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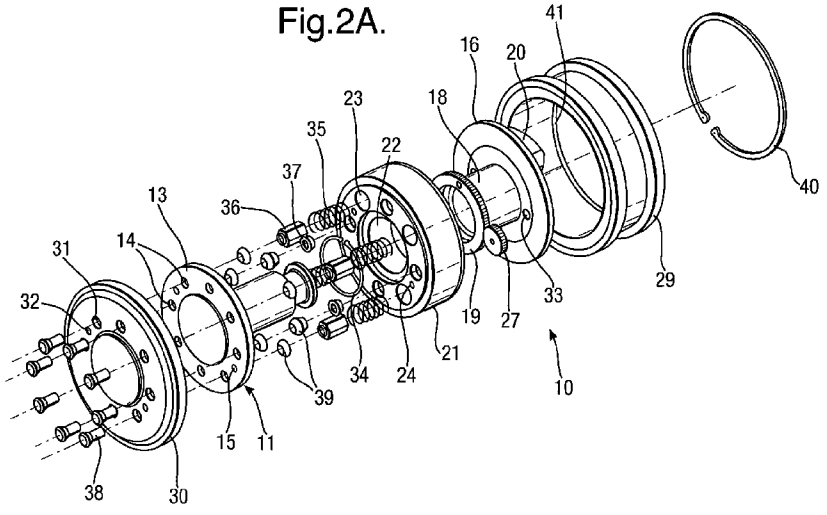
Fig.2A.



(57) **Abstract:** In one embodiment, a kingpin assembly (10) has a kingpin (11) mounted so as to be fixed against rotation relative to a trailer (1). A sensor driver (16) is rotatable relative to the kingpin (11) and is engageable with a fifth wheel of a tractor unit so that when the trailer (1) rotates relative to the tractor unit, the sensor driver (16) rotates relative to the kingpin (11). A rotary sensor (26) is drivable by the sensor driver (16) to output a signal corresponding to the rotation of the sensor driver (16) relative to the kingpin (11). The sensor driver (16) is translatable in a direction generally parallel to the central longitudinal axis of the kingpin (11) between an engaging position and a non- engaging position. In this way, if the kingpin (11) is inserted incorrectly into a fifth wheel of a tractor unit, the sensor driver (16) can move along the length of the kingpin (11) to the non-engaging position so as not to engage with the fifth wheel.

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KINGPIN ASSEMBLY

This application claims the benefit of priority to US application serial no. 60/945721, filed June 22nd, 2007, and US application serial no. 60/991255, filed November 30th, 2007, the contents of which are hereby incorporated by reference.

The present invention relates to a kingpin assembly.

Conventionally, the wheels of a vehicle trailer have typically not been steerable and, instead, have traditionally been fixed in the straight ahead position. However, as is well known, this can make it difficult to steer or otherwise manoeuvre the combination of a vehicle tractor unit and a connected trailer, particularly when tight turns are required. With no steering to the wheels of the trailer, when turning, this often means that the tractor unit drags the trailer, causing the tyres of the trailer to scrub across the road surface or the like. This causes significant wear to the tyres of the trailer as well as generally increasing fuel consumption. There is a growing desire to make the wheels of a trailer steerable, both for environmental reasons and to meet new legislative requirements that arise from environmental concerns in many countries.

A number of arrangements have been proposed to cause the wheels of a trailer axle to steer by an amount that depends on the rotation of the tractor unit relative to the trailer. Some of these arrangements are purely hydraulic displacement systems which operate by displacing hydraulic oil to cylinders, which are provided on one or more of the

trailer axles, so that as the rotation of the tractor unit relative to the trailer increases, the amount of oil displaced to the cylinders correspondingly increases, giving a corresponding amount of steer to the wheels on the steerable trailer axle. However, hydraulic systems tend to be rather heavy and crude and are simplistic in operation.

Electronic systems have also been proposed. For example, in a system proposed by Vehicle Systems Engineering BV (v-s-e) of the Netherlands, a hole is drilled into the top of a kingpin and an electronic rotary sensor is mounted therein. Projecting out from the lower, engagement end of the kingpin (i.e. the end that engages with the so-called fifth wheel of a tractor unit) is a short sheet metal sensor arm that carries a generally C-shape engagement arm. The C-shape engagement arm engages with the tapered guide part of the standard fifth wheel of a tractor unit when the kingpin is locked into the fifth wheel of the tractor unit. Then, as the trailer rotates relative to the tractor unit, the engagement of the C-shape arm with the fifth wheel of the tractor unit causes the rotary sensor to output a signal corresponding to the amount of rotation. However, a number of problems exist with this system. First, the rotary sensor is difficult to access after the kingpin has been fitted to a vehicle trailer. This is because the rotary sensor is mounted into the top of the kingpin and it is a fact that the top of the kingpin is typically often located under a (false) floor of the trailer unit, which means that the floor of the trailer unit has to be removed or opened up in order to allow access to the rotary sensor on the kingpin. Secondly, the relatively large C-shape arm is very prone to damage. It is a simple fact that when connecting a trailer to a

tractor unit, it is often the case that the kingpin is not initially lined up correctly with the guide slot of the fifth wheel on the tractor unit. Accordingly, it is often the case that the downwardly facing end of the kingpin rides up the wedge-like surface at the rear of the fifth wheel on the tractor unit and may then only drop into the correct position in the fifth wheel by entering sideways rather than up through the tapered guide slot of the fifth wheel. Thus, incorrect alignment of the kingpin with the fifth wheel on the tractor unit can easily damage the C-shape sensor arm of this known sensor arrangement, effectively rendering the sensor arrangement useless. Last, this prior art arrangement effectively has a fixed "gear ratio" between the C-shape arm and the rotary sensor which means that this prior art arrangement cannot easily accommodate trailers of different lengths for example.

In other cases, a non-contact rotation sensor may be used, which detects rotation by detecting a change in one or more of inductance, capacitance and resistance as the sensor rotates relative to some fixed part, which may be on the trailer or the tractor unit. As well as suffering from one or more of the problems mentioned above, these non-contact rotation sensors must typically be positioned to be close to the fixed part in order to ensure that a sufficiently strong signal is generated. However, this can be difficult in practice given that many of the parts of a kingpin assembly and the fifth wheel of a tractor unit become damaged and dented over time.

The present invention, in its various aspects, is intended to overcome one or more of the problems identified above.

According to a first aspect of the present invention, there is provided a kingpin assembly for a trailer, the assembly comprising:

a kingpin, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer;

a sensor driver, the sensor driver being rotatable relative to the kingpin about a central longitudinal axis of the kingpin, the sensor driver being engageable with a fifth wheel of a tractor unit so that when a trailer to which the kingpin assembly is in use mounted rotates relative to a tractor unit to which the trailer is in use coupled, the sensor driver rotates relative to the kingpin; and,

a rotary sensor that is drivable by the sensor driver so that in use, when the sensor driver rotates relative to the kingpin, the rotary sensor can output a signal corresponding to the rotation of the sensor driver relative to the kingpin;

the sensor driver being mounted in the assembly so as to be translatable in a direction generally parallel to the central longitudinal axis of the kingpin between an engaging position and a non-engaging position so that if the kingpin is inserted incorrectly into a fifth wheel of a tractor unit, the sensor driver can move along the length of the kingpin to the non-engaging position so as not to engage with a fifth wheel of a said tractor unit.

In this aspect, if the kingpin is inserted incorrectly into a fifth wheel of a tractor unit and instead, as will often be the case, strikes the wedge-like surface at the

rear of the fifth wheel for example, then the sensor driver can in effect retract and move out of harm's way. The integrity of the sensor driver can therefore be preserved even if the kingpin is not inserted correctly into the fifth wheel.

In an embodiment, the kingpin assembly comprises a biasing arrangement that is arranged to bias the sensor driver towards the engaging position at which it will engage with a fifth wheel of a said tractor unit if the kingpin is inserted correctly into a fifth wheel of a tractor unit. In this arrangement, the relaxed condition of the sensor driver is at the engaging position so that, when the kingpin is inserted correctly into the fifth wheel, the sensor driver is already at the correct, engaging position for engagement with the fifth wheel.

In an embodiment, the kingpin assembly comprises a switch that is operable to output a control signal that is dependent on whether the sensor driver is in the engaging position or the non-engaging position. In this arrangement, the switch preferably operates so that steering control to the steered trailer wheels is not effected if the sensor driver is not in the engaging position. This provides an important fail-safe in that if the sensor driver is not in the engaging position, then clearly it cannot operate the rotary sensor properly. In this case, the switch may cause output from the rotary sensor to be ceased (or not started, as the case may be) and/or may otherwise cause the steered trailer wheels to be locked in the straight ahead orientation. If for example the kingpin is located correctly in the fifth wheel such that the sensor driver moves into its engaging position,

then the switch may operate to allow the rotary sensor to output control signals and/or otherwise allow the steered trailer wheels to be steered accordingly.

In an embodiment, the sensor driver carries an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit. The engagement block may have tapered sides to correspond to the tapered sides of the guide slot conventionally provided on a fifth wheel. The engagement block moves with the sensor driver as the sensor drives moves to the non-engaging or to the engaging position as described above, and therefore also moves out of harm's way if the kingpin is not inserted correctly into the fifth wheel.

In an embodiment, the sensor driver carries a spur gear, the spur gear being fixed against rotation relative to the sensor driver, and a rotary sensor drive gear, the rotary sensor drive gear being rotatable relative to the sensor driver and being drivingly connected to the rotary sensor and engaged with the spur gear, whereby as the sensor driver and spur gear rotate, the rotary sensor drive gear is driven to operate the rotary sensor. By using a spur gear on the sensor driver to drive the rotary sensor via the rotary sensor drive gear, the operable parts of the sensor can in effect be contained within the kingpin assembly and therefore not exposed to possible damage if the kingpin or the kingpin assembly as a whole strikes another object, such as the wedge surface at the rear of a tractor unit fifth wheel.

In an embodiment, the kingpin assembly comprises a bush through which the kingpin passes and that is fixed

against rotation relative to the kingpin, the rotary sensor being mounted in the bush so as to be fixed relative thereto. The bush provides a simple yet secure way of fixing the rotary sensor in the kingpin assembly. The bush may also provide some support to the sides of the kingpin, thus effectively strengthening the kingpin.

In an embodiment, the bush is translatable in a direction generally parallel to the central longitudinal axis of the kingpin so that if the sensor driver moves along the length of the kingpin, the bush moves correspondingly along the length of the kingpin. In an embodiment, the kingpin has an engagement end for engagement with the fifth wheel of a tractor unit and an outwardly extending flange at the other end, the kingpin assembly comprising one or more compression springs between the outwardly extending flange of the kingpin and the bush and arranged to bias the bush and the sensor driver towards the engaging position at which the sensor driver will engage with a fifth wheel of a said tractor unit if the kingpin is inserted correctly into a fifth wheel of a tractor unit.

In an embodiment, the kingpin assembly comprises an outer sleeve that can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the sensor driver being contained within the outer sleeve so as to be rotatable therein, and a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into a part of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve. The outer sleeve in this embodiment can be used effectively to house and protect the

sensor driver and rotary sensor and, where provided, the bush and gears described above. The top plate is used to fix the kingpin against rotation and can be used to close off one end of the outer sleeve.

In an embodiment, the kingpin has an engagement end for engagement with the fifth wheel of a tractor unit and an outwardly extending flange at the other end, the kingpin assembly comprising:

an outer sleeve which can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the sensor driver being contained within the outer sleeve so as to be rotatable therein;

a bush through which the kingpin passes, the rotary sensor being mounted in the bush so as to be fixed relative thereto, the bush being translatable in a direction generally parallel to the central longitudinal axis of the kingpin so that if the sensor driver moves along the length of the kingpin, the bush moves correspondingly along the length of the kingpin;

one or more compression springs between the outwardly extending flange of the kingpin and the bush and arranged to bias the bush and the sensor driver towards the engaging position at which the sensor driver will engage with a fifth wheel of a said tractor unit if the kingpin is inserted correctly into a fifth wheel of a tractor unit; and,

a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into the outwardly extending flange of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve, said bolt or the like passing

into the bush to fix the bush against rotation relative to the top plate and outer sleeve.

According to a second aspect of the present invention, there is provided a kingpin assembly for a trailer, the assembly comprising:

a kingpin, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer, the kingpin having an engagement end for engagement with the fifth wheel of a tractor unit; and,

a rotation sensor for sensing rotation of the kingpin relative to a tractor unit when the kingpin assembly is fixedly mounted to a said trailer and said trailer is connected to a said tractor unit;

the rotation sensor being mounted in the assembly so as to be translatable in a direction generally parallel to the central longitudinal axis of the kingpin between a first position near the engagement end of the kingpin and a second position remote from the engagement end of the kingpin.

In one embodiment of this aspect, as for the first aspect described above, if the kingpin is inserted incorrectly into a fifth wheel of a tractor unit and instead, as will often be the case, strikes the wedge-like surface at the rear of the fifth wheel for example, then the rotation sensor can in effect retract and move out of harm's way. The integrity of the rotation sensor can therefore be preserved even if the kingpin is not inserted correctly into the fifth wheel. In another embodiment, the separation between the rotation sensor and the moving part, the rotation of which is sensed by the rotation sensor, can

be fixed, which facilitates calibration and proper functioning of the rotation sensor.

The kingpin assembly may comprise a biasing arrangement that is arranged to bias the rotation sensor towards the first position. This allows the rotation sensor to be biased to an appropriate position so that it can properly detect rotation. In effect, the rotation sensor can move up to move over ridges or the like on the fifth wheel of a tractor unit as the kingpin is inserted into the fifth wheel and then be moved down into the correct or appropriate position for detecting rotation.

The kingpin assembly may comprise a bush through which the kingpin passes and that is fixed against rotation relative to the kingpin, the bush being translatable in a direction generally parallel to the central longitudinal axis of the kingpin, the rotation sensor being mounted to the bush so as to be fixed relative thereto. The bush provides a simple yet secure way of fixing the rotation sensor in the kingpin assembly. The bush may also provide some support to the sides of the kingpin, thus effectively strengthening the kingpin.

The kingpin may have an outwardly extending flange at the end opposite the engagement end, the assembly comprising one or more compression springs between the outwardly extending flange of the kingpin and the bush and arranged to bias the bush and the rotation sensor towards the first position.

In an embodiment, the rotation sensor is mounted to the bush via a mounting plate that is removably connected

to the bush and that is fixed against rotation relative to the bush. This allows the same bush and some other parts to be used in various different examples of the kingpin assembly and thus keeps down the number of different parts that need to be manufactured and stocked for the different examples. It also makes it relatively straightforward to swap out the sensor parts of one example for the sensor parts of a different example, as explained further below.

In an embodiment, the rotation sensor is a non-contact rotation sensor which is mounted in a recess in the bush, the assembly comprising a locating plate that covers the rotation sensor in the recess in the bush, the locating plate having an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit. In this embodiment, the locating plate serves to protect the rotation sensor as the rotation sensor can in effect be contained entirely within the assembly and therefore not exposed to the elements or damage by striking other components.

In an embodiment, the locating plate has a through hole at a fixed position relative to the engagement block, whereby rotation of the engagement block causes the locating plate and the through hole to rotate relative to the rotation sensor such that the rotation sensor can detect relative rotation between the engagement block and the kingpin. In this embodiment, there is in effect a gap of substantially fixed size between the rotation sensor and the part the movement of which is detected. This makes it very much easier to install and calibrate the whole assembly and means that the measurements of rotation that are obtained in practice are much more reliable.

In another embodiment, the rotation sensor is a contact rotation sensor which is mounted to a face of the bush, the assembly comprising a locating plate that covers the rotation sensor on the bush, the locating plate having an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit. The contact sensor of this embodiment is of the "touch screen" type that operates by providing an output signal representative of where on the sensor pressure is applied which, in turn, can be used to provide a signal representative of the amount of rotation of a vehicle trailer relative to a tractor unit.

The kingpin assembly may comprise a stylus which is fixed against rotation relative to the engagement block and which engages with the contact rotation sensor such that the contact rotation sensor can detect relative rotation between the engagement block and the kingpin.

The kingpin assembly may comprise an outer sleeve that can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the rotation sensor being contained within the outer sleeve at least when at the second position, and a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into a part of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve. The outer sleeve in this embodiment can be used effectively to house and protect various operative parts of the assembly. The top plate is used to fix the kingpin against rotation and can be used to close off one end of the outer sleeve.

The kingpin assembly may comprise a switch that is operable to output a control signal that is dependent on whether or not the rotation sensor is at the first position. As above, the switch preferably operates so that steering control to the steered trailer wheels is not effected if the rotation sensor is not in the appropriate position to detect rotation of the trailer relative to the tractor unit correctly.

According to a third aspect of the present invention, there is provided a kingpin assembly for a trailer, the assembly comprising:

a kingpin having an engagement end for engagement with the fifth wheel of a tractor unit, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer;

a sensor driver, the sensor driver being rotatable relative to the kingpin about a central longitudinal axis of the kingpin, the sensor driver being engageable with a fifth wheel of a tractor unit so that when a trailer to which the kingpin assembly is in use mounted rotates relative to a tractor unit to which the trailer is in use coupled, the sensor driver rotates relative to the kingpin;

a rotary sensor that is drivable by the sensor driver so that in use, when the sensor driver rotates relative to the kingpin, the rotary sensor can output a signal corresponding to the rotation of the sensor driver relative to the kingpin; and,

an outer sleeve that can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the sensor driver being contained within the outer sleeve so as to be rotatable therein;

wherein the sensor driver can be removed from the kingpin assembly by accessing the outer sleeve from the engagement end of the kingpin.

In this aspect, maintenance of the kingpin assembly, e.g. to remove and replace the rotary sensor, can be very straightforward because the sensor driver can be removed "from underneath", i.e. from under the vehicle trailer to which the kingpin assembly is in use fixed. This avoids having to access the kingpin assembly from above, i.e. at the end of the kingpin remote from the engagement end that in use locks into the fifth wheel, which avoids having to lift the (false) floor or to provide access panels in the (false) floor that is often provided in a trailer.

In an embodiment, the sensor driver carries an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit. The engagement block may have tapered sides to correspond to the tapered sides of the guide slot conventionally provided on a fifth wheel.

In an embodiment, the sensor driver carries a spur gear, the spur gear being fixed against rotation relative to the sensor driver, and a rotary sensor drive gear, the rotary sensor drive gear being rotatable relative to the sensor driver and being drivingly connected to the rotary sensor and engaged with the spur gear, whereby as the sensor driver and spur gear rotate, the rotary sensor drive gear is driven to operate the rotary sensor. By using a spur gear on the sensor driver to drive the rotary sensor via the rotary sensor drive gear, the operable parts of the sensor can in effect be contained within the kingpin assembly and therefore not exposed to possible damage if

the kingpin or the kingpin assembly as a whole strikes another object, such as the wedge surface at the rear of a tractor unit fifth wheel.

In an embodiment, the kingpin assembly comprises a bush through which the kingpin passes and that is fixed against rotation relative to the kingpin, the rotary sensor being mounted in the bush so as to be fixed relative thereto. The bush provides a simple yet secure way of fixing the rotary sensor in the kingpin assembly. The bush may also provide some support to the sides of the kingpin, thus effectively strengthening the kingpin.

In an embodiment, the kingpin assembly comprises a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into a part of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve, said bolt or the like passing into the bush to fix the bush against rotation relative to the top plate and outer sleeve. The top plate is used to fix the kingpin against rotation and can be used to close off one end of the outer sleeve.

According to a fourth aspect of the present invention, there is provided a kingpin assembly for a trailer, the assembly comprising:

a kingpin, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer;

a sensor driver, the sensor driver being rotatable relative to the kingpin about a central longitudinal axis

of the kingpin, the sensor driver being engageable with a fifth wheel of a tractor unit so that when a trailer to which the kingpin assembly is in use mounted rotates relative to a tractor unit to which the trailer is in use coupled, the sensor driver rotates relative to the kingpin, the sensor driver carrying a spur gear which is fixed against rotation relative to the sensor driver; and,

a rotary sensor having a rotary sensor drive gear which is rotatable relative to the sensor driver and engaged with the spur gear, whereby as the sensor driver and spur gear rotate, the rotary sensor drive gear is driven to operate the rotary sensor so that in use, when the sensor driver rotates relative to the kingpin, the rotary sensor can output a signal corresponding to the rotation of the sensor driver relative to the kingpin.

In this aspect, because the sensor driver and the rotary sensor are geared together, the gear ratio between the sensor driver and the rotary sensor can easily be altered by changing one or both of the spur gear and the rotary sensor drive gear with a different gear having a different number of teeth. In this way, the effective sensitivity of the assembly to the amount of rotation of the tractor unit to the trailer can easily be adjusted. This makes it easier to adapt the assembly to trailers of different length. It will be understood that for example a relatively short trailer can be turned more quickly than a relatively long trailer so it is desirable for the steered wheels of trailer to turn more quickly for the same amount of relative rotation between the tractor unit and the trailer than for a long trailer.

In an embodiment, the sensor driver carries an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit.

In an embodiment, the assembly comprises a bush through which the kingpin passes and that is fixed against rotation relative to the kingpin, the rotary sensor being mounted in the bush so as to be fixed relative thereto.

In an embodiment, the assembly comprises an outer sleeve that can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the sensor driver being contained within the outer sleeve so as to be rotatable therein, and a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into a part of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve.

According to a fifth aspect of the present invention, there is provided a kingpin assembly for a trailer, the assembly comprising:

a kingpin, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer, the kingpin having an engagement end for engagement with the fifth wheel of a tractor unit; and,

a contact rotation sensor and a stylus for pressing against the contact rotation sensor to enable sensing of rotation of the kingpin relative to a tractor unit when the kingpin assembly is fixedly mounted to a said trailer and said trailer is connected to a said tractor unit.

The contact sensor of this embodiment is of the "touch screen" type that operates by providing an output signal representative of where on the sensor pressure is applied which, in turn, can be used to provide a signal representative of the amount of rotation of a vehicle trailer relative to a tractor unit.

In an embodiment, the stylus is translatable back and forth relative to the contact rotation sensor so that the pressure with which the stylus presses against the contact rotation sensor can be adjusted. This can be achieved for example by use of a screw as the stylus which can be screwed in and out as required.

In an embodiment, the contact rotation sensor is mounted to a face of a bush through which the kingpin passes and that is fixed against rotation relative to the kingpin, the assembly comprising a locating plate that covers the contact rotation sensor on the bush, the locating plate having an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 shows schematically a perspective view of the main parts of a vehicle trailer;

Figs. 2A and 2B respectively show exploded side and perspective views of examples of a kingpin assembly according to an embodiment of the present invention;

Figs. 3A to 3E respectively show a first end view, a side view, a second end view, a perspective view and a lateral cross-section through the kingpin assembly of Figure 2 in a first configuration;

Fig. 4 shows a perspective view of the kingpin assembly of Figures 2 and 3 in a second configuration;

Figs. 5 and 6A to 6C show a schematic cross-section through a part of and various perspective and elevations of a second example of a kingpin assembly according to an embodiment of the present invention;

Figs. 7A, 7B and 8 show exploded perspective views and a schematic cross-section through a part of a third example of a kingpin assembly according to an embodiment of the present invention; and,

Figures 9A, 9B, 10 and 11 show exploded perspective views and a schematic cross-section through a part of a fourth example of a kingpin assembly according to an embodiment of the present invention.

Referring to the drawings, first Figure 1 shows schematically the main parts of a vehicle trailer 1. In the example shown, the trailer 1 has three axles 2,3,4. The front axle 2 is a fixed axle, i.e. the wheels 5 on this axle 2 are fixed in the straight ahead position. The mid and rear axles 3,4 are steerable, i.e. their wheels 6 can be steered. Hydraulic rams 7 are provided on the steered axles 3,4 to effect the steer of the steered wheels 6. The hydraulic rams 7 are driven in a manner known per se by respective oil supply systems 8. A coupler plate 9 is

provided at the front of the trailer 1. A kingpin assembly 10 is mounted to the coupler plate 9, for example by bolting or, more preferably, by welding the kingpin assembly 10 to the coupler plate 9.

Referring then to Figures 2 to 4, there is shown an example of a kingpin assembly 10 according to an embodiment of the present invention.

The kingpin assembly 10 includes a kingpin 11, which may be made of steel or the like. The kingpin 11 has an engagement end 12 which in use projects downwardly from the coupler plate 9 on the trailer 1 and in use engages with and is locked into the parallel-sided locking portion of the slot of a so-called fifth wheel provided on a tractor unit (not shown). At the opposite end of the kingpin 11 is a radially outwardly projecting flange 13 which, in this example, has eight bolt holes 14 and two further holes 15 therethrough.

The kingpin assembly 10 further includes a generally plate-like sensor driver 16, which may be made of steel or the like. The sensor driver 16 has a central through hole 17 which has a diameter that is just larger than the maximum diameter of the stem of the kingpin 11 so that the stem of the kingpin 11 can pass through the through hole 17 in the sensor driver plate 16. The sensor driver plate 16 has an axial stem tube 18 around the periphery of the through hole 17 and extending from one side of the plate-like portion. The sensor driver plate 16 furthermore has a large spur gear 19 fixed to the plate-like portion, for example by welding and/or by screws, around the base of the stem tube 18. The large spur gear 19 is therefore fixed

against rotation relative to the sensor driver plate 16, i.e. the large spur gear 19 rotates with the sensor driver plate 16. On the opposite side of the plate-like portion of the sensor driver plate 16 is fixed, for example by welding, an engagement block 20. The engagement block 20 has parallel sides which in use engage snugly with the parallel sides of the locking portion of the guide slot of a fifth wheel on a tractor unit (which is of standard dimensions).

The kingpin assembly 10 further includes a hollow cylindrical bush 21, which may be made of nylon for example. The bush 21 has a central through hole 22 which is sized to receive the stem tube 18 of the sensor driver plate 16 so that the bush 22 can fit snugly over the stem tube 18 of the sensor driver plate 16. The bush 21 has a number of blind recesses 23 in its face that in use faces the flange 13 of the kingpin 11 and that correspond in position to the first set of through holes 14 in the flange 13 of the kingpin 11. The bush 21 furthermore has two through holes 24 which correspond to the second set of through holes 15 in the flange 13 of the kingpin 11. On the opposite face of the bush 21 are provided two relatively large blind recesses 25. In the assembled kingpin assembly 10, each of these large recesses 25 has an electronic rotary sensor 26 mounted therein and fixed against rotation relative to the bush 21 for example by a grub screw. Whilst one rotary sensor 26 is sufficient, it is preferred to provide at least two and possibly more rotary sensors 26 for redundancy in case one rotary sensor 26 fails in operation. A respective drive gear 27 is connected to a pinion 28 on each of the rotary sensors 26 and fixed thereto for example by a respective grub screw

which engages a flat on the pinion 28. Each drive gear 27 engages in the assembled kingpin assembly 10 with the spur gear 19 on the sensor driver plate 16.

The kingpin assembly 10 further includes a hollow generally cylindrical outer sleeve 29, which may be made of steel or the like. The central through hole of the outer sleeve 29 is just large enough to snugly receive the bush 21. The kingpin assembly 10 further includes a top plate 30, which may be made of steel or the like. The top plate 30 has plural through holes 31 corresponding to the first set of through holes 14 in the flange 13 of the kingpin 11 and two further through holes 32 which correspond to the two further through holes 15 in the flange 13 of the kingpin 11.

To assemble the kingpin assembly 10, first the or each rotary sensor 26 is mounted into the respective large blind recesses 25 in the bush 21. The bush 21 is then slid over the stem tube 18 on the sensor driver plate 16. Here, it is important to ensure that the rotary sensors 26 are located at the correct angular position relative to the engagement block 20 on the sensor driver plate 16 given that it is the angular movement of the engagement block 20 relative to the kingpin 11 that is effectively detected by the rotary sensors 26 in order ultimately to effect correct steering of the steered axles 7 on the trailer 1. To help achieve this, the sensor driver plate 16 has two small through holes 33 through which the engagement between the large spur gear 19 and the respective sensor drive gears 27 can be seen. The appropriate teeth on the large spur gear 19 and sensor drive gears 27 can be visibly marked, for example by a dot of paint. The person assembling the

kingpin assembly 10 therefore only has to look through the sight holes 33 and line up the dots or other marks on the respective gears 19,27 to know that the correct angular orientation between the respective gears 19,27 has been achieved. A small circlip 34 is then fitted into a groove 18' provided in the outer periphery of the stem tube 18 at the free end opposite the plate-like end of the sensor driver plate 16. The small circlip 34 overlies slightly the adjacent end face of the bush 21 and thus holds the bush 21 and the sensor driving plate 16 together.

Then, the engagement end 12 of the kingpin 11 needs to be passed into the stem tube 18 of the sensor driver plate 16. First, however, for reasons which will be explained further below, a biasing arrangement is provided between the bush 21 and the flange 13 of the kingpin 11. In this example, four compression springs 35 are located in respective ones of the blind recesses 23 in the bush 21. A respective tube nut 36 is fitted into each spring 35. Also, a respective nut 37 is placed in each of the other blind recesses 23 in the same face of the bush 21.

Once the springs 35, tube nuts 36 and short nuts 37 are in position in the bush 21, the kingpin 11 is pushed into the bush 21 and the stem tube 18 of the sensor driver plate 16. The top plate 30 is then offered up to the flange 13 of the kingpin 11. Respective bolts 38 are then passed through each of the first set of plural through holes 31 in the top plate 30 and then through the corresponding holes 14 of the first set of through holes in the flange 13 of the kingpin 11. The bolts 38 then pass into either the tube nuts 36 or the short nuts 37 in the bush 21 and the bolts 38 then tightened. The bolts 38

therefore prevent relative rotation between the bush 21, the kingpin 11 and the top plate 30 such that these are all fixed against rotation with respect to each other. In the example shown, convex spring washers 39 are provided between the flange 13 of the kingpin 11 and the adjacent ends of the tube nuts 36 and short nuts 37.

The rotary sensors 26 have electrical wires (not shown in Figures 2 to 4) extending therefrom. When assembling the kingpin assembly 10, these electrical wires are threaded first through the small through holes 24 in the bush 21 and then through the similar small through holes 15 in the flange 13 of the kingpin 11 and finally out through the similar small through holes 32 in the top plate 30. It is therefore important to line up each of these small through holes 24,15,32 during assembly of the kingpin assembly 10, which is easily achieved by eye. Each of the small through holes 15,32 in the flange 13 of the kingpin 11 and the top plate 30 may be lined with a small nylon or similar bush in order to reduce the sliding friction arising on contact with the electrical wires as the bush 21 moves up and down relative to the kingpin 11 and the top plate 30 as discussed below.

The final step in the assembly of the kingpin assembly 10 is to slide the outer sleeve 29 over the sensor driver plate 16 and the bush 21. The top plate 30 is then fixed to the sleeve 29, for example by welding the top plate 30 to the sleeve 29 or by some other suitable fixing method. Then, to hold the sensor driver plate 16 and the bush 21 (which are held together by the small circlip 34) in the sleeve 29, a large circlip 40 is fitted into a groove 41 provided in the outwardly facing end of the sleeve 29.

Typically, the compression springs 35 will have to be compressed slightly in order to achieve this, which provides a desired amount of residual bias in the kingpin assembly 10.

The assembled kingpin assembly 10 is then fixed to the coupler plate 9 of the trailer 1. (The position of the coupler plate 9 is shown in Figure 3B in which, bearing in mind that the engagement end 12 of the kingpin 11 faces downwardly, "downwards" is to the left.) This may be achieved by welding the adjacent face of the sleeve 29 to the coupler plate 9 on the trailer 1 and/or by use of bolts.

In normal operation, when the trailer 1 is being correctly coupled to a tractor unit (not shown), the engagement end 12 of the kingpin 11 enters the tapered entry part of the guide slot of the fifth wheel on the tractor unit and is guided into the parallel-sided locking part of the fifth wheel. A locking mechanism is typically provided in the fifth wheel to lock the kingpin 11 in position so that the trailer 1 can then be safely towed. As the kingpin 11 moves up the guide slot in the fifth wheel, the engagement block 20 naturally falls into the correct position in the guide slot in the fifth wheel.

At this point, it is to be remembered that the sensor driver plate 16 is fixed against rotation relative to the tractor unit because the engagement block 20 snugly engages the guide slot of the fifth wheel on the tractor unit. On the other hand, the kingpin 11 is fixed against rotation relative to the trailer 1 because the kingpin 11 is fixed against rotation relative to the top plate 30 by the bolts

38 and by virtue of the top plate 30 being fixed to the sleeve 29 which in turn is fixed to the coupler plate 9 of the trailer 1. Thus, as the tractor unit turns relative to the trailer 1 during steering of the articulated vehicle, the sensor driver plate 16 rotates correspondingly relative to the kingpin 11. This turning of the sensor driver plate 16 carries with it the large spur gear 19, which therefore correspondingly rotates the small gears 27 which in turn drive the pinions of the rotary sensors 26. Accordingly, the amount of steer of the tractor unit relative to the trailer 1 is effectively measured by the rotary sensors 26, which can output a corresponding output signal to electronics (not shown) that is then used to drive the hydraulic rams 7 on the steered axles 3,4 of the trailer 1.

Now, as in practice is often the case, if the kingpin 11 does not enter the guide slot of the fifth wheel correctly when the trailer 1 is being coupled to the tractor unit, then a number of outcomes are possible. If the kingpin 11 is only just out of alignment, it may be that the engagement block 20 will nevertheless strike the tapered sides of the guide slot of the fifth wheel, which will tend to draw the kingpin 11 into the correct position in the fifth wheel. Otherwise, if the kingpin 11 is not sufficiently close to the guide slot of the fifth wheel, then it can happen that the engagement block 20 strikes the main body part of the fifth wheel (which is typically a wedge-like surface that faces rearwardly of the fifth wheel). In that case, the sensor driver plate 16 and bush 21 can retract into the sleeve 29, the springs 35 compressing in order to allow this movement. Accordingly, if the kingpin 11 is seriously out of alignment with the fifth wheel on the tractor unit, the sensor driver plate 16

and attached engagement block 20 effectively move out of harm's way by retracting into the sleeve 29 and therefore damage to the engagement block 20 and sensor driver plate 16 is avoided. If, as again is often the case in practice, the kingpin 11 then drops sideways into the locking portion of the fifth wheel, the springs 35 push the bush 21 and sensor driver plate 16 in a direction outwardly of the sleeve 29 so that the engagement block 20 can drop into position in the slot in the fifth wheel.

It may happen that the kingpin 11 becomes locked into the correct position in the fifth wheel of the tractor unit but the engagement block 20 is not located correctly or at all in the slot in the fifth wheel. If this happens, it is preferred to effectively disable the steering system so that the steered wheels 6 of the steered trailer axles 3,4 are not steered because it may be considered that the readings from the rotary sensor 26 are not a sufficiently accurate indicator of the actual amount of steer of the tractor unit relative to the trailer 1. (In practice, in this mode, the hydraulic rams 7 are operated to lock the steered wheels 6 in the straight ahead position.) A number of ways to achieve this are possible. In one preferred arrangement, a proximity sensor (not shown) in the form of a switch or the like is provided in the kingpin assembly 10, for example between the bush 21 and the flange 13 of the kingpin 11. This proximity sensor detects when the bush 21 has moved up towards the flange 13 of the kingpin 11, which indicates that the engagement block 20 has not engaged and cannot engage with the guide slot of the fifth wheel on the tractor unit and that therefore steering of the steered axles 3,4 of the trailer 1 should be disabled.

It will be seen that most of the main operable parts of the kingpin assembly 10 are safely housed within the sleeve 29, reducing the risk of damage to these parts in use. Moreover, because the sensor driver plate 16 and engagement block 20 can retract into the sleeve 29 if the kingpin 11 is not correctly aligned with the fifth wheel, damage to the part (i.e. the engagement block 20) that ultimately operates the rotary sensors 26 is avoided.

Moreover, if for example the or each rotary sensor 26 fails, it can easily and quickly be replaced. In particular, by accessing the kingpin assembly 10 from underneath the coupler plate 9, the large circlip 40 can be removed, which allows the connected sensor driver plate 16 and bush 21 to be removed from the sleeve 29. The small circlip 34 can then be removed from the top of the stem tube 18 of the sensor driver plate 16, which allows the bush 21 to be slid off the stem tube 18 of the sensor driver plate 16. The or each rotary sensor 26 can then be replaced and the kingpin assembly 10 re-assembled. As mentioned, this maintenance can be carried out in situ from under the trailer coupler plate 9 and does not for example require access to the kingpin assembly 10 from above, which can be difficult given that this is often hidden under a false floor of the trailer 1.

As mentioned above, each of the through holes 15,32 in the flange 13 of the kingpin 11 and the top plate 30 may be lined with a small nylon or similar bush which reduces the frictional contact with the electrical wires that pass from the rotary sensors 26 through these through holes 15,32. Another desirable feature is to provide small drain holes (not shown) in the cylindrical wall of the sleeve 29 so as

to allow water to drain out if water enters the kingpin assembly 10.

Referring now to Figs. 5 and 6A to 6C, there is shown a part of a second example of a kingpin assembly 10 according to an embodiment of the present invention. For this second example, not all parts that are the same or substantially the same as for the first example are shown and will not be further described here.

In this example, a non-contact rotation sensor 50 is used in place of the mechanically driven rotary sensor(s) 26 of the first example. This particular example of rotation sensor 50 is annular and may detect rotation of the trailer 1 relative to the tractor unit to which the trailer 1 is connected by any known non-contact method, such as by detecting a change in one or more of inductance, capacitance and resistance as the rotation sensor 50 rotates relative to the fifth wheel of the tractor unit. Here it is recalled that the fifth wheel of the tractor unit has a tapered entry part to the guide slot through which the kingpin 11 passes into the parallel-sided locking part of the fifth wheel. The non-contact rotation sensor 50 may operate by detecting change in one or more of inductance, capacitance and resistance as the rotation sensor 50 rotates over the guide slot or other open part of the fifth wheel.

Compared to the first example of a kingpin assembly 10 described above, in this second example, there is no sensor driver plate 16 as such, no spur gear 19, and no rotary sensor(s) 26 or associated drive gear(s) 27. Instead, in this example, the non-contact rotation sensor 50 is mounted

in a sensor mounting plate 51, which may be made of steel or the like and which in some respects is similar in construction to the sensor driver plate 16 of the first example. The sensor mounting plate 51 has a central through hole 52 which has a diameter that is just larger than the maximum diameter of the stem of the kingpin 11 so that the stem of the kingpin 11 can pass through the through hole 52. The sensor mounting plate 51 has an axial stem tube 53 around the periphery of the through hole 52 and extending from one side of the plate-like portion. On the other side of the plate-like portion is an annular groove 54 in which the annular sensor 50 is fixed, such as by one or more of interference fit, screws and adhesive. A sloped surface 55 surrounds the annular groove 54. A short blind recess 56 is provided on the first side of the plate-like portion of the sensor mounting plate 51 to receive a corresponding peg or dowel 57.

Assembly of this second example of the kingpin assembly 10 is similar to that of the first example. The bush 21 is slid over the stem tube 53 on the sensor mounting plate 51. At this point in the assembly, the dowel 57 is positioned in the recess 56 in the sensor mounting plate 51. The dowel 57 is also received in one of the large blind recesses 25 in the bush 21 (which received the rotary sensors 26 of the first example described above). This fixes the sensor mounting plate 51 against rotation relative to the bush 21 and, therefore, against rotation relative to the rest of the kingpin assembly 10.

The small circlip 34 is then fitted into the groove 53' provided in the outer periphery of the stem tube 53 at the free end opposite the plate-like end of the sensor

mounting plate 51. The small circlip 34 overlies slightly the adjacent end face of the bush 21 and thus holds the bush 21 and the sensor mounting plate 51 together. The springs 35, tube nuts 36, nuts 37, spring washers 39 are put in position in the bush 21 and the kingpin 11 is pushed into the bush 21 and the stem tube 53 of the sensor mounting plate 51. The top plate 30 is then offered up to the flange 13 of the kingpin 11. The bolts 38 are then passed through each of the first set of plural through holes 31 in the top plate 30 and then through the corresponding holes 14 of the first set of through holes in the flange 13 of the kingpin 11. The bolts 38 then pass into either the tube nuts 36 or the short nuts 37 in the bush 21 and the bolts 38 then tightened. The bolts 38 prevent relative rotation between the bush 21, the kingpin 11 and the top plate 30 such that these are all fixed against rotation with respect to each other.

Finally, the outer sleeve 29 is slid over the sensor mounting plate 51 and the bush 21. The top plate 30 is then fixed to the sleeve 29, for example by welding the top plate 30 to the sleeve 29 or by some other suitable fixing method. Then, to hold the sensor mounting plate 51 and the bush 21 (which are held together by the small circlip 34) in the sleeve 29, a large circlip 40 is fitted into a groove 41 provided in the outwardly facing end of the sleeve 29. Typically, the compression springs 35 will have to be compressed slightly in order to achieve this, which provides a desired amount of residual bias in the kingpin assembly 10. The assembled kingpin assembly 10 is then fixed to the coupler plate 9 of the trailer 1.

Similarly as for the first example, if the kingpin 11 does not enter the fifth wheel on the tractor unit correctly, the sensor mounting plate 51 can retract into the outer sleeve 29 so as to be protected against damage and particularly to protect the rotation sensor 50 against damage. The sloped surface 55 around the rotation sensor 50 assists this retraction.

More significantly for this example however, the compression springs 35 tend to bias the rotation sensor 50 towards the fifth wheel on the tractor unit. Given that the rotation sensor 50 is a non-contact sensor and therefore relies on measuring a change in for example inductance, capacitance and resistance as the rotation sensor 50 rotates relative to the fifth wheel of the tractor unit, it is important that the rotation sensor 50 be close to the fifth wheel of the tractor unit. This is facilitated by the bias that tends to push the rotation sensor 50 towards the fifth wheel. Thus, the retractable bush 21, etc. not only protects the rotation sensor 50 but also tends to bias it to the correct position (height) relative to the fifth wheel of the tractor unit.

In addition, similarly to the first example, this arrangement allows the rotation sensor 50 to be maintained and replaced as necessary from "underneath", i.e. from the engagement end of the kingpin 11. This allows maintenance to be carried out with assembly 10 in situ on the trailer 1 and without having to obtain access through the floor of the trailer 1.

As in the first example, a proximity sensor (not shown) in the form of a switch or the like is preferably

provided in the kingpin assembly 10, for example between the bush 21 and the flange 13 of the kingpin 11. This proximity sensor detects when the bush 21 has moved up towards the flange 13 of the kingpin 11 and can be used to disable steering of the steered axles 3,4 of the trailer 1.

It will be understood that in this example, the rotation sensor 50 is fitted to the bush 21 via the sensor mounting plate 51 principally in order to permit the same bush 21 to be used in this example and in the first example. This aids manufacture and stocking of the components and thus keeps down costs. It also means that if for example a kingpin assembly 10 of the first example is fitted to a trailer 1 but it is desired to change the mechanically operated rotary sensor 26 and gears 19,27 to the non-contact sensor 50 of the second example, this can easily be done, in situ, by taking out the sensor driver plate 16, gears 19,27 and rotary sensor 26 and replacing them with the non-contact sensor 50 and sensor mounting plate 51, etc. of the second example. The opposite also applies so that the second example can easily be converted to the first example. It will nevertheless be understood that if this versatility is not required, then it is possible to do away with the sensor mounting plate 51 and dowel 57 of the second example and to use instead a modified bush 21 that can receive the non-contact sensor 50 directly.

Referring now to Figures 7A, 7B and 8, there is shown a part of a third example of a kingpin assembly 10 according to an embodiment of the present invention. For this third example, not all parts that are the same or

substantially the same as for the first and second examples are shown and will not be further described here.

In this third example, again a non-contact rotation sensor 50 is used in place of the mechanically driven rotary sensor(s) 26 of the first example. This particular example of rotation sensor 50 is annular and may detect rotation of the trailer 1 relative to the tractor unit to which the trailer 1 is connected by any known non-contact method, such as by detecting a change in one or more of inductance, capacitance and resistance as the rotation sensor 50 rotates relative to the fifth wheel of the tractor unit. Here it is recalled that the fifth wheel of the tractor unit has a tapered entry part to the guide slot through which the kingpin 11 passes into the parallel-sided locking part of the fifth wheel. The non-contact rotation sensor 50 may operate by detecting change in one or more of inductance, capacitance and resistance as the rotation sensor 50 rotates over the guide slot or other open part of the fifth wheel. A particularly preferred arrangement for achieving this is described further below.

Compared to the first example of a kingpin assembly 10 described above, in this third example, there is no sensor driver plate 16 as such, no spur gear 19, and no rotary sensor(s) 26 or associated drive gear(s) 27. Instead, in this example, the hollow cylindrical nylon bush 21 is counter-bored on its face that in use faces the fifth wheel of a tractor unit in order to provide an annular recess 60. The annular non-contact rotation sensor 50 is located in this recess 60 and fixed against rotation relative to the bush 21, for example by one or more of interference fit,

adhesive, screws and locating pegs fitting into blind recesses.

The parallel-sided engagement block 61, which in use is located in the parallel sided part of the guide slot in the fifth wheel of a tractor unit, is fixed to one face of a locating plate 62 which may be made of steel or the like and which in some respects is similar in construction to the sensor driver plate 16,51 of the first and second examples. The locating plate 62 has a central through hole 63 which has a diameter that is just larger than the maximum diameter of the stem of the kingpin 11 so that the stem of the kingpin 11 can pass through the through hole 63. The locating plate 62 has an axial stem tube 64 around the periphery of the through hole 63 and extending from the side opposite the engagement block 61. Moreover, the locating plate 62 has a through hole 65 of approximately rectangular shape which is sized and located to correspond to a similarly shaped blind recess 66 in the engagement block 61. The purpose of the through hole 65 in the locating plate 62 and the blind recess 66 in the engagement block 61 is so that in use, as the tractor unit rotates relative to the trailer unit, the through hole 65 and blind recess 66 move "under" the rotation sensor 50 and therefore enable the rotation sensor 50 to detect the amount of rotation of the tractor unit relative to the trailer unit.

Assembly of this third example of the kingpin assembly 10 is similar to that of the first and second examples and will not be described in detail. Notably, the non-contact rotation sensor 50 is positioned mainly within the bush 21 and covered by and therefore protected by the locating plate 62. Also, because the springs 35 bias the bush 21

and locating plate 62 together, and because it is the recess 66 in the engagement block 61 that provides the reference for the rotation sensor 50 to detect the amount of rotation and the engagement block 61 is fixed relative to the locating plate 62, this means that there is a fixed gap or separation between the rotation sensor 50 and the part or parts, the movement of which is detected (i.e. the through hole 65 in the locating plate 62 and/or the recess 66 in the engagement block 61). Thus, irrespective of minor variations in the shape and size of the guide hole in the fifth wheel, king pin, etc. (either through manufacturing tolerances or damage in use), there is in effect a gap of substantially fixed size between the rotation sensor 50 and the part the movement of which is detected. This makes it very much easier to install and calibrate the whole assembly and means that the measurements of rotation that are obtained in practice are much more reliable.

Similarly as for the first and second examples, if the kingpin 11 does not enter the fifth wheel on the tractor unit correctly, the locating plate 62 can retract into the outer sleeve 29 so as to be protected against damage.

In addition, similarly to the first and second examples, this arrangement allows the rotation sensor 50 to be maintained and replaced as necessary from "underneath", i.e. from the engagement end of the kingpin 11. This allows maintenance to be carried out with assembly 10 in situ on the trailer 1 and without having to obtain access through the floor of the trailer 1.

As in the first example, a proximity sensor (not shown) in the form of a switch or the like is preferably provided in the kingpin assembly 10, for example between the bush 21 and the flange 13 of the kingpin 11. This proximity sensor detects when the bush 21 has moved up towards the flange 13 of the kingpin 11 and can be used to disable steering of the steered axles 3,4 of the trailer 1.

Referring now to Figures 9A, 9B, 10 and 11, there is shown a part of a fourth example of a kingpin assembly 10 according to an embodiment of the present invention. For this fourth example, not all parts that are the same or substantially the same as for the first, second and third examples are shown and will not be further described here.

In this fourth example, so-called touch screen technology is used to detect rotation of the trailer 1 relative to the tractor unit to which the trailer 1 is connected and to provide a corresponding output signal. The actual touch screen technology that is used may in principle be any one of the several touch screen technologies that are available, such as resistive, capacitive, surface acoustic waves, etc., though resistive is preferred owing to its relatively low cost and resistance to damage. A particularly preferred arrangement for achieving this is described further below.

The main functional element of the preferred touch screen technology that is employed for this purpose is a thin, flat, annular sheet 70 which is fixed to the face of the hollow cylindrical nylon bush 21 that in use faces the fifth wheel of a tractor unit. The annular sheet 70 may have a self-adhesive backing on one surface to facilitate

mounting of the annular sheet 70 to the face of the hollow cylindrical nylon bush 21. As can be seen most clearly in Figure 11, the annular sheet 70 has at least one generally C-shape track 71, which is composed of the usual elements necessary for the particular touch screen technology that is employed. For example, in the case of resistive touch screen technology, the C-shape track 71 has at least two thin metallic layers that overlay each other and are separated by a small gap such that when pressure is applied to one of the layers, the two layers touch each other, which gives a change in electrical properties of the C-shape track 71 which can be detected to provide an output signal indicative of where on the C-shape track 71 the pressure is being applied. This in turn provides a measure of the amount of rotation of the trailer 1 relative to the tractor unit. In this example, two such C-shape tracks 71,72 are coaxially arranged on the sheet 70 to provide redundancy in case one should fail. Respective sets of wires 73 are connected to each track 71,72 to allow the change in resistance to be detected as known per se.

The parallel-sided engagement block 61, which in use is located in the parallel sided part of the guide slot in the fifth wheel of a tractor unit, is fixed to one face of a locating plate 62. The locating plate 62 may be made of steel or the like and in many respects is similar in construction to the locating plate 62 of the third example described above. The locating plate 62 has a central through hole 63 which has a diameter that is just larger than the maximum diameter of the stem of the kingpin 11 so that the stem of the kingpin 11 can pass through the through hole 63. The locating plate 62 has an axial stem

tube 64 around the periphery of the through hole 63 and extending from the side opposite the engagement block 61.

In this example, the engagement block 61 is fixed to the locating plate 62 by two screws 74 which pass into screw holes 75 in the locating plate 62. As can perhaps be seen most clearly in Figure 10, the tips of the two screws 74 pass through the screw holes 75 to project slightly beyond the opposite face of the locating plate 62. The amount by which the tips of the two screws 74 project beyond the opposite face of the locating plate 62 can easily be varied by screwing the screws 74 in or out as necessary. In this way, when the kingpin assembly 10 is fully assembled as discussed further below, the tips of the two screws 74 each act as a "stylus" that presses against a respective one of the C-shape tracks 71,72 on the annular sheet 70 and the position of the tips of the screws 74 can be adjusted to apply an appropriate force to the tracks 71,72. The tips of the screws are nylon-coated to reduce friction on contact with the tracks 71,72.

Assembly of this fourth example of the kingpin assembly 10 is similar to that of the first, second and third examples and will not be described in detail. Notably, the annular sheet 70 is positioned within the hollow generally cylindrical outer sleeve 29 and covered by and therefore protected by the locating plate 62. Also, because the springs 35 bias the bush 21 and locating plate 62 together, the position of the tips of the screws 74 relative to the annular sheet 70 is fixed, ensuring that an appropriate force is always applied to the tracks 71,72 by the screws 74. This makes it very much easier to install and calibrate the whole assembly and means that the

measurements of rotation that are obtained in practice are much more reliable.

Similarly as for the first, second and third examples, if the kingpin 11 does not enter the fifth wheel on the tractor unit correctly, the locating plate 62 can retract into the outer sleeve 29 so as to be protected against damage.

In addition, similarly to the first, second and third examples, this arrangement allows the annular sheet 70 and contact screws 74 to be maintained and replaced as necessary from "underneath", i.e. from the engagement end of the kingpin 11. This allows maintenance to be carried out with assembly 10 in situ on the trailer 1 and without having to obtain access through the floor of the trailer 1.

As in the examples described above, a proximity sensor 76 in the form of a switch or the like is preferably provided in the kingpin assembly 10 to detect when the bush 21 has moved up towards the flange 13 of the kingpin 11 and can be used to disable steering of the steered axles 3,4 of the trailer 1.

Embodiments of the present invention have been described with particular reference to the examples illustrated. However, it will be appreciated that variations and modifications may be made to the examples described within the scope of the present invention.

CLAIMS

1. A kingpin assembly for a trailer, the assembly comprising:

a kingpin, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer;

a sensor driver, the sensor driver being rotatable relative to the kingpin about a central longitudinal axis of the kingpin, the sensor driver being engageable with a fifth wheel of a tractor unit so that when a trailer to which the kingpin assembly is in use mounted rotates relative to a tractor unit to which the trailer is in use coupled, the sensor driver rotates relative to the kingpin; and,

a rotary sensor that is drivable by the sensor driver so that in use, when the sensor driver rotates relative to the kingpin, the rotary sensor can output a signal corresponding to the rotation of the sensor driver relative to the kingpin;

the sensor driver being mounted in the assembly so as to be translatable in a direction generally parallel to the central longitudinal axis of the kingpin between an engaging position and a non-engaging position so that if the kingpin is inserted incorrectly into a fifth wheel of a tractor unit, the sensor driver can move along the length of the kingpin to the non-engaging position so as not to engage with a fifth wheel of a said tractor unit.

2. A kingpin assembly according to claim 1, comprising a biasing arrangement that is arranged to bias the sensor driver towards the engaging position at which it will

engage with a fifth wheel of a said tractor unit if the kingpin is inserted correctly into a fifth wheel of a tractor unit.

3. A kingpin assembly according to claim 1 or claim 2, comprising a switch that is operable to output a control signal that is dependent on whether the sensor driver is in the engaging position or the non-engaging position.

4. A kingpin assembly according to any of claims 1 to 3, wherein the sensor driver carries an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit.

5. A kingpin assembly according to any of claims 1 to 4, wherein the sensor driver carries a spur gear, the spur gear being fixed against rotation relative to the sensor driver, and a rotary sensor drive gear, the rotary sensor drive gear being rotatable relative to the sensor driver and being drivingly connected to the rotary sensor and engaged with the spur gear, whereby as the sensor driver and spur gear rotate, the rotary sensor drive gear is driven to operate the rotary sensor.

6. A kingpin assembly according to any of claims 1 to 5, comprising a bush through which the kingpin passes and that is fixed against rotation relative to the kingpin, the rotary sensor being mounted in the bush so as to be fixed relative thereto.

7. A kingpin assembly according to claim 6, wherein the bush is translatable in a direction generally parallel to the central longitudinal axis of the kingpin so that if the

sensor driver moves along the length of the kingpin, the bush moves correspondingly along the length of the kingpin.

8. A kingpin assembly according to claim 7, wherein the kingpin has an engagement end for engagement with the fifth wheel of a tractor unit and an outwardly extending flange at the other end, the kingpin assembly comprising one or more compression springs between the outwardly extending flange of the kingpin and the bush and arranged to bias the bush and the sensor driver towards the engaging position at which the sensor driver will engage with a fifth wheel of a said tractor unit if the kingpin is inserted correctly into a fifth wheel of a tractor unit.

9. A kingpin assembly according to any of claims 1 to 8, comprising an outer sleeve that can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the sensor driver being contained within the outer sleeve so as to be rotatable therein, and a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into a part of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve.

10. A kingpin assembly according to claim 1, wherein the kingpin has an engagement end for engagement with the fifth wheel of a tractor unit and an outwardly extending flange at the other end, the kingpin assembly comprising:

an outer sleeve which can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the sensor driver being contained within the outer sleeve so as to be rotatable therein;

a bush through which the kingpin passes, the rotary sensor being mounted in the bush so as to be fixed relative thereto, the bush being translatable in a direction generally parallel to the central longitudinal axis of the kingpin so that if the sensor driver moves along the length of the kingpin, the bush moves correspondingly along the length of the kingpin;

one or more compression springs between the outwardly extending flange of the kingpin and the bush and arranged to bias the bush and the sensor driver towards the engaging position at which the sensor driver will engage with a fifth wheel of a said tractor unit if the kingpin is inserted correctly into a fifth wheel of a tractor unit; and,

a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into the outwardly extending flange of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve, said bolt or the like passing into the bush to fix the bush against rotation relative to the top plate and outer sleeve.

11. A kingpin assembly for a trailer, the assembly comprising:

a kingpin, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer, the kingpin having an engagement end for engagement with the fifth wheel of a tractor unit; and,

a rotation sensor for sensing rotation of the kingpin relative to a tractor unit when the kingpin assembly is fixedly mounted to a said trailer and said trailer is connected to a said tractor unit;

the rotation sensor being mounted in the assembly so as to be translatable in a direction generally parallel to the central longitudinal axis of the kingpin between a first position near the engagement end of the kingpin and a second position remote from the engagement end of the kingpin.

12. A kingpin assembly according to claim 11, comprising a biasing arrangement that is arranged to bias the rotation sensor towards the first position.

13. A kingpin assembly according to claim 11 or claim 12, comprising a bush through which the kingpin passes and that is fixed against rotation relative to the kingpin, the bush being translatable in a direction generally parallel to the central longitudinal axis of the kingpin, the rotation sensor being mounted to the bush so as to be fixed relative thereto.

14. A kingpin assembly according to claim 13, the kingpin having an outwardly extending flange at the end opposite the engagement end, the assembly comprising one or more compression springs between the outwardly extending flange of the kingpin and the bush and arranged to bias the bush and the rotation sensor towards the first position.

15. A kingpin assembly according to claim 13 or claim 14, wherein the rotation sensor is mounted to the bush via a mounting plate that is removably connected to the bush and that is fixed against rotation relative to the bush.

16. A kingpin assembly according to any of claims 13 to 14, wherein the rotation sensor is a non-contact rotation

sensor which is mounted in a recess in the bush, the assembly comprising a locating plate that covers the rotation sensor in the recess in the bush, the locating plate having an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit.

17. A kingpin assembly according to claim 16, wherein the locating plate has a through hole at a fixed position relative to the engagement block, whereby rotation of the engagement block causes the locating plate and the through hole to rotate relative to the rotation sensor such that the rotation sensor can detect relative rotation between the engagement block and the kingpin.

18. A kingpin assembly according to claim 13 or claim 14, wherein the rotation sensor is a contact rotation sensor which is mounted to a face of the bush, the assembly comprising a locating plate that covers the rotation sensor on the bush, the locating plate having an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit.

19. A kingpin assembly according to claim 18, comprising a stylus which is fixed against rotation relative to the engagement block and which engages with the contact rotation sensor such that the contact rotation sensor can detect relative rotation between the engagement block and the kingpin.

20. A kingpin assembly according to any of claims 11 to 15, wherein the rotation sensor is a non-contact sensor.

21. A kingpin assembly according to any of claims 11 to 15, wherein the rotation sensor is a contact sensor.

22. A kingpin assembly according to any of claims 11 to 21, comprising an outer sleeve that can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the rotation sensor being contained within the outer sleeve at least when at the second position, and a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into a part of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve.

23. A kingpin assembly according to any of claims 11 to 22, comprising a switch that is operable to output a control signal that is dependent on whether or not the rotation sensor is at the first position.

24. A kingpin assembly for a trailer, the assembly comprising:

a kingpin having an engagement end for engagement with the fifth wheel of a tractor unit, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer;

a sensor driver, the sensor driver being rotatable relative to the kingpin about a central longitudinal axis of the kingpin, the sensor driver being engageable with a fifth wheel of a tractor unit so that when a trailer to which the kingpin assembly is in use mounted rotates relative to a tractor unit to which the trailer is in use coupled, the sensor driver rotates relative to the kingpin;

a rotary sensor that is drivable by the sensor driver so that in use, when the sensor driver rotates relative to the kingpin, the rotary sensor can output a signal corresponding to the rotation of the sensor driver relative to the kingpin; and,

an outer sleeve that can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the sensor driver being contained within the outer sleeve so as to be rotatable therein;

wherein the sensor driver can be removed from the kingpin assembly by accessing the outer sleeve from the engagement end of the kingpin.

25. A kingpin assembly according to claim 24, wherein the sensor driver carries an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit.

26. A kingpin assembly according to claim 24 or claim 25, wherein the sensor driver carries a spur gear, the spur gear being fixed against rotation relative to the sensor driver, and a rotary sensor drive gear, the rotary sensor drive gear being rotatable relative to the sensor driver and being drivingly connected to the rotary sensor and engaged with the spur gear, whereby as the sensor driver and spur gear rotate, the rotary sensor drive gear is driven to operate the rotary sensor.

27. A kingpin assembly according to any of claims 24 to 26, comprising a bush through which the kingpin passes and that is fixed against rotation relative to the kingpin, the rotary sensor being mounted in the bush so as to be fixed relative thereto.

28. A kingpin assembly according to claim 27, comprising a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into a part of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve, said bolt or the like passing into the bush to fix the bush against rotation relative to the top plate and outer sleeve.

29. A kingpin assembly for a trailer, the assembly comprising:

a kingpin, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer;

a sensor driver, the sensor driver being rotatable relative to the kingpin about a central longitudinal axis of the kingpin, the sensor driver being engageable with a fifth wheel of a tractor unit so that when a trailer to which the kingpin assembly is in use mounted rotates relative to a tractor unit to which the trailer is in use coupled, the sensor driver rotates relative to the kingpin, the sensor driver carrying a spur gear which is fixed against rotation relative to the sensor driver; and,

a rotary sensor having a rotary sensor drive gear which is rotatable relative to the sensor driver and engaged with the spur gear, whereby as the sensor driver and spur gear rotate, the rotary sensor drive gear is driven to operate the rotary sensor so that in use, when the sensor driver rotates relative to the kingpin, the rotary sensor can output a signal corresponding to the rotation of the sensor driver relative to the kingpin.

30. A kingpin assembly according to claim 29, wherein the sensor driver carries an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit.

31. A kingpin assembly according to claim 29 or claim 30, comprising a bush through which the kingpin passes and that is fixed against rotation relative to the kingpin, the rotary sensor being mounted in the bush so as to be fixed relative thereto.

32. A kingpin assembly according to any of claims 29 to 31, comprising an outer sleeve that can be fixed to a trailer so as to mount the kingpin assembly to a said trailer, the sensor driver being contained within the outer sleeve so as to be rotatable therein, and a top plate fixed to the outer sleeve, the top plate having at least one through hole through which a bolt or the like passes into a part of the kingpin to fix the kingpin against rotation relative to the top plate and outer sleeve.

33. A kingpin assembly for a trailer, the assembly comprising:

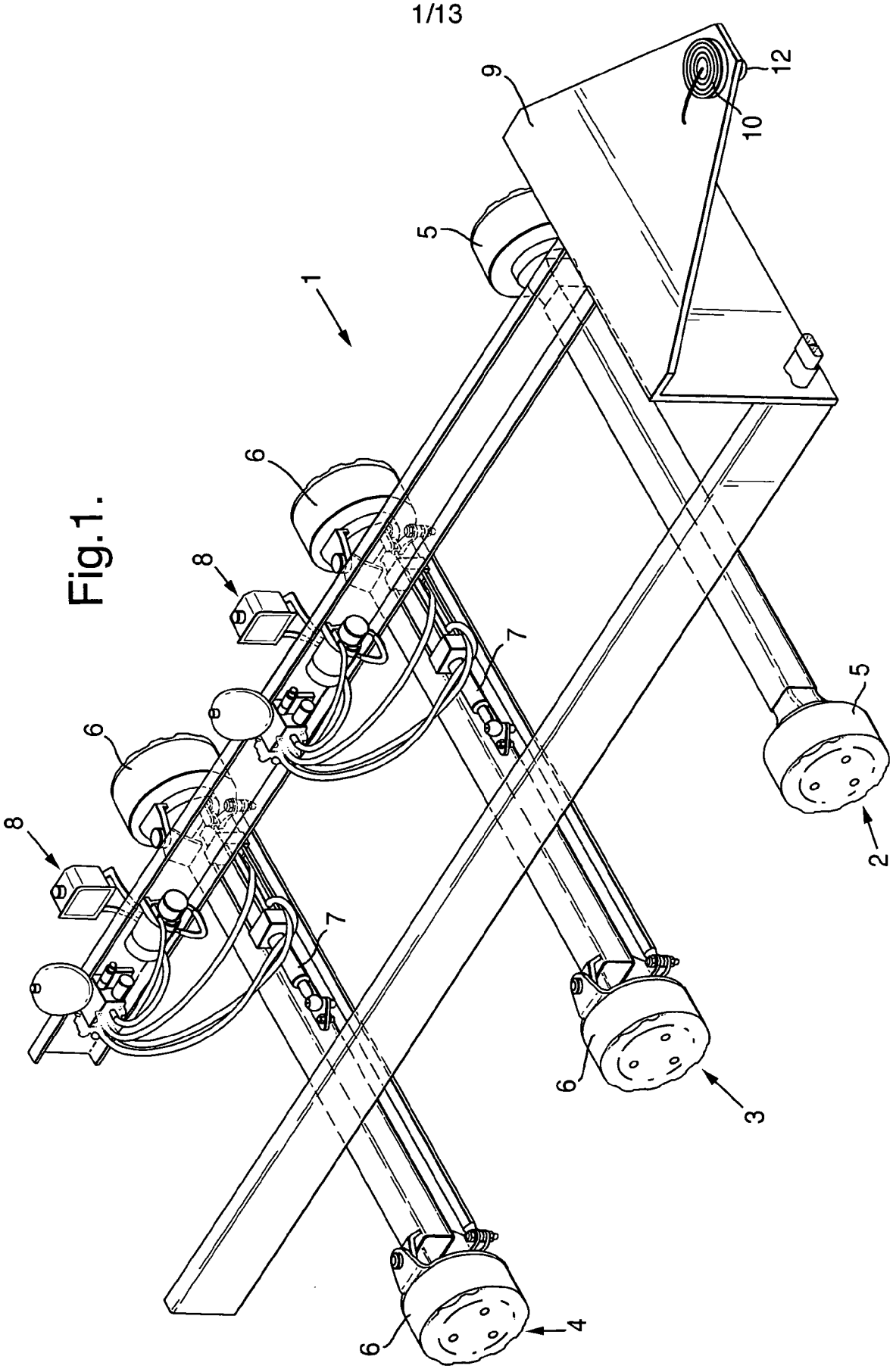
a kingpin, the kingpin being mounted in the assembly so as to be fixed against rotation relative to a trailer when the kingpin assembly is fixedly mounted to a said trailer, the kingpin having an engagement end for engagement with the fifth wheel of a tractor unit; and,

a contact rotation sensor and a stylus for pressing against the contact rotation sensor to enable sensing of rotation of the kingpin relative to a tractor unit when the kingpin assembly is fixedly mounted to a said trailer and said trailer is connected to a said tractor unit.

34. A kingpin assembly according to claim 33, wherein the stylus is translatable back and forth relative to the contact rotation sensor so that the pressure with which the stylus presses against the contact rotation sensor can be adjusted.

35. A kingpin assembly according to claim 33 or claim 34, wherein the contact rotation sensor is mounted to a face of a bush through which the kingpin passes and that is fixed against rotation relative to the kingpin, the assembly comprising a locating plate that covers the contact rotation sensor on the bush, the locating plate having an engagement block for engagement with the tapered sides of a fifth wheel of a tractor unit.

Fig.1.



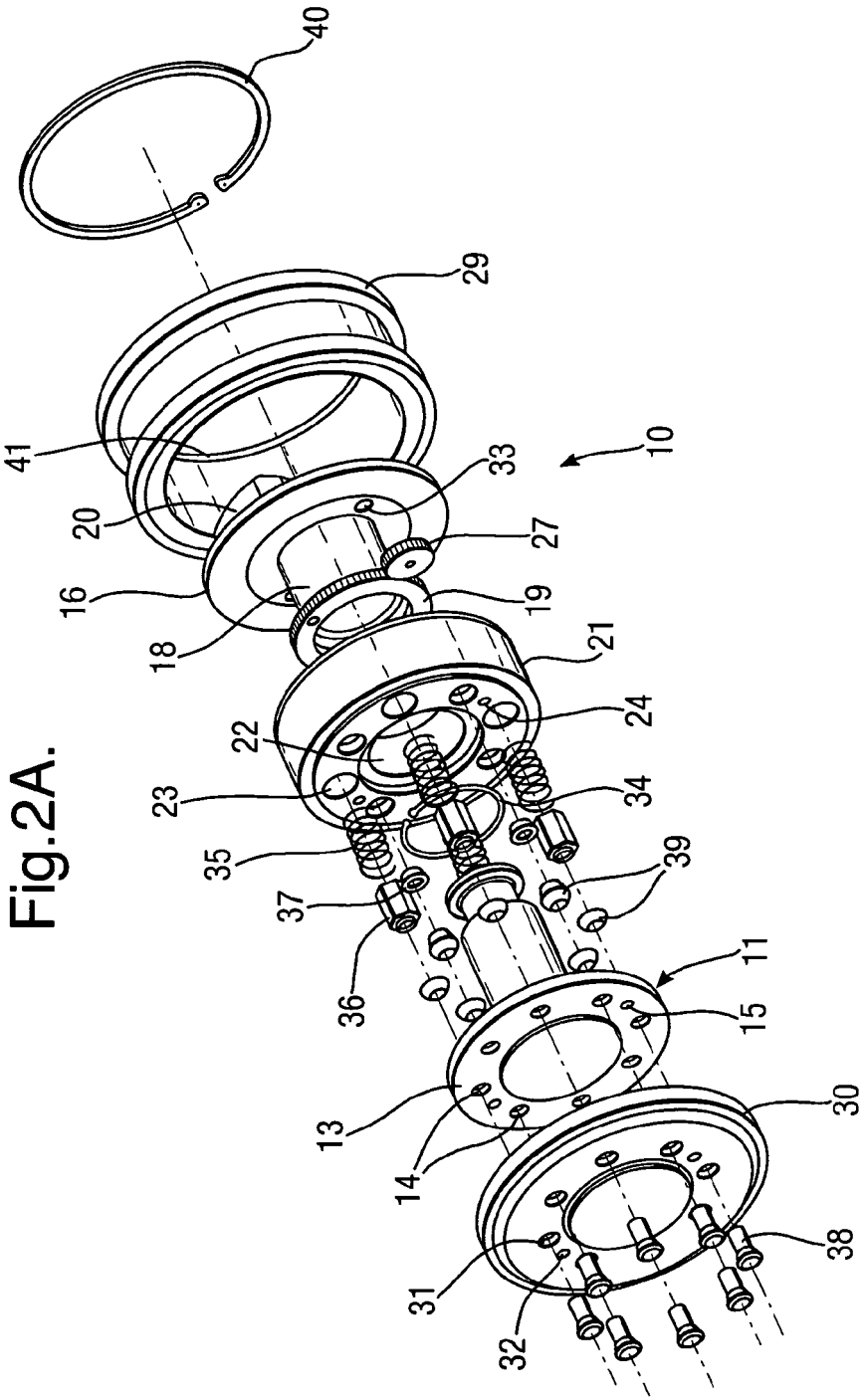

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Fig.2A.

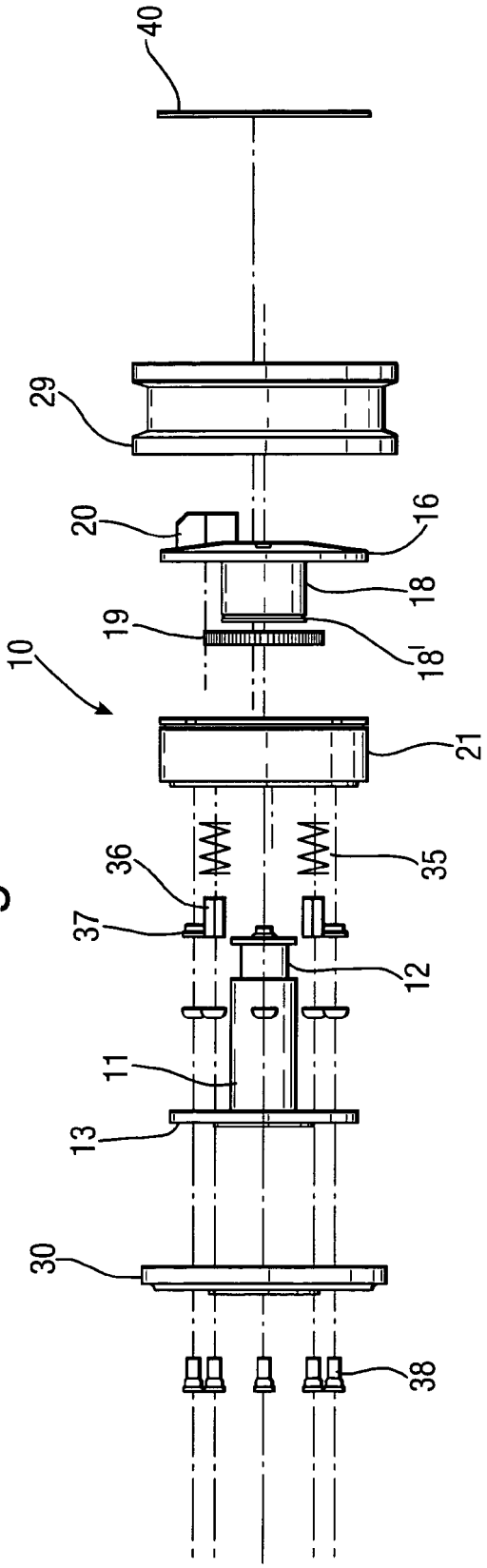


Fig.2B.

Fig.3A.

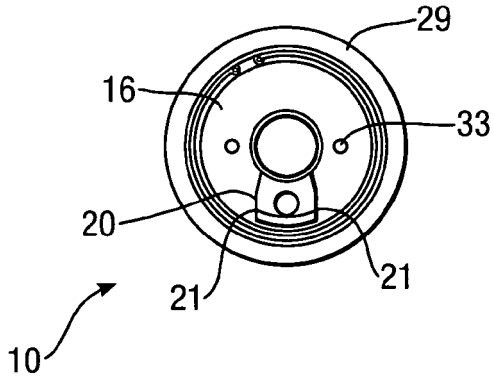


Fig.3B.

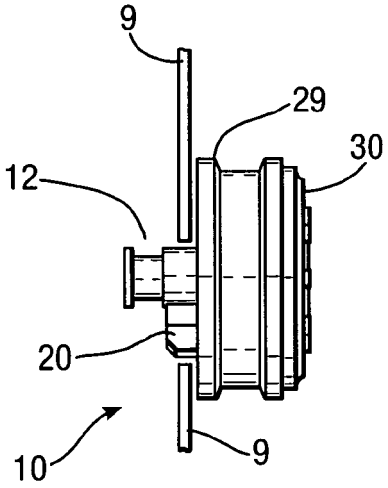


Fig.3C.

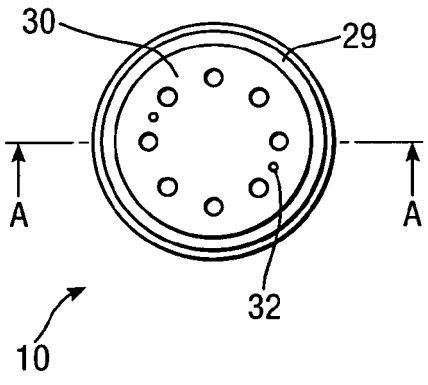


Fig.3D.

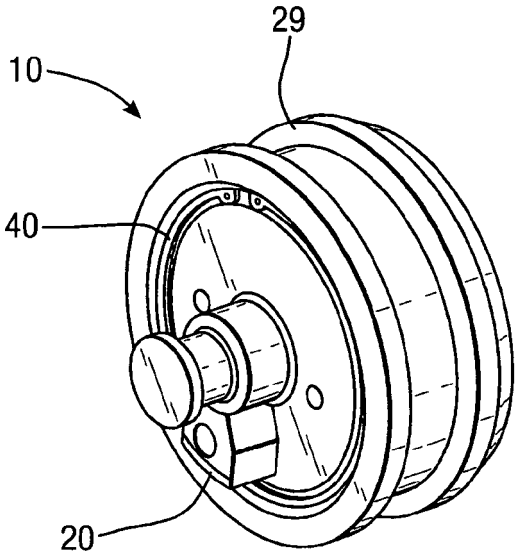


Fig.3E.

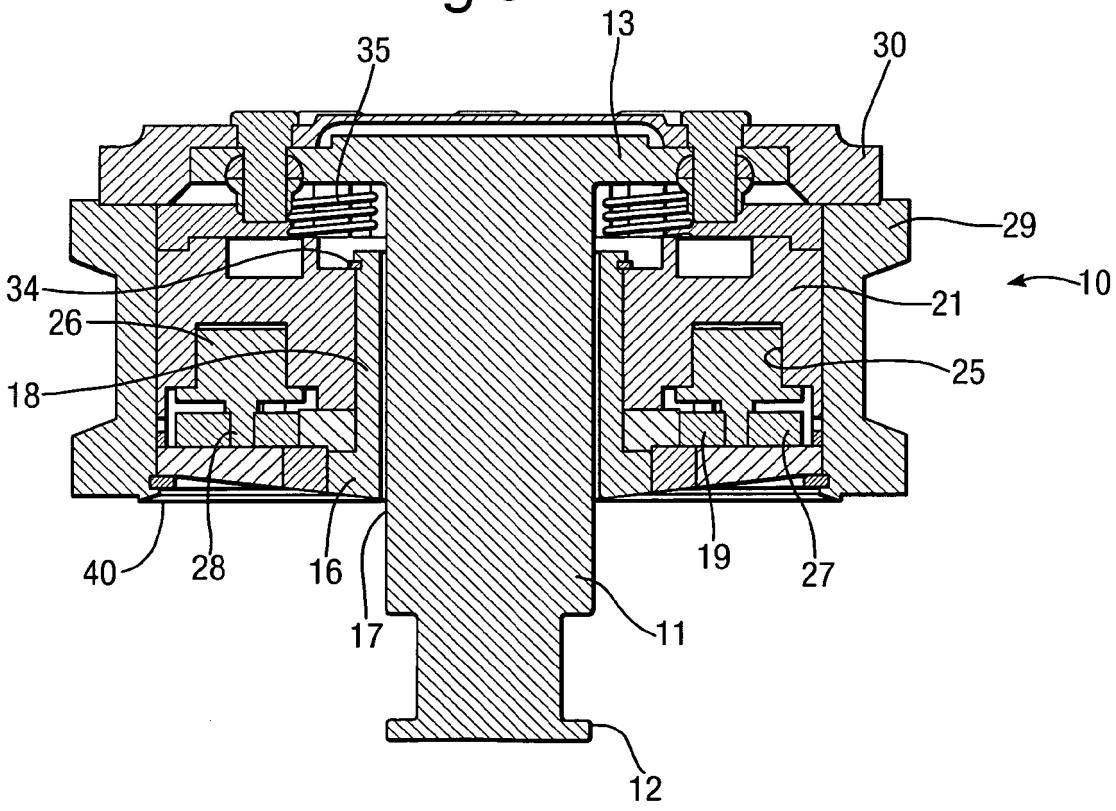
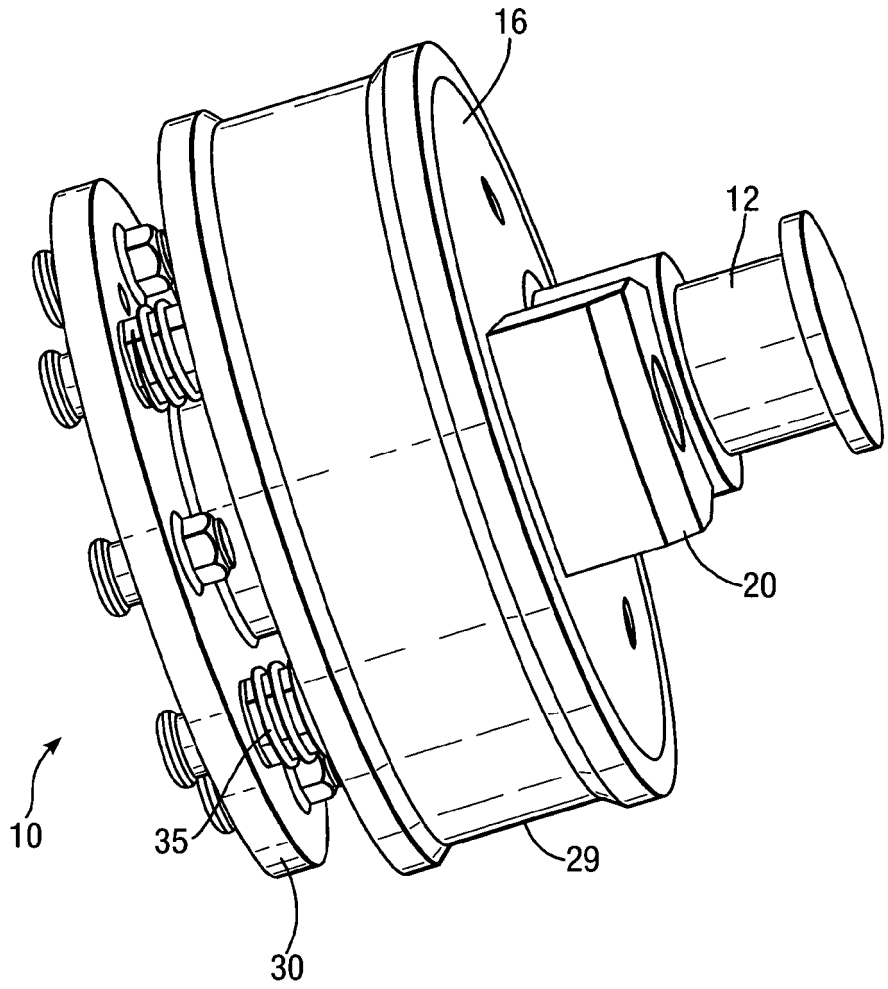


Fig.4.



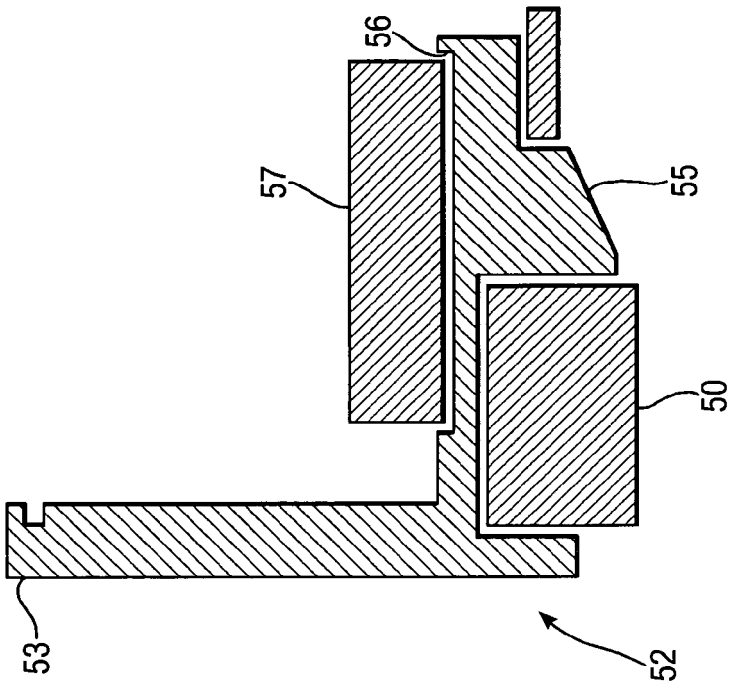


Fig.5.

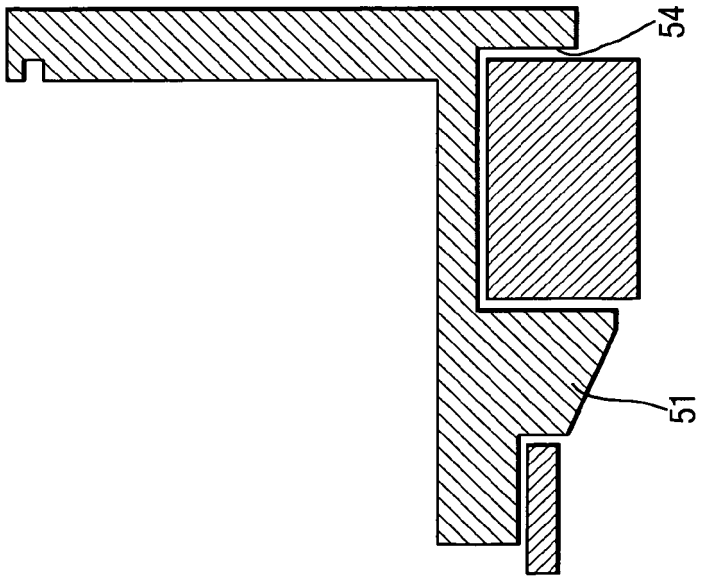


Fig.6A.

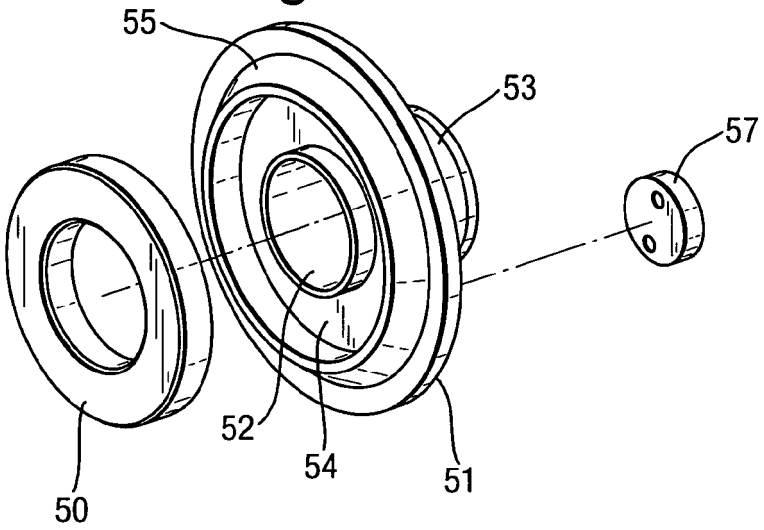


Fig.6B.

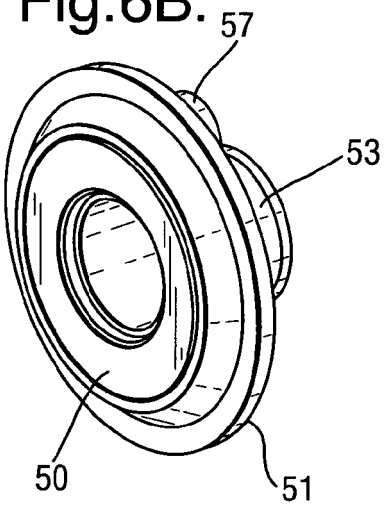
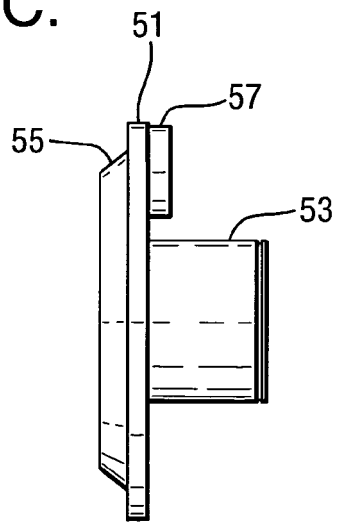


Fig.6C.



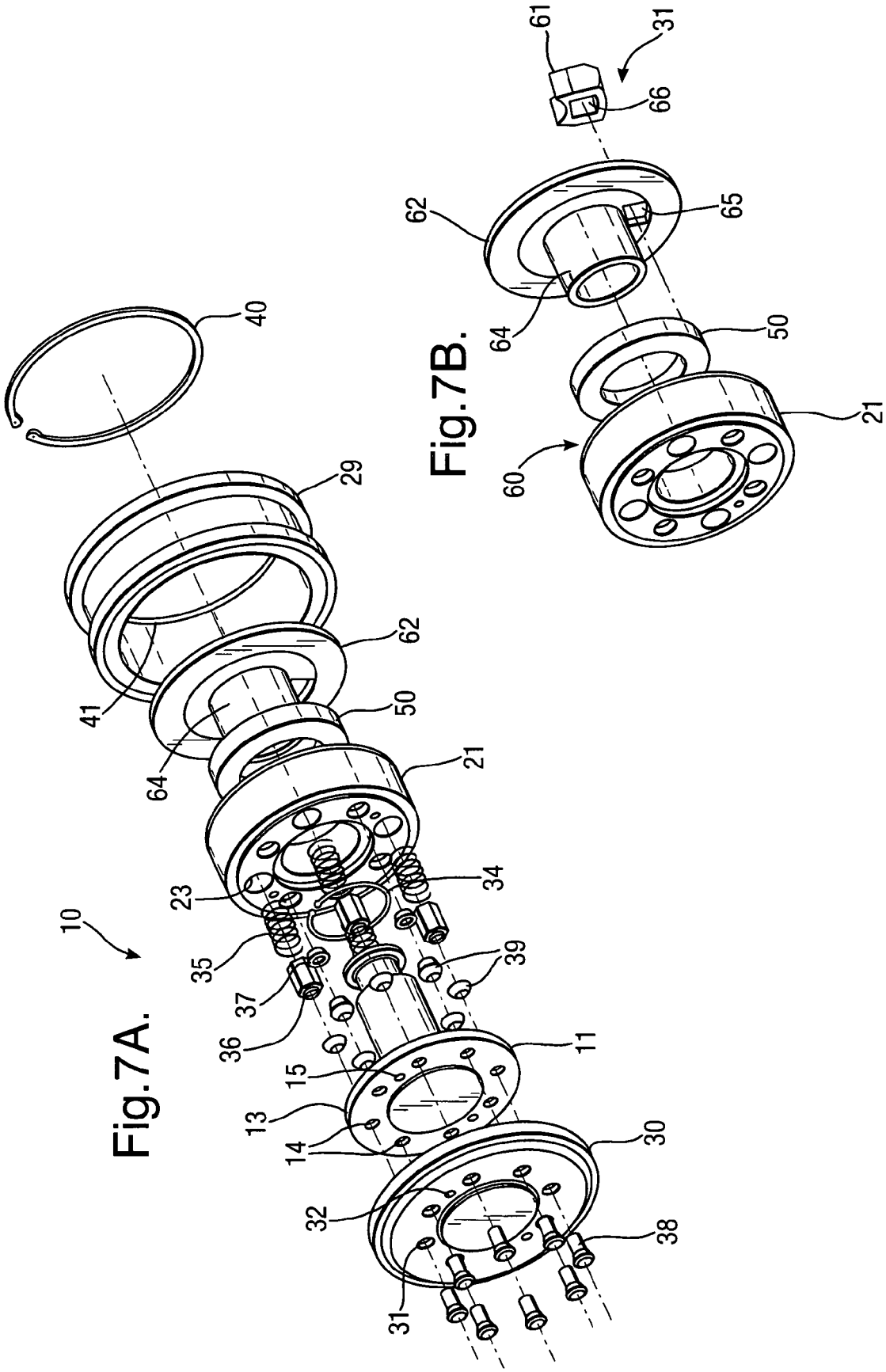
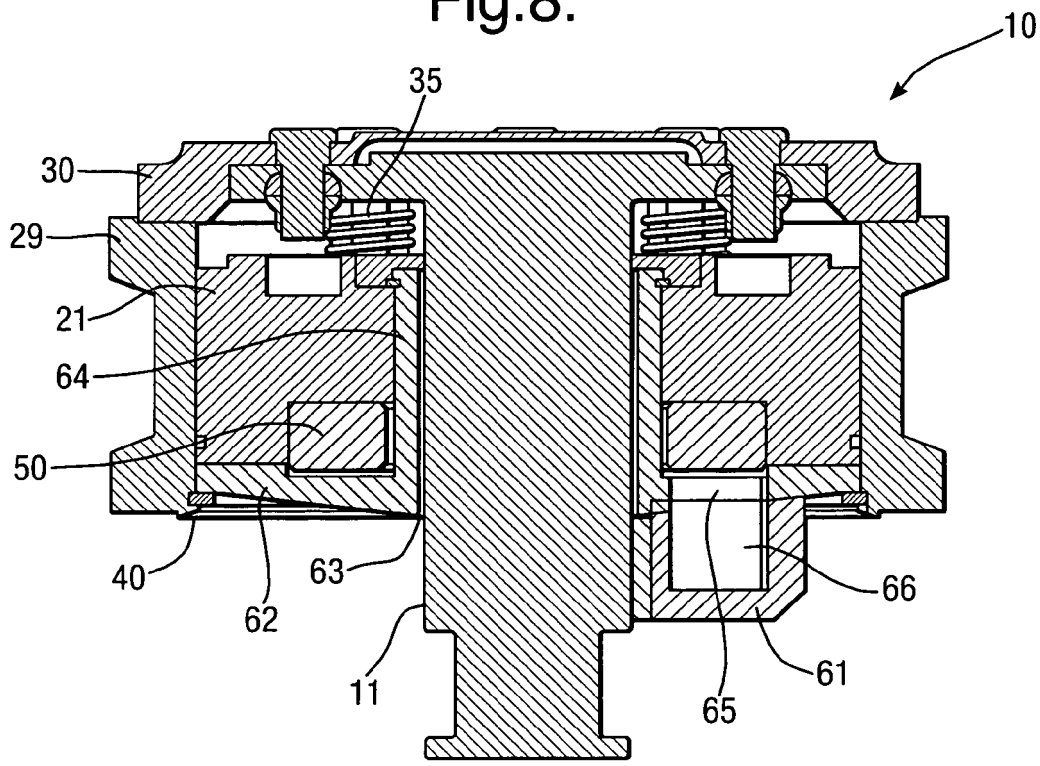


Fig.7A.

Fig.7B.

Fig.8.



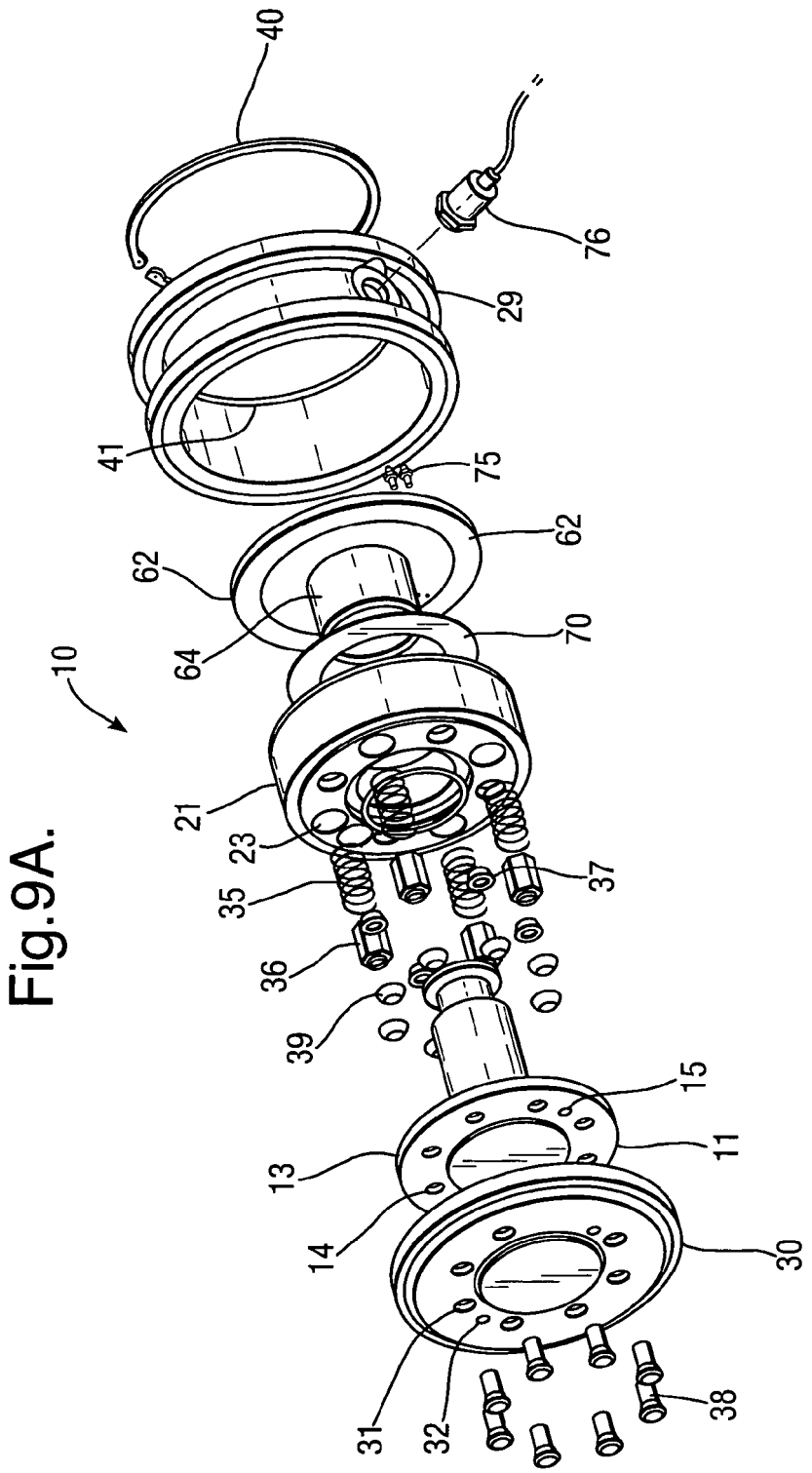


Fig.9A.

Fig.9B.

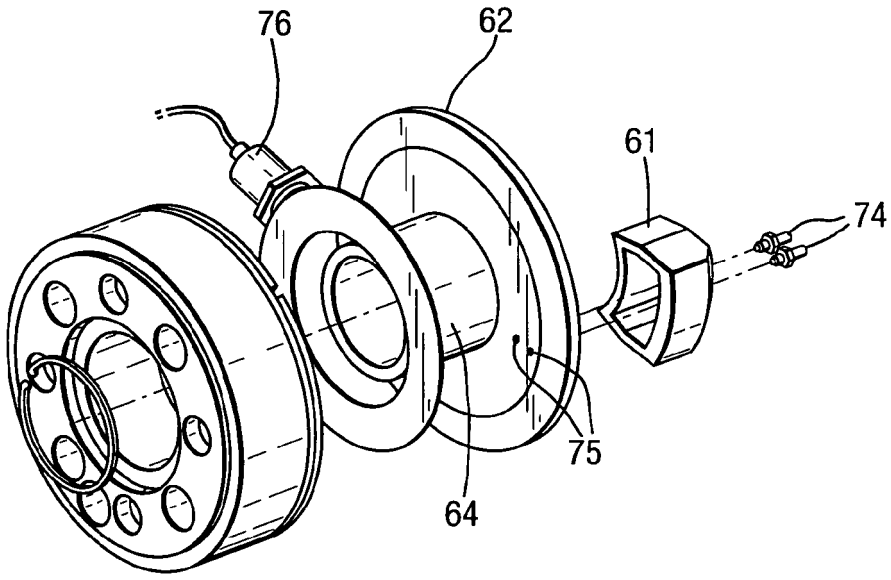


Fig.10.

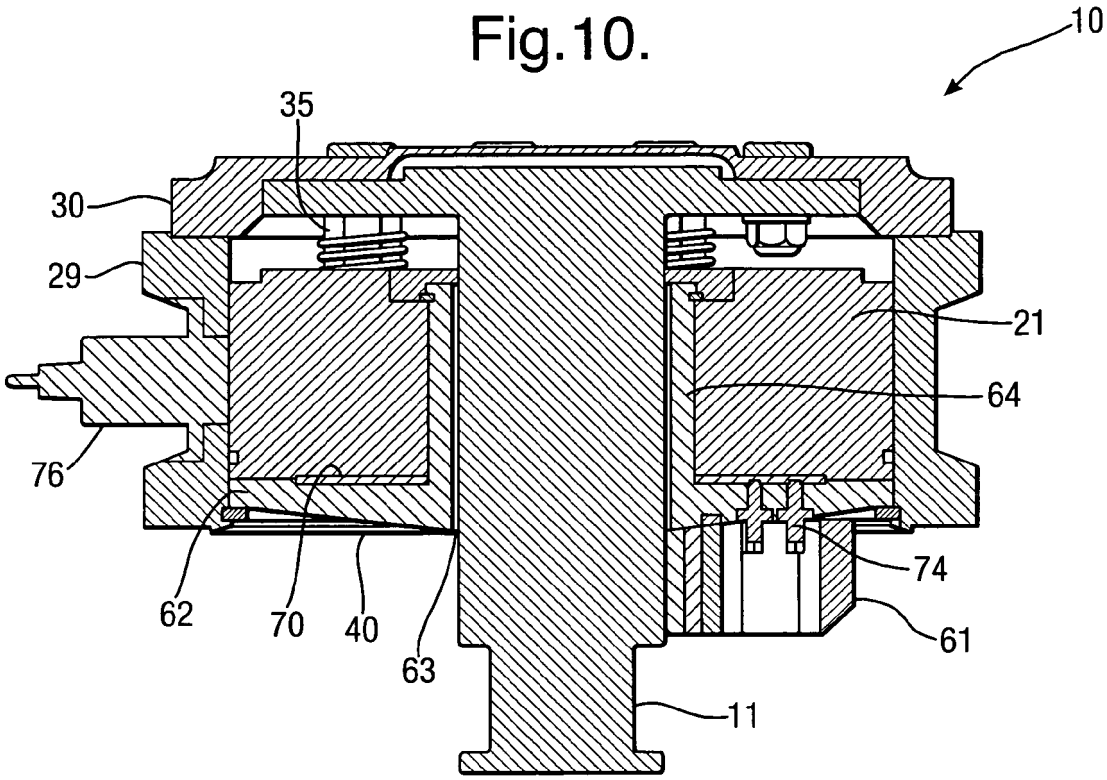


Fig.11.