing. This adjustment can be made by enlarging the bottom rear of slot 35 to form a trajectory curve angle 57. The severity of the trajectory curve angle 57 may be varied to achieve the desired curvature through which the bridging device 10 telescopically extends.

Alternatively or in combination, the angle of extension can be varied by tilting the entire housing itself relative to its mounting point. This allows the ramp to automatically find the correct level of the landing surface. Should upward tilting be required for situations where the landing surface is higher, a separate driving mechanism can be incorporated. The bridging device may even be able to sense the necessary degree of tilt by using a sensor to detect the opposite surface and adjust the tilt accordingly.

Alternatively, the bridging device may be associated with a microprocessor which can be pre-programmed to tilt the housing according to a pre-programmed location. For example, a bridging device mounted on a train could be programmed to tilt at a specific angle as the train arrives at a particular station.

For example, if the bridging device 10 is mounted underneath the doorway entrance of a commuter train the tilt angle of the housing can adjust to the angle required to bridge the relative height of the platforms and train floor. This is useful for accommodating different platform heights commuters must negotiate when travelling by trains.

To prevent the plates from slipping out over each other under the effect of gravity or friction a stack

restrainer 38 at the front of the housing applies pressure onto the stack so to catch against any slipping beams. The stack restrainer 38 is illustrated in Figures 3(a) to 3(c) and Figure 6. The restrainer may be a member attached to the housing having a spring-biased ball, preferably stainless steel, located in a recess at the top of the member. As the stack rises incrementally the restrainer allows only the top beam in the cassette to depress the sprung ball and pass over.

Alternatively, Figure 6 illustrates a restrainer 38 in the form of a member having an upper end shaped as a leaf spring which will depress to allow the top most beam to pass over and out of the opening.

The last beam 14 that remains stationery inside the housing is in the form of a more stable brace angle 60 as illustrated in Figure 10. The end plates 30 on either side of the brace angle 60 are fixed to the housing by way of vertical track brackets 25.

Springs 63 are mounted under the last beam 14 to assist in the stack rising evenly in the cassette (see Figures 9 and 10).

In one embodiment of the bridging device there may be a need for assistance in keeping the stack of beams level during extension. In this case, an end pull is used to force the nose of the last plates 30 downwards. As shown in Figures 9 and 10 the end pull comprises a tension spring 26 located horizontally between the last pair of end plates 30. A tether 27 is attached to each end of the string and extends in opposite directions towards the end plates 30. Tethers 27 are turned through 90° by rollers 28 so as to extend upward towards their respective end plates 30. The ends of tethers 27 are connected to brace angle 60 close to the end plates 30 by means of a pin. This is

illustrated in Figure 10. The tension force of spring 26 pulls the tethers 27 in a downward direction to react against the tendency of the last pair of plates to pull upwards.

While an end pull is illustrated in Figures 9 and 10, it is understood that the components of the end pull (spring 26, tethers 27 and rollers 28) may be omitted from the bridging device where an end pull is not required.

The last end plates themselves are restrained horizontally in the housing and are provided with limited vertical movement for raising the stack of beams. Vertical restraint is effected by guide wheels 61 and slide guide wheels 62 which enable the last end plates 30 to slide on the vertical track brackets 25. Alternatively, other vertical sliding means, such as bearing tracks, may be used.

The bridging device may be usefully applied to a range of applications from small scale pedestrian ramps to larger scale bridges for vehicles where a temporary bridge is required.

Whilst in the extended position, in this embodiment the ramp inherently acquires a trapezoid shape (on account of the first beam being longer than the last beam). This shape may be exaggerated to give the ramp a flared trapezium shape, which may be desirable in certain applications.

It is possible to construct the bridging device 10 to achieve a straight rectangular ramp with parallel sides. In this case the end plates would be angled inwards as illustrated in Figure 11. The mechanics of each end plate would be different to that described above, for example

bosses may be replaced with a dove tail key, but the working concept would remain the same.

In another embodiment illustrated in Figure 12 rather than mounting the beams on top of the end plates as illustrated in the preferred embodiment, the beams may be upturned with the end plates projecting upwards. When the bridging device is in an extended position in this embodiment, it gives the ramp borders along the edges of the ramp and reduces the likelihood of wheel chairs, prams, and the like falling off the side of the ramp before reaching the end.

The bridging device may be made entirely of metal and foreseeably of high strength steel, or high strength aluminium or cast metal or the like. Alternatively, the device may involve composite materials made of carbon fibres or plastics. It is an advantage to choose high strength but lightweight materials to reduce the weight of the bridging device and overall vehicle load. When in the retracted position, the bridging device allows a large ramp to be stored in a small space, which is desirable.

It will be understood to persons skilled in the art of the invention that many modifications may be made without departing from the spirit and scope of the invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A bridging device for providing a bridging surface between two points comprising:

a stack of interjoined beams housed in a retracted position in a housing mounted at a first point; and

a drive system that drives the beams to slide one over the other to telescopically extend out of the housing from the retracted position to an extended position to thereby form a bridging surface to a second point.

2. The bridging device claimed in claim 1, wherein the beams are supported by end plates located at each end of the beam.

3. The bridging device claimed in claim 2, wherein the end plates are adapted to be stacked adjacent to each other and to slidingly engage the end plates on each adjacent side.

4. The bridging device claimed in claim 3, wherein the end plates slide relative to one another by way of a boss and key slot sliding engagement between adjacent end plates.

5. The bridging device claimed in claim 3, wherein an underside of each end plate is provided with a gear rack that meshes with a drive gear on a drive shaft driven by a drive source in the drive system.

6. The bridging device claimed in claim 5, wherein each end plate meshes with its own dedicated drive gear, wherein the drive gears are coaxially mounted on the drive shaft.

7. The bridging device claimed in claim 5 or 6, wherein the drive shaft is bearing mounted in the housing and is driven by a motor defining the drive source.

8. The bridging device claimed in claim 7, wherein the motor is mounted in the housing.

9. The bridging device claimed in any one of claims 2 to 8, wherein each end plate is provided with a lock to lock adjacent plates in the extended position.

10. The bridging device claimed in claim 9, wherein the lock is a pivoting lever pinned in a recess on the end plate and adjacent a key slot on the same end plate, through which a boss on an adjacent plate protrudes, whereby the lever pivots to protrude into the key slot and obstruct the boss from sliding along the key slot.

11. The bridging device claimed in claim 10, wherein the pivoting lever is provided with two tabs; whereby during extension of the bridging device the drive gear contacts a first tab to move the lock into a locked position; and during retraction of the bridging device the drive gear contacts the second tab to move the lock into an unlocked position thereby allowing the end plates and beams to retract back into the housing.

12. The bridging device claimed in claim 4, wherein the key slot is angled at a rear end to create a curve such that when the end plates are in an extended position the bridging surface is cambered.

13. The bridging device claimed in claim 4, wherein the key slot and boss have a wide tolerance such that the bridging surface drops downwardly under gravity.

14. The bridging device claimed in any one of the preceding claims wherein the beams are substantially flat and slat-like in shape so as to stack one on top of the other.

15. The bridging device claimed in claim 14, wherein the beams have a forward edge that is downturned at an angle.

16. The bridging device claimed in any one of claims 2 to 15, wherein the end plates at a leading front beam are defined as the first plates and are each provided with a wheel adapted to contact a surface at the second point.

17. The bridging device claimed in any one of the preceding claims, wherein the beams are made of high strength metal.

18. The bridging device claimed in any one of claims 1 to 16, wherein the beams are made of composite materials including carbon fibers or plastics.

19. The bridging device claimed in any one of the preceding claims, wherein the housing is an enclosed elongated structure having a front opening through which the beams extend.

20. The bridging device claimed in claim 19, wherein the opening is provided with a tilting sprung cover.

21. The bridging device claimed in any one of the preceding claims, wherein biasing means is provided in the housing to provide an upward force on the stack of beams for incrementally raising the stack during extension.

22. The bridging device claimed in claim 21, wherein a restraining catch at the front of the housing permits only

the top-most beam in the rising stack of beams to extend through the housing during extension.

23. The bridging device claimed in claim 22, wherein the catch is a biased sprung ball or a leaf spring.

24. The bridging device claimed in any one of the preceding claims, wherein the interjoined beams are of different lengths so as to create a trapezium shaped bridging surface.

25. The bridging device claimed in any one of claims 1 to 23, wherein the interjoined beams are of the same length to create a rectangular bridging surface.

26. The bridging device claimed in claim 2, wherein the beams are supported on top of the end plates or underneath the end plates.

27. The bridging device claimed in any one of the preceding claims, wherein the housing is mounted so as to be capable of tilting relative to the first point.

28. The bridging device claimed in claim 27, wherein the angle of tilt may be automatically or manually controlled to vary.

29. The bridging device claimed in claim 27, wherein the housing may be provided with a sensor that senses the required angle of tilt such that the tilt angle may be automatically adjusted.

30. The bridging device claimed in claim 27, wherein the housing is associated with a microprocessor that is pre-programmed to tilt the bridging device at an angle.

31. The bridging device claimed in claim 2, wherein the housing is provided with an end pull for stabilizing the last end plates which remain inside the housing when the device is fully extended.

32. The bridging device claimed in claim 31, wherein the end pull pulls a leading edge of the last end plates downwards.

33. The bridging device claimed in claim 32, wherein the end pull comprises a tension spring located horizontally between the last end plates and a tether attached to each end of the spring which extends in opposite directions, turns through 90° around guide rollers and extends upwards to each attach to, or close to, the last end plates.

34. A method of bridging two points including mounting a bridging device at a first point, wherein the bridging device includes a housing containing a stack of interjoined beams; and

driving a drive system of the bridging device to telescopically extend the stack of beams out of the housing from a retracted position to an extended position to thereby form a bridging surface to a second point.

35. The method claimed in claim 34 including extending the beams to create a partially or fully extended bridging surface.

36. The method claimed in claim 34 including creating a cambered bridging surface.

37. The method claimed in claim 34 including extending the bridging surface such that the leading edge is supported on a surface at the second point.

38. The method claimed in claim 34 including extending the bridging surface to act as a cantilever such that the leading edge locates adjacent a surface at the second point.

39. The method claimed in claim 34 including tilting the housing to extend the beams at an angle to a surface at the first point.

40. The method claimed in claim 39 including actuating the tilting of the housing automatically or manually.

Dated this 9th day of May 2005
KEVIN JOHN FULLERTON and
THEODOR REINHARDT SCHACHT
By their Patent Attorneys
GRIFFITH HACK
Fellows Institute of Patent and
Trade Mark Attorneys of Australia

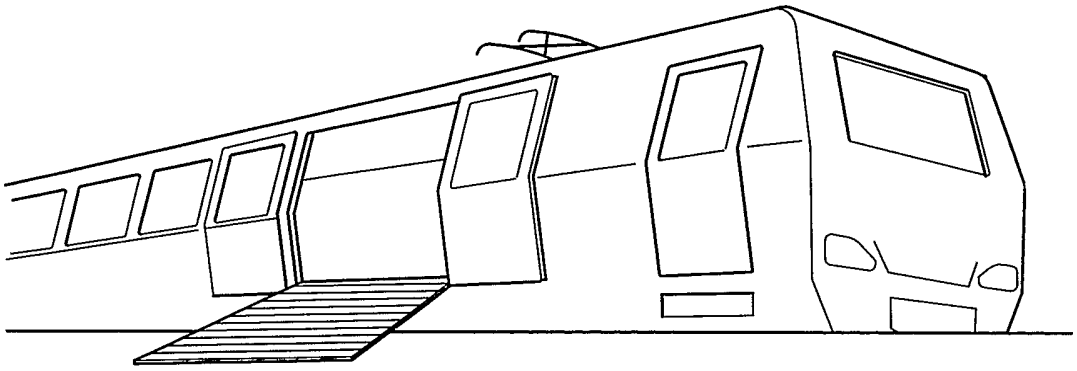

FIGURE 1(a)

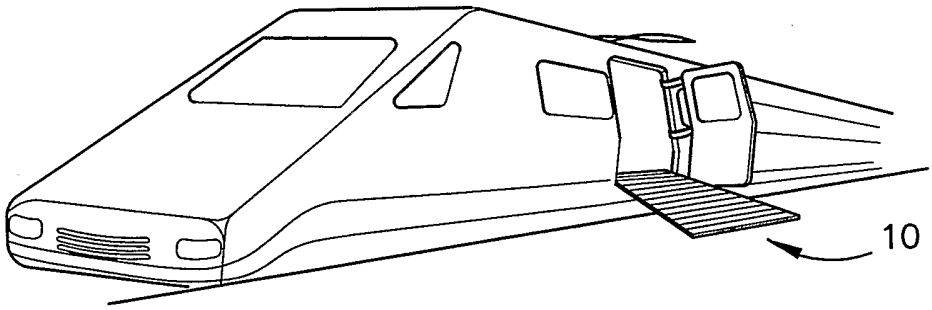

FIGURE 1(b)

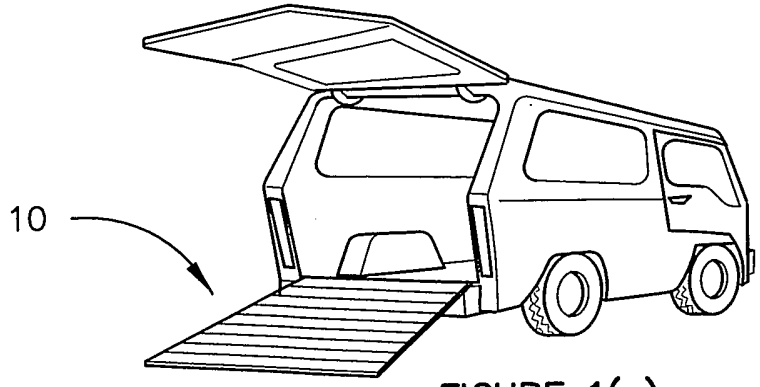

FIGURE 1(c)

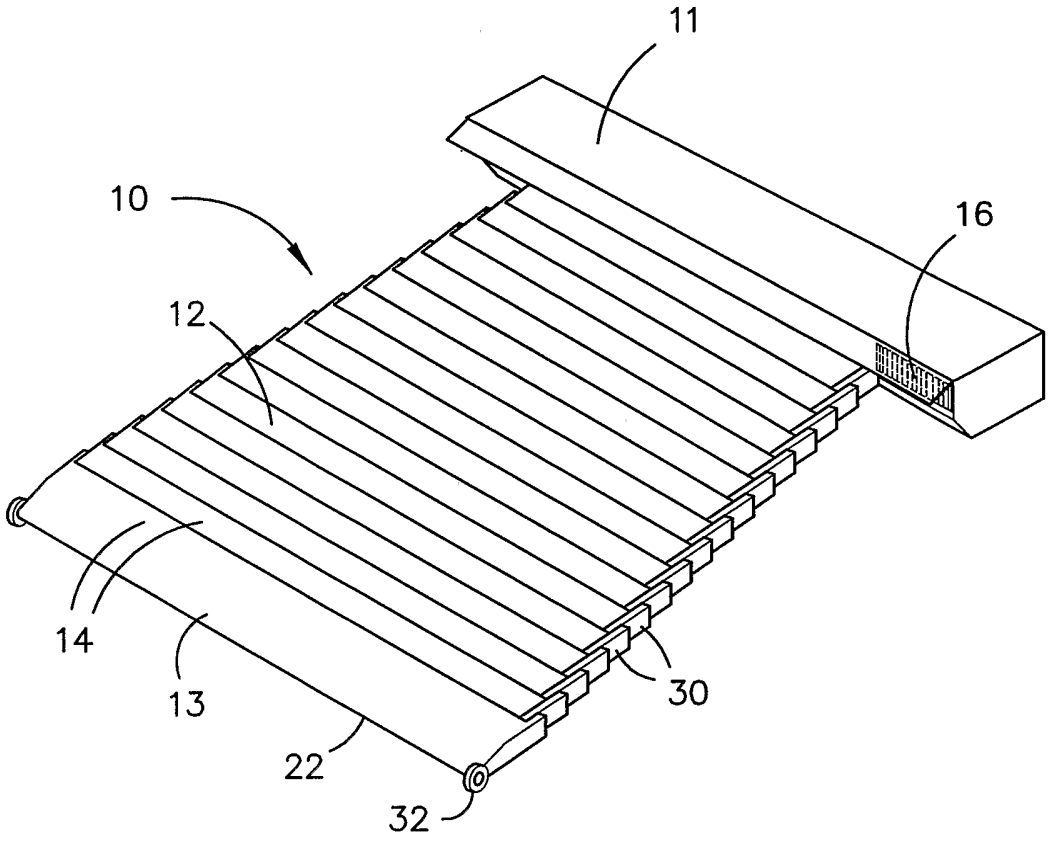

FIGURE 2

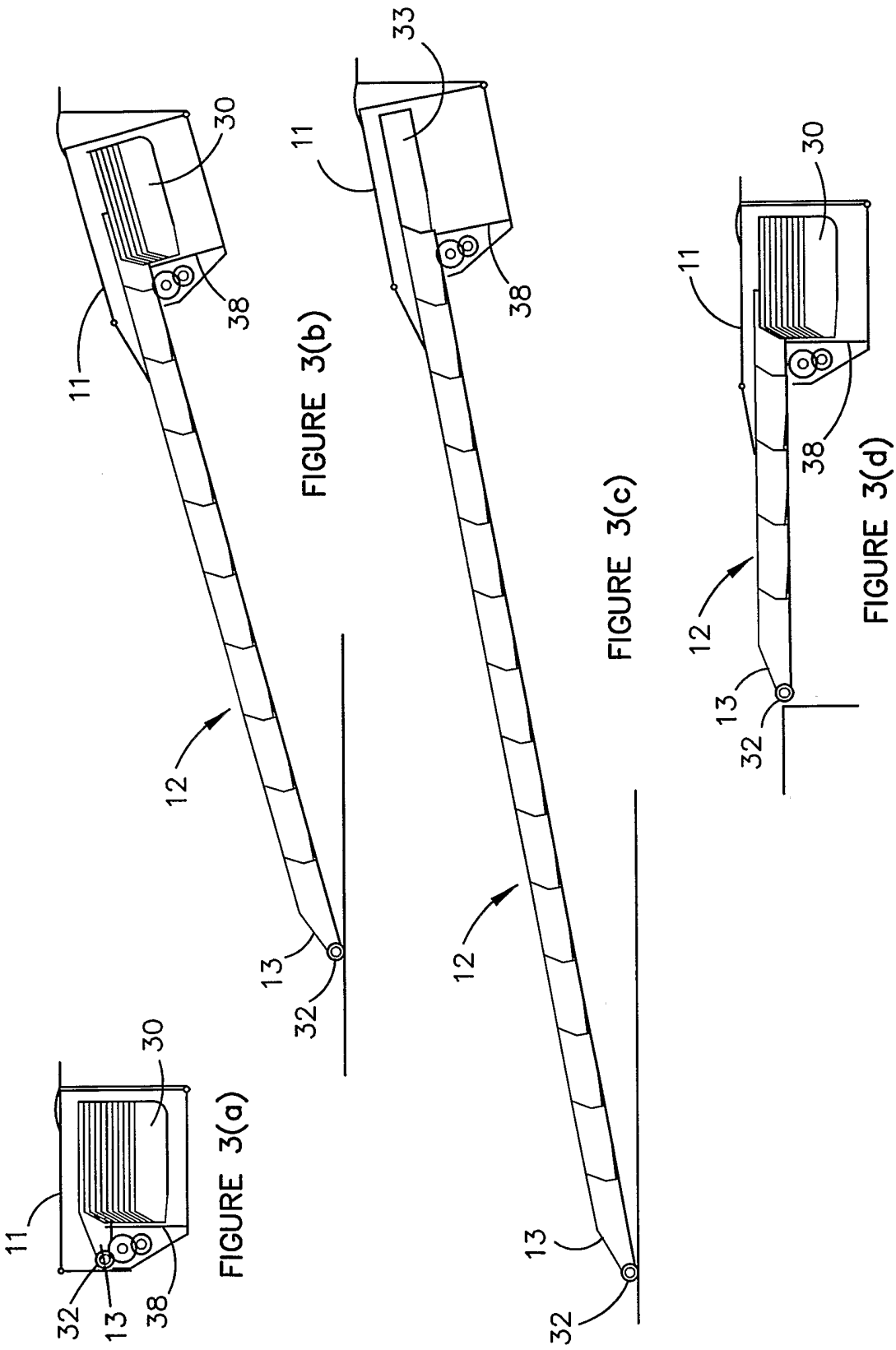
11
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FIGURE 3(a)
FIGURE 3(b)
FIGURE 3(c)
FIGURE 3(d)

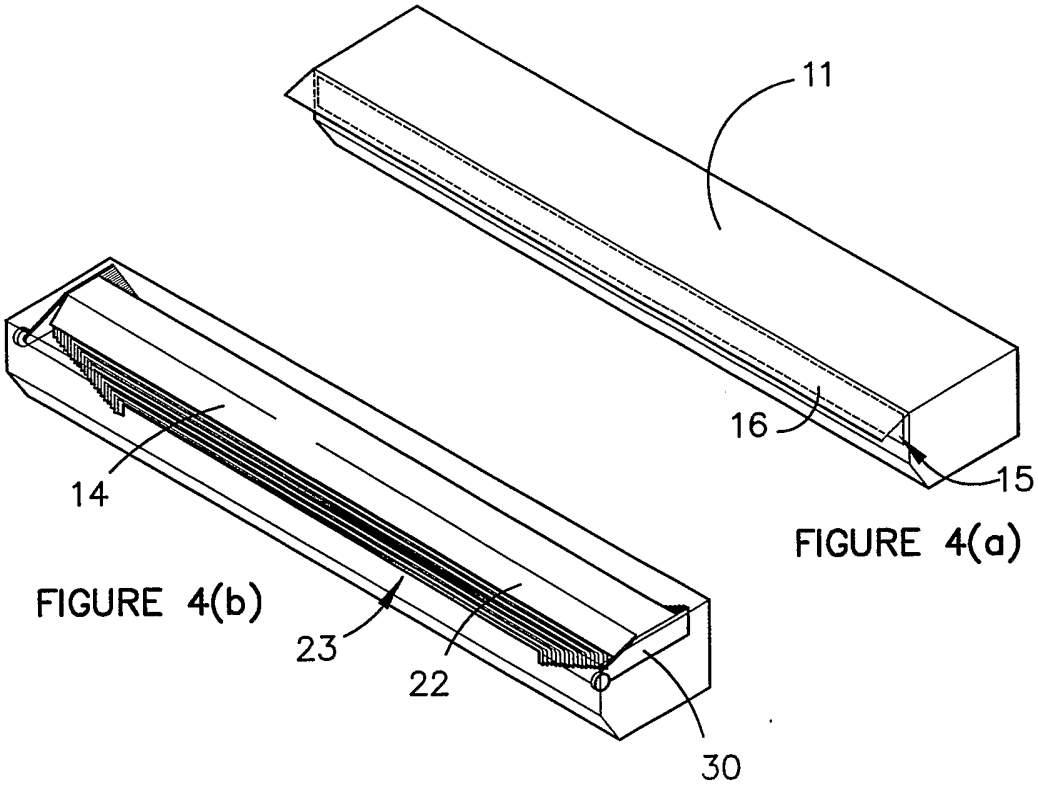


FIGURE 4(a)

FIGURE 4(b)

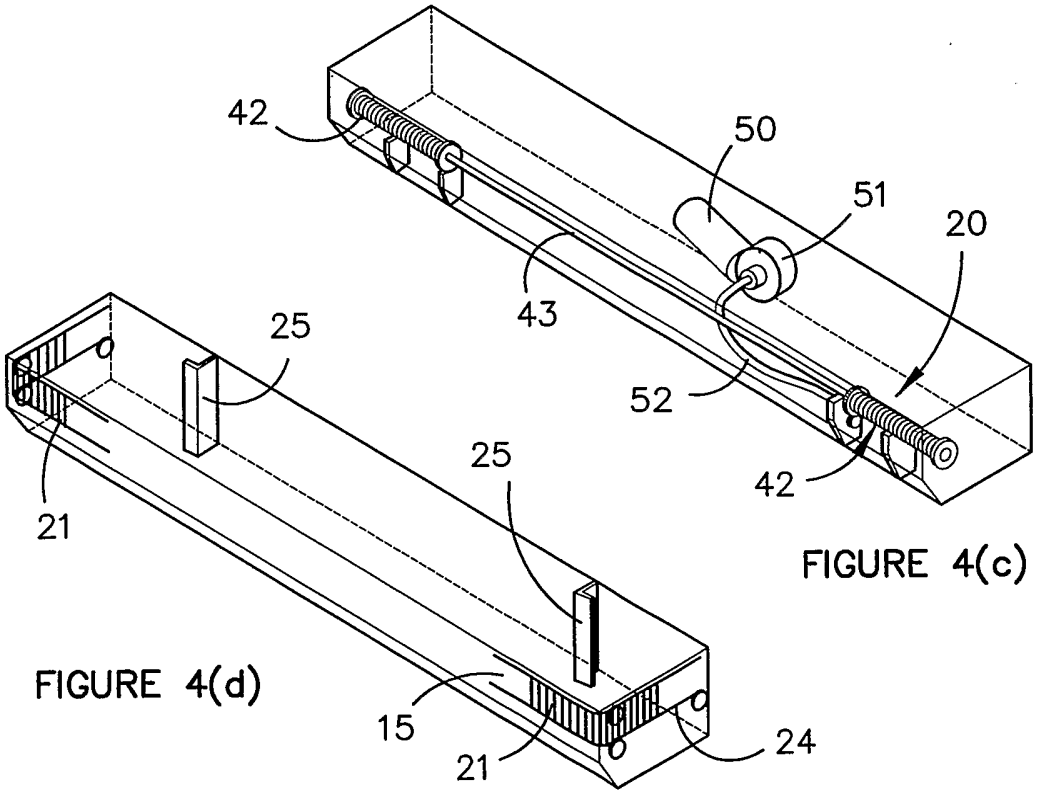


FIGURE 4(c)

FIGURE 4(d)

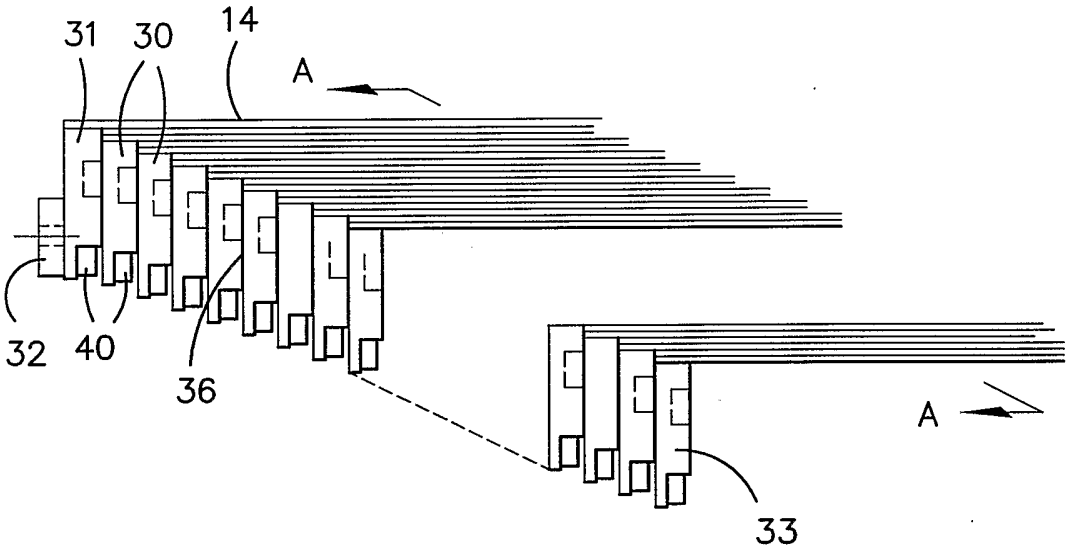


FIGURE 5

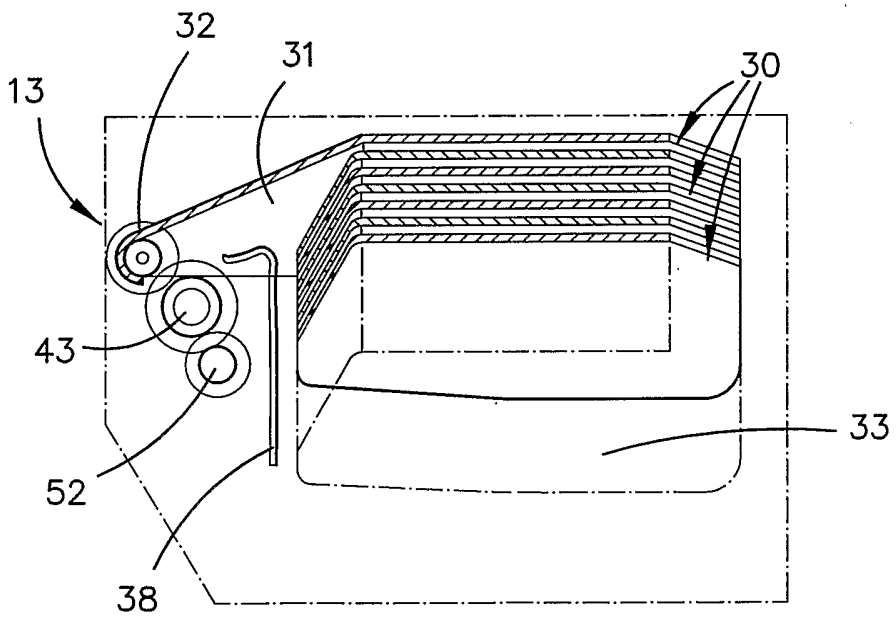
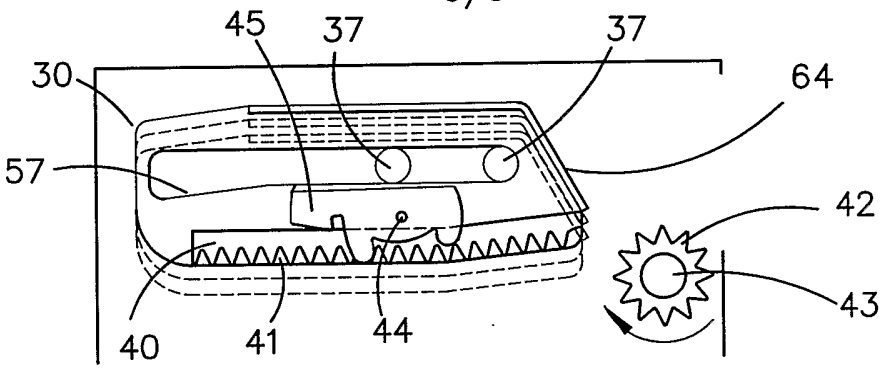


FIGURE 6



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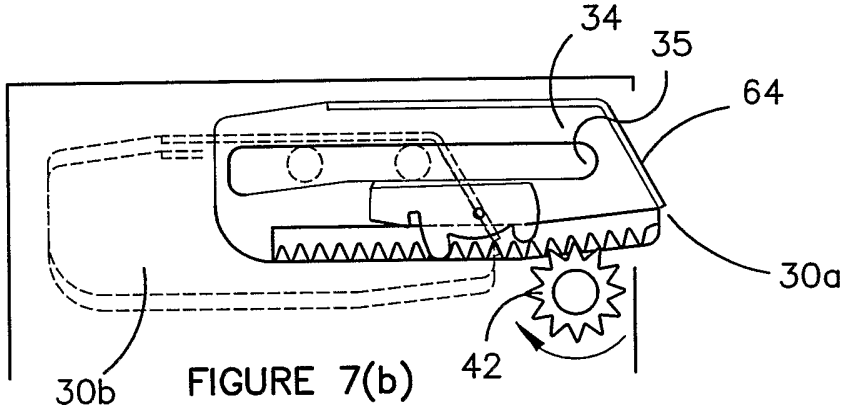
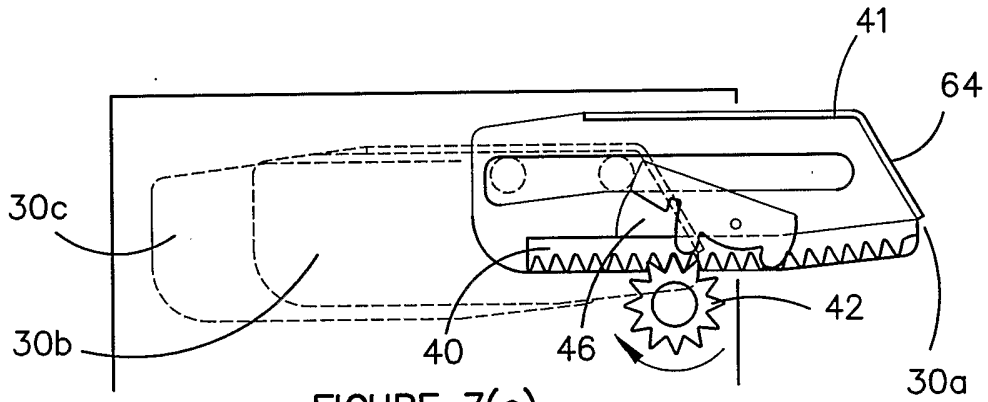


FIGURE 7(b)



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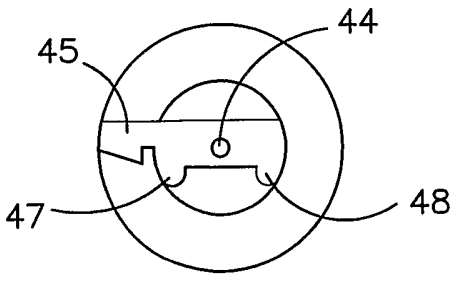

FIGURE 8

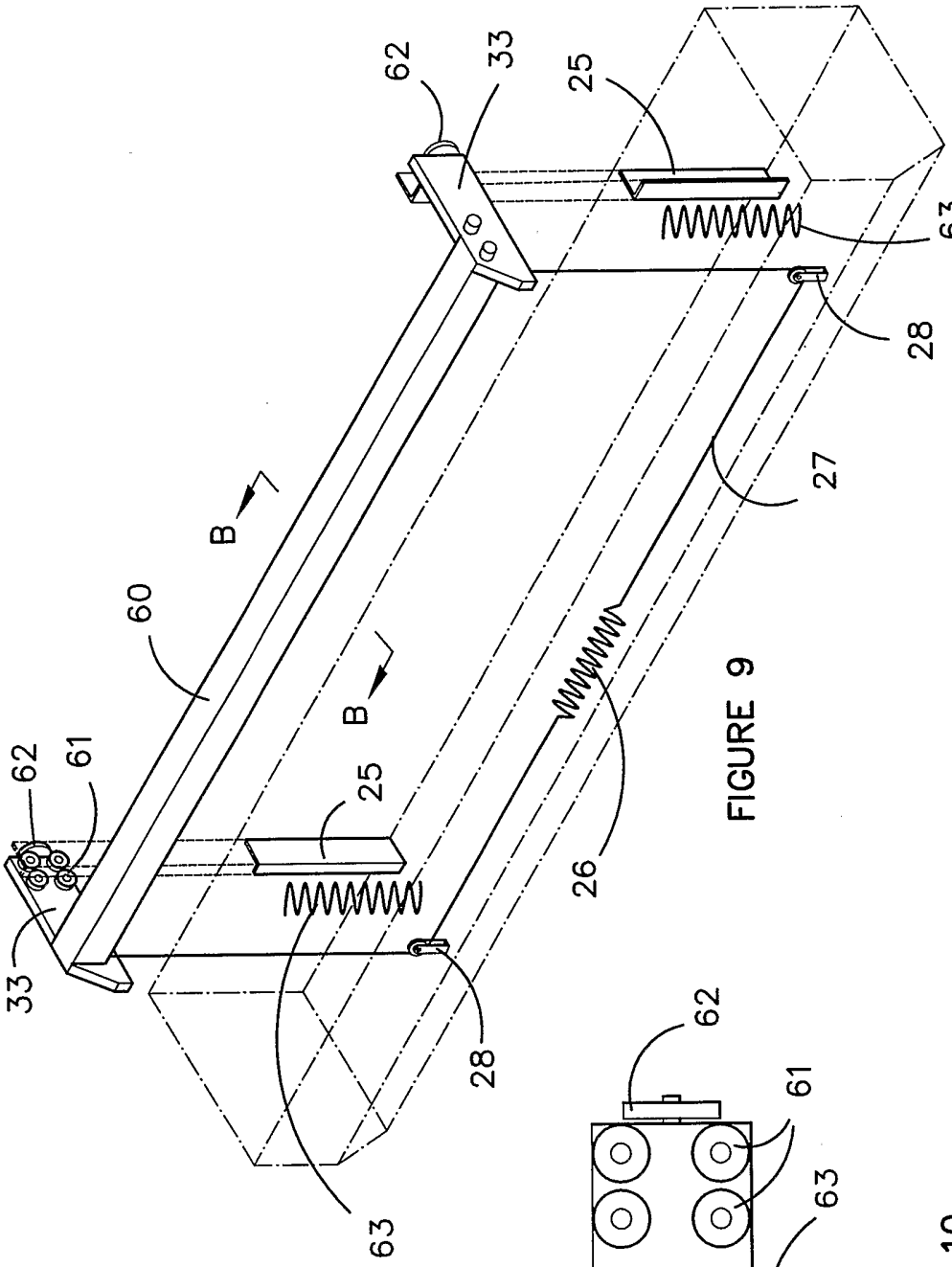

FIGURE 9

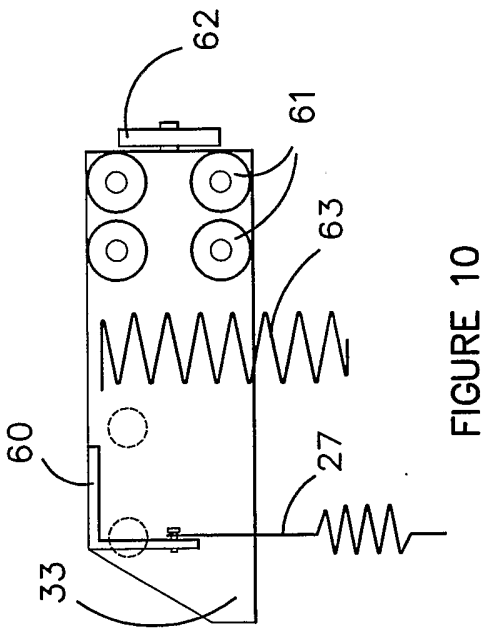

FIGURE 10

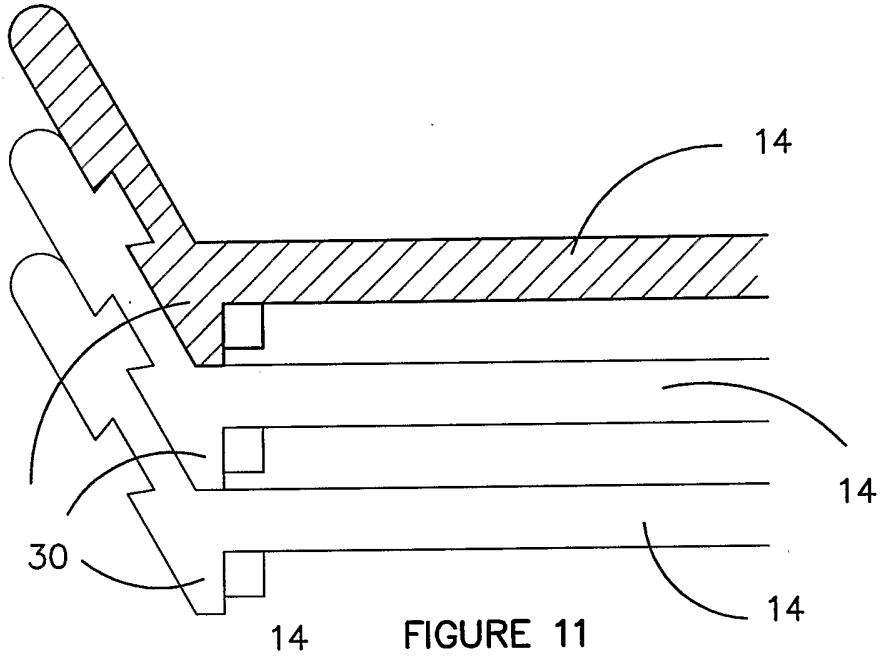

FIGURE 11

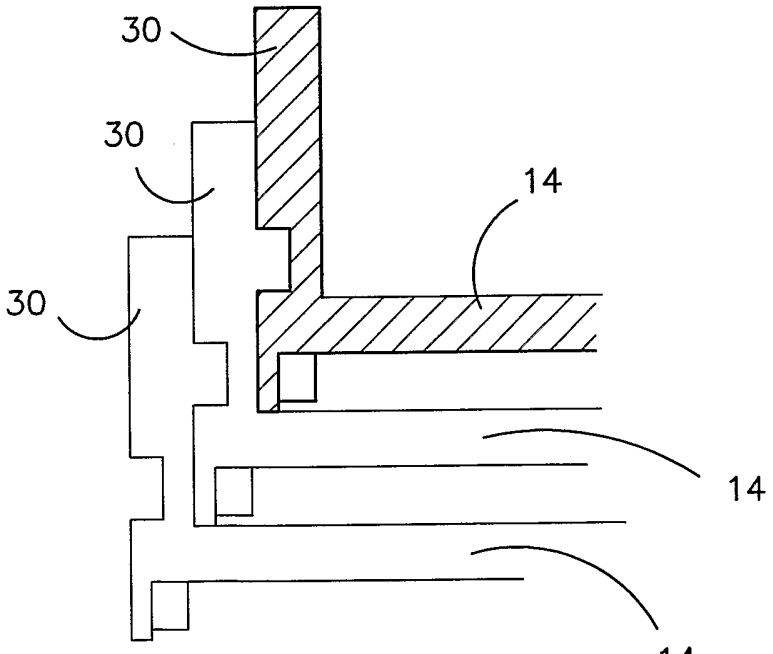

FIGURE 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2005/000652

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B60P 1/43, B62D 25/22, B65G 69/28, A61G 3/06.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI with keywords (vehicle, bridge, access, telescope, drive)
USPTO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2002/002043 A1 (METALIC SA) 10 January 2002. Whole document	1-4, 9, 12-32, 34-40
X	WO 2002/055334 A1 (TRUCK-ALIGN CO. LTD.) 18 July 2002 Whole document	1-4, 9, 12-32, 34-40
X	WO 2000/020252 A1 (TRUCK-ALIGN CO. LTD) 13 April 2000 Whole document	1-4, 9, 12-32, 34-40
X	US 5244335 A (JOHNS) 14 September 1993 Whole document	1-4, 9, 12-32, 34-40

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 June 2005	15 JUN 2005

Name and mailing address of the ISA/AU	Authorized officer
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	**ZBIGNIEW BIELAWSKI** Telephone No : (02) 6283 2218

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2005/000652

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	0202043	EP	1296628	FR	2811223		
WO	02055334						
WO	0020252	AU	61118/99	CA	2309198	EP	1034088
		US	6598253				
US	5244335						

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX