

PATENT SPECIFICATION

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(54) UNIVERSAL COUPLING AND MASSES COUPLED
 THEREBY

(71) I, HARRY SAUNDERS, of "Springfield", Harewood Road, Chalfont St. Giles, Buckinghamshire, a British Subject, do hereby declare the invention, which was communicated from CUSHMAN, DARBY & CUSHMAN, 1801 K Street N.W., Washington D.C. 20006, U.S.A. Attorneys at law of the bar of the District of Columbia, United States of America, for which I pray that a patent may be granted to me and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a universal coupling for coupling two bodies together in such a manner that the said bodies remain free for movement relative to each other in planes of roll, yaw, and pitch, the coupling comprising a first coupling unit for attachment to one of said bodies and a second coupling unit for attachment to the other of said bodies and for releasable coupling attachment to the first coupling unit. Such a universal coupling will be referred to herein as a "coupling of the kind hereinbefore specified". The invention relates also to a pair of bodies such as water-going vessels coupled together by a said coupling, in combination.

The said bodies to which the couplings of the invention are applicable are typically water-going vessels, which term is to be understood as meaning any boat, ship or other craft whether intended to operate on rivers or canals or whether an ocean-going, sea-going or offshore vessel. A particularly useful application is in coupling a barge to another barge or to a towing vessel such as a tug, so that for example a train of barges can be coupled together and to the towing vessel. Another particularly useful application is in closely coupling large marine vessels for towing purposes.

Universal joints are old in the art and include ball and socket joints, and interconnected annular objects in which

each intersects the annular space of the other. These devices have proven satisfactory for coupling small objects, but efforts to adapt these couplings for use with large objects of the magnitude of ocean-going vessels have not proven feasible economically or mechanically.

One object of the invention is to provide a coupling between two large bodies of the magnitude of marine vessels that will space the vessels apart a fixed distance, i.e. provide an articulated coupling such as to allow each vessel to move independently in the three planes or axes of movement nautically referred to as planes or axes of roll, pitch and yaw.

According to the invention in a first aspect, in a coupling of the kind hereinbefore specified the first coupling unit has a first mounting member, arranged to be fixed upstandingly to a first body, and a first coupling means carried by said first mounting member for movement with respect thereto in planes of pitch and yaw and having a first fastening means; and the second coupling unit has a second mounting member, arranged to be fixed to a second body to be articulated to said first body by the coupling, and a substantially horizontally-disposed second coupling means, having a second fastening means for releasable fastening engagement with said first fastening means, the second coupling means being carried by the second mounting member for movement of the second fastening means with respect to the second mounting member in planes of roll and yaw, and the first and second fastening means being adapted to be coupled together for relative movement about a common pivot axis so as to fasten the coupling units together whereby to articulate the said bodies together whilst providing for relative movement between the two fastening means in the plane of pitch.

According to a preferred feature of the

invention, in a said coupling said first coupling unit has a generally-cylindrical said first mounting member arranged to be fixed by one of its ends upstandingly to said first body, and said first coupling means comprises a sleeve adapted to fit on the mounting member for rotational movement relative thereto in a plane of yaw and for sliding movement relative to the mounting member in a plane of pitch, the sleeve having said first fastening means for releasable fastened pivotal engagement on a transverse pivot axis with said second fastening means of said second coupling unit.

The first fastening means preferably comprises: opposed parallel walls longitudinally arranged externally of the sleeve and spaced transversely apart, each of said walls being formed with a respective complementary outwardly-facing transverse coupling slot, whereby said slots can together accommodate a transversely extending elongate member therein; and a fastening member carried by the walls and movable relative thereto between a closed position, such that it can trap in the slots a said elongate member defining a transverse pivot axis with respect to said walls, and an open position such as to allow a said elongate member to be released sideways from the slots.

Preferably the movable member is a bifurcated lever having outwardly-projecting arms arranged so that when the lever is in said closed position, the arms can trap a said elongate member in the slots for pivotal movement relative to the slots.

According to a further preferred feature of the invention, in a said coupling said second coupling unit has a hollow, open-ended said second mounting member adapted to be fixed to said second body and defining a substantially horizontal passage therein which is divergent towards each open end, and said second coupling means extends through said passage and is pivoted in the second mounting member for movement with respect thereto in a plane of yaw, the second coupling means including said second fastening means for pivotal engagement on a pivot axis with said first fastening means of said first coupling unit the arrangement being such as to permit relative rotational movement between the second fastening means and the second mounting member in a plane of roll.

The second coupling means preferably includes a cylinder having an open end, and plunger means mounted in the cylinder and having a free end projecting from said open end and carrying the second fastening means, the cylinder extending through said passage and being pivoted in the second mounting member for said movement in the

plane of yaw, and the plunger means being arranged for rotatable movement in the cylinder in the plane of roll. Preferably the said second fastening means comprises a longitudinal extension of the free end of the plunger means and is arranged to carry an elongate pivot pin projecting transversely thereof. The cylinder is preferably closed at its other end and has plunger support means extending radially inwards at its open end for slidably supporting the plunger means projecting therethrough; the plunger means then preferably includes a radially-extending head at its other end for slidably engaging the bore of the cylinder. A second coupling unit having a preferred coupling means of this type includes damping means for exerting on the plunger opposed resilient axial forces to dampen forces tending to break the coupling, whilst permitting limited longitudinal sliding movement of the plunger means in the cylinder.

The invention in a second aspect thereof provides, in combination, a coupling according to the said first aspect of the invention coupling a water-going vessel with a second water-going vessel, wherein said first fastening means is in releasable fastening pivotal engagement with said second fastening means about a common pivot axis transverse to the longitudinal axes of the vessels so that each said vessel is articulated to the other but free to undergo pitch, roll and yaw with respect thereto.

A preferred embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, of which:—

Figure 1 is a plan view of two coupling units or halves of a coupling according to the invention;

Figure 2 is a cross-sectional view of the two coupling halves of the coupling of the invention, along sectional lines 2—2 of Figure 1;

Figure 3 is a connecting end view of the second or horizontal one of the said coupling units or halves;

Figure 4 is a connecting side view of the first or vertical one of the said coupling units or halves;

Figure 5 is a perspective view of the sleeve of the vertical coupling unit;

Figure 6 is a side view of a towing ship and barge being drawn together for coupling;

Figure 7 shows a plan view of the ship and barge of Figure 6;

Figure 8 shows a side view of a towing ship and barge coupled together; and

Figure 9 shows a plan view of the ship and barge of Figure 8.

Figures 1 and 2 show a universal coupling for coupling two bodies, in this case two

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- water-going vessels, together in such a manner that the vessels remain free for movement relative to each other in planes of roll, yaw and pitch, as will hereinafter be apparent. The coupling comprises a first coupling unit 12 for attachment to one vessel and a second coupling unit 10 for attachment to the other vessel, the unit 10 being arranged for releasable coupling attachment to the unit 12. For convenience the first and second coupling units 12, 10, will be called hereinafter in this description the vertical and horizontal units respectively. Complementary male and female portions of units 10 and 12 co-operate to fasten together the coupling units 10 and 12 and thereby couple the respective bodies to which they are attached.
- Referring to Figures 1, 2, 4 and 5, the vertical coupling unit 12 includes a generally-cylindrical vertical first mounting member 58 fixed by an end 60 upstandingly to an adjacent part of, or more particularly to the stern of, a towing ship. A first coupling means of the unit 12 comprises a circular sleeve 64 having first fastening means 66, 71 and 72 for releasable fastened pivotal engagement on a pivot axis transverse to the longitudinal axes of the vessels with a second fastening means 50, 54 of the unit 10. Sleeve 64 is slidably and rotationally mounted on vertical member 58 and is adapted to slide up and down and turn thereon in the planes or "axes" of pitch and yaw respectively. A block 66 is mounted on sleeve 64 and has two opposed parallel walls externally extending substantially the length of sleeve 64, as can be seen in Figure 5. The block 66 has in each of said walls a respective one of two complementary outwardly-facing horizontally transverse slots 71, adapted to receive a transverse elongate coupling pin or bolt 54 therein. Inclined surfaces 67, 68, 69 and 70 help to guide the pin 54 and the free end 50 of a plunger 42 of the unit 10 into place between the said walls. A fastening member in the form of a bifurcated lever 72 carried by the sleeve 64 is pivoted about a pivot 73 extending on block 66 roughly parallel to the slots 71 and between them and the sleeve 64 itself. Two outwardly-projecting curved arms 74 are part of the bifurcated lever 72. With the pivot 73 as a centre, and with a minimum radius equal to the distance therefrom to engage with the periphery of the transverse slots 71, the free ends of the curved arms 74 swing into and out of arm-engaging means in the form of upwardly-facing aligned channels 76 and 78 (Figure 5) of block 66 adjacent the slots 71. When lever 72 is lowered to its closed position, the curved arms 74 enter the recesses 76 and 78 and trap the coupling pin 54 in the transverse slots 71. The lever 72 is weighted by a weight 80 fixed near its free end to bias the lever 72 downward. Lever 72 is manually raised to open the transverse slots 71 to admit or allow the exit of the coupling pin 54.
- A take-up reel 82 is also carried by sleeve 64, being pivotably mounted by pivots 84 on block 66 above the transverse slots 71 and pivots 73. A cable 85 is wound on reel 82. A hook 86, adapted to fit in a shackle or eye 56, secured to the plunger 42, is fixed to the free end of the cable 85 and co-operates therewith to guide the aforementioned free end 50 with its coupling pin 54 into the slots 71 of block 66.
- In use, the lever 72 is raised to its open position, the cable 85 is unreeled manually or with an electric motor or the like, and the hook 86 is engaged in the shackle 56. Cable 85 is then reeled in on reel 82 to guide the transverse coupling pin 54 into slots 71 as described above. Lever 72 is then manually lowered to close the slots 71 behind the transverse coupling pin 54, thereby fastening together the units 10 and 12 of the coupling.
- Referring to Figures 1 to 3, the horizontal coupling unit 10 includes a hollow, open-ended second mounting member in the form of a fixed horizontal housing 18 which is constructed of a top plate 19, bottom plate 20, and V-shaped side plates 22 and 24, defining a substantially horizontal passage in housing 18, this passage being divergent towards each open end thereof. Housing 18 is attached by a rod 28 and nuts 30 and 32 to one of the vessels to be coupled, adjacent the front edge thereof. In the coupling of ships it is preferably fixed in the bow of a towed ship.
- Extending through the said horizontal passage is a second coupling means, directed to the right as seen in Figure 2, and including a cylinder 26 which is pivotably mounted in housing 18 about an axis defined by the vertical rod 28 which passes through housing 18. The plates 22 and 24 of housing 18 permit the pivoted cylinder member 26 a limited swing in the plane of yaw, as shown in dashed lines in Figure 1. The open end of the cylinder 26 is partially closed by plunger support means in the form of an inwardly-extending circular flange 38, and the other end 40 of the cylinder 26 is fully closed.
- The tubular plunger or rod 42 is both slidably and rotationally mounted in cylinder 26. It is supported therein by the flange 38 of the cylinder 26 and by an end flange or radially extending head 44 on the plunger 42. Unit 10 includes damping means in the form of helical springs 46, 48. The spring 46 is mounted in compression in the annular space 47 defined between the

flange 38 and head 44 and between the plunger 42 and the bore of cylinder 26. The second spring 48 is mounted in compression in the cylindrical space 49 defined by the bore of cylinder 26 between the head flange 44 of plunger 42 and the closed end 40 of cylinder 26. The springs 46 and 48 oppositely bias plunger 42 axially and resiliently, with the stronger spring 46 exceeding in ultimate compression force the sum of the maximum dynamic force to be ordinarily exerted compressively against it and the opposing force of spring 48. Thus the compression force to which spring 46 is subjected should not ordinarily exceed its ultimate compressive strength.

The free end 50 of the plunger 42 is tapered and projects outwardly beyond the flanged end 38 of cylinder 26. The horizontally transverse coupling pin 54 is mounted in the end 50. The shackle or eye 56 is fixed to the plunger 42 for receiving the cable 85 which is used for guiding together the two halves 10 and 12 of the coupling. The plunger 42 is therefore adapted to rotate in the cylinder 26 in the axis of roll, and for limited movement in the direction of the longitudinal axes of the vessels and oppositely as damped by springs 46 and 48.

From the above description it is evident that two objects or two ships are held apart at a distance which varies by not more than the length of the plunger 42 plus the length of projection of cylinder 26 beyond the ship edge, depending upon compression of damping spring 46 by towing or other stresses tending to disengage the coupling. The horizontal unit 10 of the coupling provides freedom of relative motion in the axes of roll and yaw, and very limited movement along the longitudinal axes of the vessels. The vertical unit 12 provides freedom of relative motion in the axes of pitch and yaw. The coupling as a whole, comprising the units 10 and 12 in combination through the pivotal fastening structure 66, 54, 50, whereby the fastening means are pivoted together about the common transverse pivot axis defined by the axis of pin 54, provides additional freedom of relative motion in the axis of pitch. Thus the coupling provides double means for freedom of relative motion in the axes of pitch and yaw and single means in the axis of roll.

Figures 6 to 9 illustrate the mounting of the coupling on a barge and towing vessel. In Figures 6 and 7 a towing vessel 100 is shown drawing a barge 102 toward it by cables 104 and 106 so that coupling units 108 and 110 and coupling units 112 and 114 can be locked together as discussed above, thus articulating the vessels together. Bumpers 116, 118, 120 and 122 protect the

bow and stern of the respective vessels. It will be understood that any number of coupling units as needed can be employed and that such units can be used to couple in articulated relationship a sequence of barges, forming a train, to a towing vessel.

Figures 8 and 9 show how effectively the coupling units move in response to ship movements while maintaining the two ships coupled together. Two pairs of coupling devices 124 and 126 connect a towing ship 128 to a towed barge 130. Bumpers 132, 134, 136 and 138 help cushion and constrain movement to avoid damage to either vessel.

WHAT I CLAIM IS:—

1. A coupling of the kind hereinbefore specified, wherein the first coupling unit has a first mounting member, arranged to be fixed upstandingly to a first body and a first coupling means carried by said first mounting member for movement with respect thereto in planes of pitch and yaw and having a first fastening means; and the second coupling unit has a second mounting member, arranged to be fixed to a second body to be articulated to said first body by the coupling; and a substantially horizontally-disposed second coupling means, having a second fastening means for releasable fastening engagement with said first fastening means, the second coupling means being carried by the second mounting member for movement of the second fastening means with respect to the second mounting member in planes of roll and yaw, and the first and second fastening means being adapted to be coupled together for relative movement about a common pivot axis so as to fasten the coupling units together whereby to articulate the said bodies together whilst providing for relative movement between the two fastening means in the plane of pitch.

2. A coupling according to claim 1, wherein said first coupling unit has a generally-cylindrical said first mounting member arranged to be fixed by one of its ends upstandingly to said first body, and said first coupling means comprises a sleeve adapted to fit on the mounting member for rotational movement relative thereto in a plane of yaw and for sliding movement relative to the mounting member in a plane of pitch, the sleeve having said first fastening means for releasable fastened pivotal engagement on a pivot axis with said second fastening means of said second coupling unit.

3. A coupling according to Claim 2, wherein the first fastening means comprises: opposed parallel walls longitudinally arranged externally of the sleeve and spaced transversely apart, each



flange 38 and head 44 and between the plunger 42 and the bore of cylinder 26. The second spring 48 is mounted in compression in the cylindrical space 49 defined by the bore of cylinder 26 between the head flange 44 of plunger 42 and the closed end 40 of cylinder 26. The springs 46 and 48 oppositely bias plunger 42 axially and resiliently, with the stronger spring 46 exceeding in ultimate compression force the sum of the maximum dynamic force to be ordinarily exerted compressively against it and the opposing force of spring 48. Thus the compression force to which spring 46 is subjected should not ordinarily exceed its ultimate compressive strength.

The free end 50 of the plunger 42 is tapered and projects outwardly beyond the flanged end 38 of cylinder 26. The horizontally transverse coupling pin 54 is mounted in the end 50. The shackle or eye 56 is fixed to the plunger 42 for receiving the cable 85 which is used for guiding together the two halves 10 and 12 of the coupling. The plunger 42 is therefore adapted to rotate in the cylinder 26 in the axis of roll, and for limited movement in the direction of the longitudinal axes of the vessels and oppositely as damped by springs 46 and 48.

From the above description it is evident that two objects or two ships are held apart at a distance which varies by not more than the length of the plunger 42 plus the length of projection of cylinder 26 beyond the ship edge, depending upon compression of damping spring 46 by towing or other stresses tending to disengage the coupling. The horizontal unit 10 of the coupling provides freedom of relative motion in the axes of roll and yaw, and very limited movement along the longitudinal axes of the vessels. The vertical unit 12 provides freedom of relative motion in the axes of pitch and yaw. The coupling as a whole, comprising the units 10 and 12 in combination through the pivotal fastening structure 66, 54, 50, whereby the fastening means are pivoted together about the common transverse pivot axis defined by the axis of pin 54, provides additional freedom of relative motion in the axis of pitch. Thus the coupling provides double means for freedom of relative motion in the axes of pitch and yaw and single means in the axis of roll.

Figures 6 to 9 illustrate the mounting of the coupling on a barge and towing vessel. In Figures 6 and 7 a towing vessel 100 is shown drawing a barge 102 toward it by cables 104 and 106 so that coupling units 108 and 110 and coupling units 112 and 114 can be locked together as discussed above, thus articulating the vessels together. Bumpers 116, 118, 120 and 122 protect the

bow and stern of the respective vessels. It will be understood that any number of coupling units as needed can be employed and that such units can be used to couple in articulated relationship a sequence of barges, forming a train, to a towing vessel.

Figures 8 and 9 show how effectively the coupling units move in response to ship movements while maintaining the two ships coupled together. Two pairs of coupling devices 124 and 126 connect a towing ship 128 to a towed barge 130. Bumpers 132, 134, 136 and 138 help cushion and constrain movement to avoid damage to either vessel.

WHAT I CLAIM IS:—

1. A coupling of the kind hereinbefore specified, wherein the first coupling unit has a first mounting member, arranged to be fixed upstandingly to a first body and a first coupling means carried by said first mounting member for movement with respect thereto in planes of pitch and yaw and having a first fastening means; and the second coupling unit has a second mounting member, arranged to be fixed to a second body to be articulated to said first body by the coupling, and a substantially horizontally-disposed second coupling means, having a second fastening means for releasable fastening engagement with said first fastening means, the second coupling means being carried by the second mounting member for movement of the second fastening means with respect to the second mounting member in planes of roll and yaw, and the first and second fastening means being adapted to be coupled together for relative movement about a common pivot axis so as to fasten the coupling units together whereby to articulate the said bodies together whilst providing for relative movement between the two fastening means in the plane of pitch.

2. A coupling according to claim 1, wherein said first coupling unit has a generally-cylindrical said first mounting member arranged to be fixed by one of its ends upstandingly to said first body, and said first coupling means comprises a sleeve adapted to fit on the mounting member for rotational movement relative thereto in a plane of yaw and for sliding movement relative to the mounting member in a plane of pitch, the sleeve having said first fastening means for releasable fastened pivotal engagement on a pivot axis with said second fastening means of said second coupling unit.

3. A coupling according to Claim 2, wherein the first fastening means comprises: opposed parallel walls longitudinally arranged externally of the sleeve and spaced transversely apart, each



of said walls being formed with a respective complementary outwardly-facing transverse coupling slot, whereby said slots can together accommodate a transversely extending elongate member therein; and a fastening member carried by the walls and movable relative thereto between a closed position, such that it can trap in the slots a said elongate member defining a transverse pivot axis with respect to said walls, and an open position such as to allow a said elongate member to be released sideways from the slot.

4. A coupling according to Claim 3, wherein the movable member is a bifurcated lever having outwardly-projecting arms arranged so that, when the lever is in said closed position, the arms can trap a said elongate member in the slots for pivotal movement relative to the slots.

5. A coupling according to Claim 4, wherein the parallel walls carry arm-engaging means for receiving the free ends of the lever arms such that said free ends fit in the arm-engaging means when the lever is in its closed position.

6. A coupling according to Claim 5, wherein said arm-engaging means comprise a pair of aligned transverse channels each formed adjacent a respective one of said slots.

7. A coupling according to any one of Claims 4 to 6, wherein said lever is weighted at or adjacent a free end thereof to bias the lever to its closed position.

8. A coupling according to any one of Claims 3 to 7, wherein the fastening member is pivoted to said parallel walls.

9. A coupling according to any one of Claims 3 to 8, including a reel carried by the sleeve and rotatable relative thereto so that cable means wound on the reel and extending from the first coupling unit can be connected to said second body having said second coupling unit, whereby when the first coupling unit is fixed to said first body, the second body can be drawn by rotation of the reel, towards the first body.

10. A coupling according to any one of the preceding claims, wherein said second coupling unit has a hollow, open-ended said second mounting member adapted to be fixed to said second body and defining a substantially horizontal passage therein which is divergent towards each open end, and said second coupling means extends through said passage and is pivoted in the second mounting member for movement with respect thereto in a plane of yaw, the second coupling means including said second fastening means, for pivotal engagement on a pivot axis with said first fastening means of said first coupling unit, the arrangement being such as to permit relative rotational movement between the

second fastening means and the second mounting member in a plane of roll.

11. A coupling according to Claim 10, wherein the second coupling means includes a cylinder having an open end, and plunger means mounted in the cylinder and having a free end projecting from said open end and carrying the second fastening means, the cylinder extending through said passage and being pivoted in the second mounting member for said movement in the plane of yaw, and the plunger means being arranged for rotatable movement in the cylinder in the plane of roll.

12. A coupling according to Claim 11, wherein the cylinder is pivoted in the second mounting member.

13. A coupling according to Claim 11 or Claim 12, wherein the said second fastening means comprises a longitudinal extension of the free end of the plunger means and is arranged to carry an elongate pivot pin projecting transversely thereof.

14. A coupling according to Claim 13 having said pivot pin projecting transversely from both sides of the said extension.

15. A coupling according to any one of Claims 11 to 14, wherein the free end of the plunger means carries an eye or shackle.

16. A coupling according to Claim 15 wherein said eye or shackle is carried by a tapered portion of said plunger means.

17. A coupling according to any one of Claims 11 to 16, wherein the cylinder is closed at its other end and has plunger support means extending radially inwards at its open end for slidably supporting the plunger means projecting therethrough.

18. A coupling according to Claim 17, wherein the plunger means includes a radially-extending head at its other end for slidably engaging the bore of the cylinder.

19. A coupling according to Claim 18, including damping means for exerting on the plunger opposed resilient axial forces to dampen forces tending to break the coupling, whilst permitting limited longitudinal sliding movement of the plunger means in the cylinder.

20. A coupling according to Claim 19, wherein said damping means comprise springs engaging opposed faces of the head and acting between the head and, respectively, the plunger support means and the closed end of the cylinder.

21. In combination, a coupling according to any one of the preceding claims coupling a first water-going vessel with a second water-going vessel, wherein said first fastening means is in releasable fastening pivotal engagement with said second fastening means about a common pivot axis transverse to the longitudinal axes of the vessels so that each said vessel is articulated to the other but free to undergo pitch, roll



and yaw with respect thereto.

22. In combination according to Claim 21, a first and a second vessel wherein said coupling is as set forth in any one of Claims 3 to 9 in combination with Claim 14, the elongate pivot pin of the second coupling unit being trapped in the slots of the first coupling unit by the fastening member of the first coupling unit, whereby to couple the first and second fastening means together for relative movement about an axis of the pin being a common said transverse pivot axis, whereby to fasten the first and second coupling units together whilst providing for relative movement therebetween in the plane of pitch.

23. A coupling according to Claim 1 wherein said first coupling unit includes a sleeve member having a pair of slotted parallel walls for receiving a pivot pin of said second coupling unit, said first coupling unit being constructed, arranged and adapted to operate substantially as hereinbefore described with reference to Figures 1, 2 and 4 to 9 of the accompanying drawings.

24. A coupling according to Claim 1,

wherein said second coupling unit includes a substantially horizontally-mounted cylinder and being constructed, arranged and adapted for operation in co-operation with said first coupling unit substantially as hereinbefore described with reference to Figures 1 to 3 and 6 to 9 of the accompanying drawings.

25. In combination, a coupling according to Claim 1, a first vessel and a second vessel, said first and second vessels being articulated together in the manner substantially as hereinbefore described with reference to Figures 8 and 9 respectively by a first coupling unit and a second coupling unit which are respectively constructed, arranged and adapted to operate substantially as hereinbefore described with reference to Figures 1, 2 and 4 to 9 and with reference to Figures 1 to 3 and 6 to 9, of the accompanying drawings.

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