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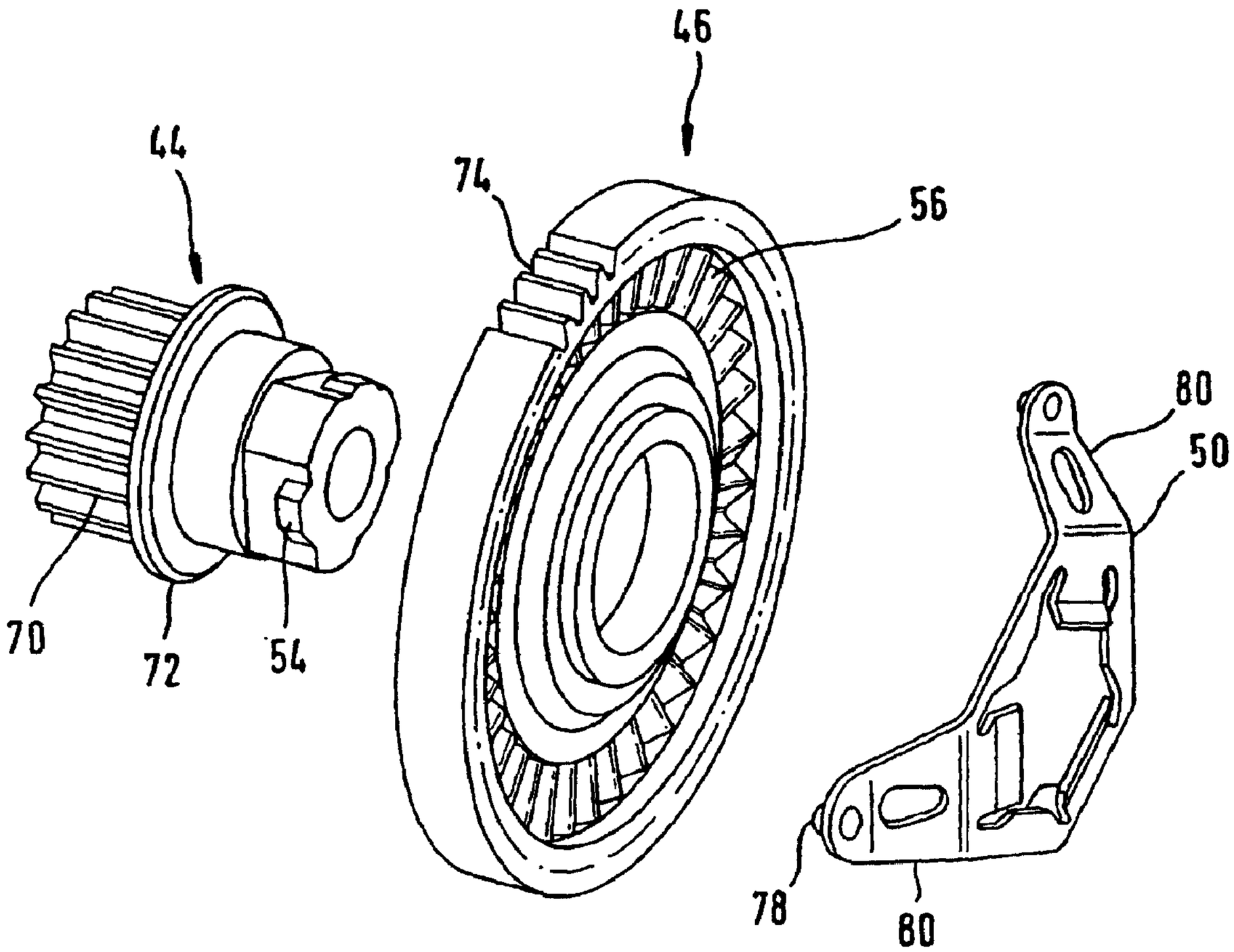

(57) Abrégé/Abstract:
A drive device (30) enabling a movable element (22) to be driven by an actuator (32) via a gear system (34) comprising a motor pinion gear (38), an intermediate gear (40) and a partial toothed gear (58). The aim of the invention is to create a particularly

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(57) Abrégé(suite)/Abstract(continued):
compact device which can capture the kinetic energy of the actuator (32) in a particularly reliable manner. The intermediate gear (40) comprises a pinion (44) and a toothed gear (46). The pinion (44) and toothed gear (46) are connected via a ratchet (50) in such a way that the pinion (44) which is rotationally fixed to the ratchet (50) can be rotated counter to the toothed wheel (46) in a manner similar to that of a locking ratchet wheel.

ABSTRACT

A drive device (30) enabling a movable element (22) to be driven by an actuator (32) via a gear system (34) comprising a motor pinion gear (38), an intermediate gear (40) and a partial toothed gear (58). The aim of the invention is to create a particularly compact device which can capture the kinetic energy of the actuator (32) in a particularly reliable manner. The intermediate gear (40) comprises a pinion (44) and a toothed gear (46). The pinion (44) and toothed gear (46) are connected via a ratchet (50) in such a way that the pinion (44) which is rotationally fixed to the ratchet (50) can be rotated counter to the toothed wheel (46) in a manner similar to that of a locking ratchet wheel.

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Description

Drive device

The invention relates to a drive device, in which a movable element can be driven by an actuator via a gear unit and in which the gear unit comprises a motor pinion, an intermediate wheel and a toothed ring, and the intermediate wheel comprises a pinion and a gearwheel, the pinion and the gearwheel being connected via a ratchet in such a way that the pinion connected fixedly in terms of rotation to the ratchet can be rotated in relation to the gearwheel in the manner of a locking pawl.

To control the quantity of fresh gas of a motor vehicle, throttle valve assemblies are usually used. Throttle valve assemblies comprise a housing with a throttle orifice and a throttle member arranged in the throttle orifice. The throttle member conventionally comprises a throttle valve which is arranged on a throttle valve shaft and which is arranged pivotably in the housing of the throttle valve assembly. The throttle valve assumes a defined position in the throttle orifice for the passage of a defined quantity of fresh gas. For this purpose, the throttle valve shaft can be activated mechanically or electromechanically.

In an electromechanical activation of the throttle valve shaft, the throttle valve assembly normally has a position detection means, via which the in each case current position of the throttle valve shaft can be detected. Depending on the in each case current position of the throttle

valve shaft, a signal is then generated either inside or outside the throttle valve assembly, by means of which signal the throttle valve shaft can be activated via the actuator arranged in the throttle valve assembly. In this case, depending on the position of the throttle valve shaft and consequently of the throttle valve, the throttle orifice is partially closed by the throttle valve, this corresponding to an open position of the throttle valve, or else is also closed completely by the throttle valve, this corresponding to a closing position of the throttle valve.

If, then, the actuator adjusts the throttle valve from an open position into a closing position, the actuator is switched to currentless only after the throttle valve shaft, together with the throttle valve arranged on it, assumes a position in which the throttle valve closes the throttle orifice approximately completely. However, after the actuator has been switched off or switched to currentless, it still rotates a little further on account of the kinetic energy of its rotor and consequently transmits kinetic energy to the gear unit. The gear unit should absorb this kinetic energy, without at the same time being damaged. If, however, the throttle valve shaft is in a position which corresponds to the closing position of the throttle valve and the throttle valve bears mechanically, in the closing position, against a step in the throttle orifice, the gear unit, on account of the kinetic energy transmitted to it, will attempt to rotate the throttle valve beyond the step in the throttle orifice. Since the abutment is normally harder than the gearwheels of the gear unit, this often results in a fracture of individual gears of the gearwheels of the gear unit, without the throttle valve being pivoted by the throttle valve shaft. This foreseeable gear unit damage considerably shortens the useful life of gear units of this type, as a result of which their use,

particularly in throttle valve assemblies, is uneconomical.

Such a drive device is known, for example, from EP 0 272 352 A2. In this, the intermediate gearwheel has a ratchet. Here, the gearwheel has a ring of detent pawls and the pinion has ratchet geometries prestressed in relation to the detent pawls. The pinion is manufactured in one piece with the ratchet geometries. The ratchet consequently prevents excess kinetic energy from being transmitted to the movable element. One disadvantage of the known drive device, however, is that the gear unit has a high weight. The high weight of the drive device decisively contributes, however, to the generation of the excess kinetic energy.

It is known from US 6,189,507 B1, in a drive device, to design the toothed ring as a part-toothed ring. This leads to a reduction in the weight. This drive device has the disadvantage, however, that the remaining kinetic energy is transmitted directly to the movable element, thus resulting in a short useful life of the drive device.

The object on which the invention is based is, therefore, to specify a drive device of the abovementioned type, the gear unit of which has a particularly low weight and which can be manufactured in a particularly simple way.

This object is achieved, according to the invention, in that the toothed ring is designed as a part-toothed ring, and in that the gearwheel and the pinion are manufactured from plastic and the ratchet from metal, the ratchet being snapped onto the pinion.

As a result of this configuration, first, the weight of the gear unit is reduced by the toothed ring being designed as a part-toothed ring. Furthermore, the gearwheel and the pinion are manufactured from plastic instead of from metal, thus resulting in a further reduction in the weight. The ratchet itself

may be manufactured as a thin and stable sheet-metal part and, for assembly, can simply be snapped onto the pinion.

Advantageously, the movable element is a throttle valve shaft which is arranged in a throttle valve assembly and on which a throttle valve is arranged pivotably. Throttle valve assemblies with a drive device of this type have a particularly low space requirement and can therefore be used in a particularly versatile way.

The advantages achieved by means of the invention are, in particular, that, on the one hand, the drive device has a particularly low space requirement, and that kinetic energy of the actuator can be absorbed reliably with a gear unit of the drive device even when the throttle valve shaft is secured in a fixed position via the throttle valve bearing against an abutment in the throttle orifice.

A first embodiment and a second embodiment are explained in more detail with reference to a drawing, in which:

fig. 1 shows diagrammatically a cross section through a throttle valve assembly with a drive device for pivoting a throttle valve arranged on a throttle valve shaft,

(continues on page 5)

fig. 2 shows diagrammatically a longitudinal section through the throttle orifice of the throttle valve assembly according to figure 1,

fig. 3 shows diagrammatically a top view of the drive device of the throttle valve assembly according to figure 1,

fig. 4 shows diagrammatically the individual parts of the intermediate wheel of the gear unit, and

fig. 5 shows diagrammatically the intermediate wheel in various views.

Parts corresponding to one another are given the same reference symbols in all the figures.

The throttle valve assembly 10 according to figure 1 serves for supplying an air or a fuel/air mixture to a consumer, not illustrated, for example an injection device of a motor vehicle, likewise not illustrated, the fresh gas quantity to be supplied to the consumer being capable of being controlled by means of the throttle valve assembly 10. For this purpose, the throttle valve assembly 10 has a housing 16 which is manufactured predominantly from metal 18, in particular aluminum, and has been produced by the injection molding method. Alternatively, however, the housing 16 may also be manufactured completely from plastic. The housing 16 has a throttle orifice 20 via which air or a fuel/air mixture can be supplied to the consumer, not illustrated.

To set the volume of fresh gas to be supplied, a throttle valve 23 is arranged on a throttle valve shaft 22. The throttle valve 23 cannot be seen on account of the sectional illustration, but is illustrated in figure 2. However, the fastening points 24, at which the throttle valve 23 is fastened on the

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throttle valve shaft 22, can be seen. A rotation of the

throttle valve shaft 22 about its axis of rotation 26 gives rise at the same time to the pivoting of the throttle valve 23 arranged on the throttle valve shaft 22, with the result that the active cross section of the throttle orifice 20 is increased or reduced. By means of an increase or reduction in the active cross section of the throttle orifice 20 by means of the throttle valve 23, a regulation of the throughput of the air or fuel/air mixture through the throttle orifice 20 of the throttle valve assembly 10 takes place.

The throttle valve shaft 20 may be connected to a rope pulley, not illustrated in any more detail, which, in turn, is connected via a Bowden cable to a setting device for a power requirement. The setting device may in this case be designed as the accelerator pedal of a motor vehicle, so that, by this setting device being actuated by the driver of the motor vehicle, the throttle valve 23 can be brought from a position of minimum opening, in particular a closing position, into a position of maximum opening, in particular an open position, in order thereby to control the power output of the vehicle.

In contrast to this, the throttle valve shaft 22, shown in figure 1, of the throttle valve assembly 10 either can be set in a part range by an actuator and otherwise via the accelerator pedal or else the throttle valve 23 can be set over the entire range of adjustment by an actuator. In these E-gas or Drive-by-wire systems, as they are known, the mechanical power control, for example the depression of an accelerator pedal, is converted into an electrical signal. This signal is supplied, in turn, to a control unit which generates an activation signal for the actuator. In these systems, there is no mechanical coupling between the accelerator pedal and the throttle valve during normal operation.

In order to adjust the throttle valve shaft 22 and consequently the throttle valve 23, therefore, the throttle valve assembly 10 has a drive device 30 which is arranged in the housing 16 of the throttle valve assembly 10. The drive device 30 is shown in section in figure 1.

The drive device 30 is arranged in the housing 16 of the throttle valve assembly 10 and comprises an actuator 32 designed as an electric motor. The actuator 32 designed as an electric motor moves the throttle valve shaft 22 via a gear unit 34 designed as a reduction gear unit. The gear unit 34 also belongs to the drive device 30. The actuator 32 is connected, in a way not illustrated in any more detail, to a current source arranged outside the throttle valve assembly 10 and to a control unit. The control unit transmits to the actuator 32 a signal, by means of which the actuator 32 brings about a defined position of the throttle valve shaft 22 via the gear unit 34 designed as a reduction gear unit. The actual position of the throttle valve shaft 22 can be detected via a position detection means 36 which is designed as a potentiometer and in which the slide of the position detection means 36 designed as a potentiometer is connected to the throttle valve shaft 22 in a way not illustrated in any more detail.

To transmit a rotational movement from the actuator 32 designed as an electric motor to the throttle valve shaft 22, the gear unit 34 designed as a reduction gear unit comprises a motor pinion 38 which is connected fixedly in terms of rotation to the drive shaft, not illustrated in any more detail in the drawing, of the actuator 32 designed as an electric motor. The motor pinion 38 meshes with an intermediate wheel 40 which likewise belongs to the gear unit 34 and which is arranged on an axle 42 rotatably in the housing 16 of the throttle valve assembly 10.

The intermediate wheel 40 comprises a pinion 44 and a gearwheel 46. The pinion 44 and the gearwheel 46 are manufactured from plastic 48. The pinion 44 and the gearwheel 46 are connected to one another in the manner of a locking pawl via a ratchet 50. The ratchet 50 is in this case manufactured in a spring-like manner from metal 52. The ratchet 50 engages, on the one hand, into undercuts 54 of the pinion 44, in such a way that the ratchet 50 and the pinion 44 are connected fixedly in terms of rotation to one another. On the other hand, the ratchet 50 engages into a ratchet arrangement 56 which is arranged on the toothed ring 46. The ratchet arrangement 56 is designed in such a way that, when a defined force threshold is exceeded, the gearwheel 46 rotates in relation to the pinion 44. In this case, the ratchet 50 in the ratchet arrangement 56 moves one or more units along the ratchet arrangement 56 as a function of the force exerted on the gearwheel. Below a defined force threshold, therefore, the gearwheel 46 and the pinion 44 are connected fixedly in terms of rotation to one another, whereas, above a defined force threshold, the gearwheel 46 can be rotated in relation to the pinion 44.

The pinion 44 meshes with a part-toothed ring 58 which is likewise assigned to the gear unit 34. The part-toothed ring 58 is arranged on a lever 60 which is connected fixedly in terms of rotation to the throttle valve shaft 22. The part-toothed ring 58 and the lever 60 are likewise assigned to the gear unit 34. Furthermore, the throttle valve shaft 22 is connected to a first end of a coil spring 62, the second end of which is connected fixedly to the housing 16.

The throttle orifice 20 has a contour 64, as can be seen in detail in figure 2. This contour has the effect that, during an adjustment of the throttle valve 23 by means of the drive device 30 in the direction of the closing position, the throttle valve 23 comes to bear

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against the contour 64 and cannot be moved beyond this abutment position by the actuator 32.

Figure 3 shows the drive device 30 of the throttle valve assembly 10 in a top view. The motor pinion 38 connected fixedly in terms of rotation to the drive shaft of the actuator 32 meshes with the gearwheel 46 of the intermediate wheel 40. The gearwheel 46 is connected to the pinion 44 via the ratchet 50. This connection is arranged on the side facing away from the observer of figure 3 and therefore cannot be seen in figure 3. What can be seen, however, is the pinion 44 which meshes with the part-toothed ring 58. The part-toothed ring 58 is in this case arranged on the lever 60 connected fixedly to the throttle valve shaft 22.

Figure 4 shows the individual parts, pinion 44, toothed ring 46 and ratchet 50. The pinion 44 of the intermediate wheel 40 has, on one of its sides, a toothed-ring structure 70 and, on its other side, an undercut 54, into which the ratchet 50 can be locked for a rotationally fixed connection to the pinion 44. In this case, the pinion 44 is to be arranged in the gearwheel 46 of the intermediate wheel 40 by means of a continuous web 72.

The toothed ring 46 has an outer continuous toothed-ring structure 74 and an inner ratchet arrangement 56. The ratchet arrangement 56 comprises a number of regular inclined planes or ratchet arrangements 76 which are lined up with one another in a circle. In three of these planes or ratchet arrangements 76, the ratchet 50 engages with ratchet geometries 78, preferably spherical, which are arranged at the ends of the three legs 80 of the ratchet 50.

Figure 5 shows the intermediate wheel from the front in figure 5a, from the side in figure 5b and from the rear in figure 5c.

If, then, a force which exceeds a defined force threshold acts on the gearwheel 46, the spheres or

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ratchet geometries 78 of the ratchet 50 travel up on the respective inclined planes or ratchet arrangements 76, in order then to lock into the next adjacent

inclined plane or ratchet arrangement 78. In this case, as a function of the force acting on the gearwheel, the spheres or ratchet geometries 78 of the ratchet 50 move one or more inclined planes or ratchet arrangements 76 further on.

When the throttle valve assembly 10 is in operation, the throttle valve 23 arranged on the throttle valve shaft 22 is opened and closed via the drive device 30. In this case, the actuator 32 is activated by a control device, not illustrated in any more detail in the drawing. If, then, the actuator 32 or the coil spring 62 moves the throttle valve 23 into the closing position via the gear unit 34, high forces can act on the gear unit 34 in the closing position. The closing position is in this case the position in which the throttle valve 23 closes the throttle orifice 20 approximately completely. After the closing position of the actuator 32 is reached, however, its drive shaft moves further on on account of the kinetic energy which is still present in the electric motor. This residue of kinetic energy is transmitted from the drive shaft of the actuator 32 to the gearwheel 46 of the intermediate wheel 40 via the motor pinion 38. However, since the throttle valve 32 now bears against the contour 64, the pinion 44 does not follow the rotational movement of the gearwheel 46. The forces in this case acting on the gearwheel 46 are such that the gearwheel 46 rotates in relation to the pinion 44 by means of the ratchet 50. The ratchet arrangement 56 of the gearwheel 46 is in this case arranged in such a way that the rotational movement of the gearwheel 46 in relation to the pinion 44 corresponds to the preferential direction of rotation of the ratchet engagement between the pinion 44 and the gearwheel 46. Without the ratchet engagement between the pinion 44 and the gearwheel 46, there would be the risk that, when the closing position was reached by the throttle valve 23, individual teeth of the gear unit, in particular of the pinion 44, could fracture,

with the result that the throttle valve assembly 10 would, in an extreme situation, become incapable of functioning.

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The connection of the pinion 44 to the gearwheel 46 via the ratchet 50 reliably ensures that excess kinetic energy of the actuator 32 can be absorbed even when the throttle valve 23 is secured, for example, in a closing position in the throttle orifice 20 of the throttle valve assembly 10.

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Patent claims

1. A drive device (30), in which a movable element (22) can be driven by an actuator (32) via a gear unit (34) and in which the gear unit (34) comprises a motor pinion (38), an intermediate wheel (40) and a toothed ring, and the intermediate wheel (40) comprises a pinion (44) and a gearwheel (46), the pinion (44) and the gearwheel (46) being connected via a ratchet (50) in such a way that the pinion (44) connected rigidly to the ratchet (50) can be rotated in relation to the gearwheel (46) in the manner of a locking pawl, characterized in that the toothed ring is designed as a part-toothed ring (58), and in that the gearwheel (46) and the pinion (44) are manufactured from plastic and the ratchet (50) from metal, the ratchet (50) being snapped onto the pinion (44).

2. The drive device (30) as claimed in claim 1, characterized in that the movable element (22) is a throttle valve shaft (22) which is arranged in a throttle valve assembly (10) and on which a throttle valve (23) is arranged pivotably.

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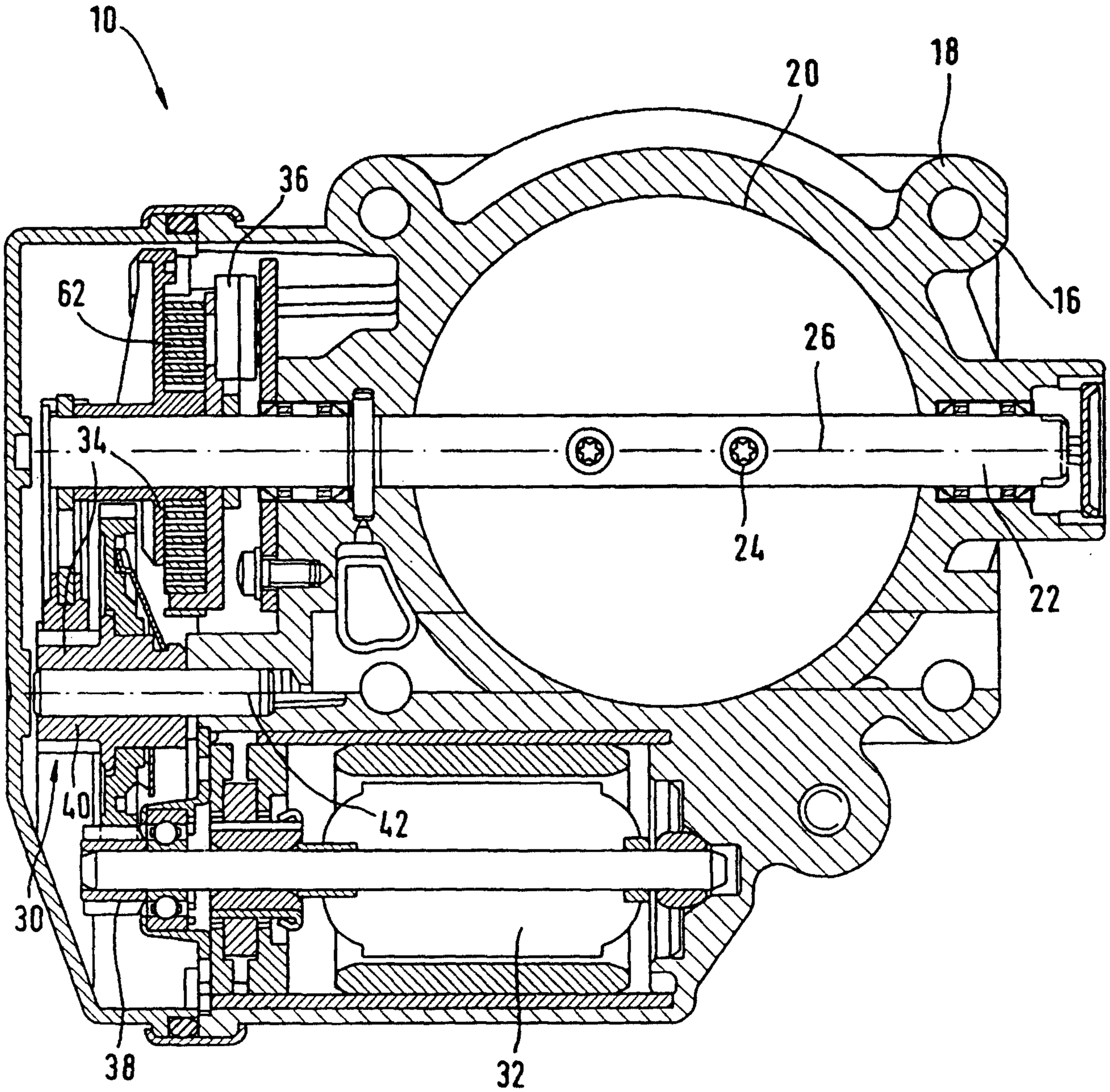
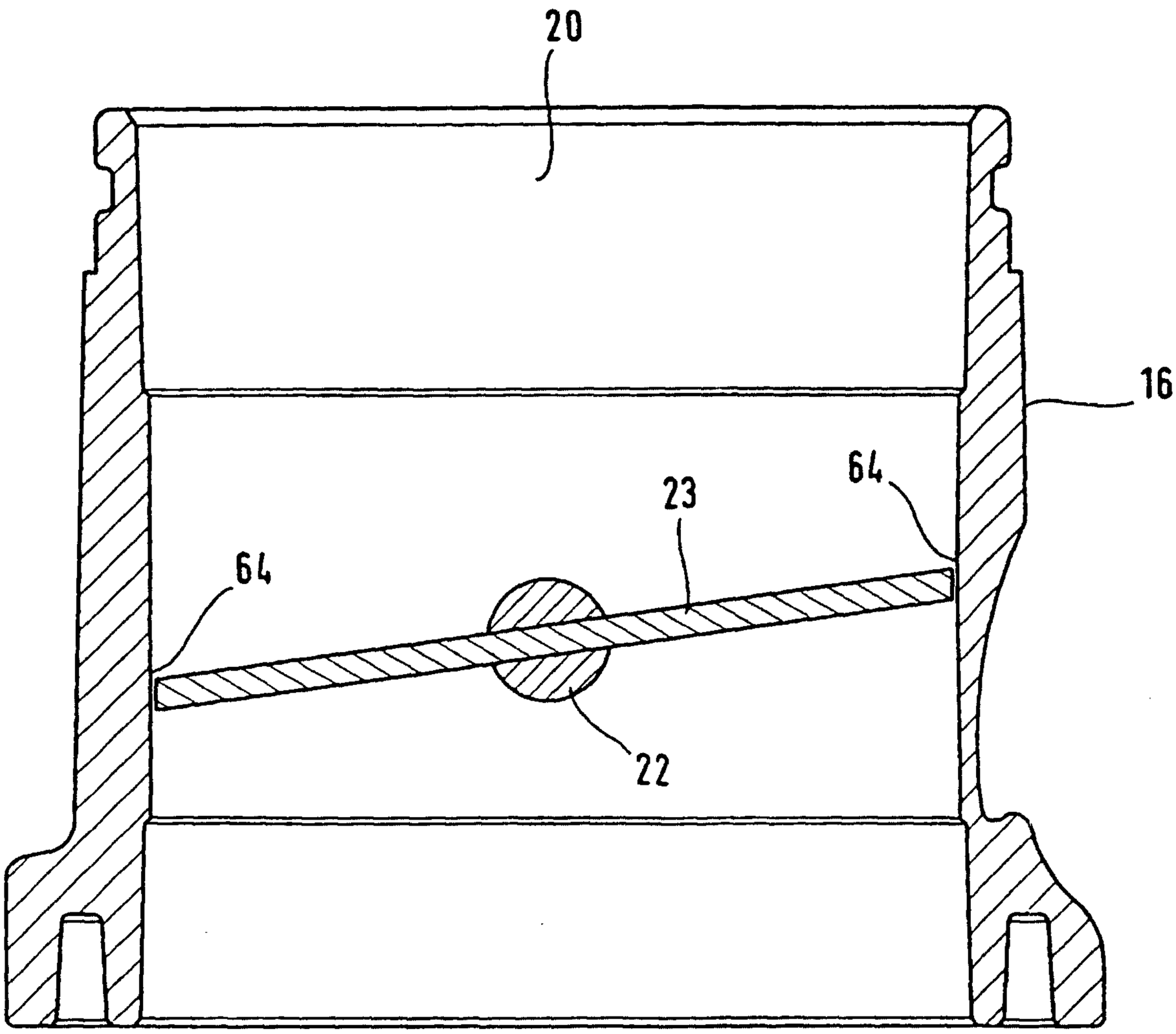


Fig. 1

Fig. 2



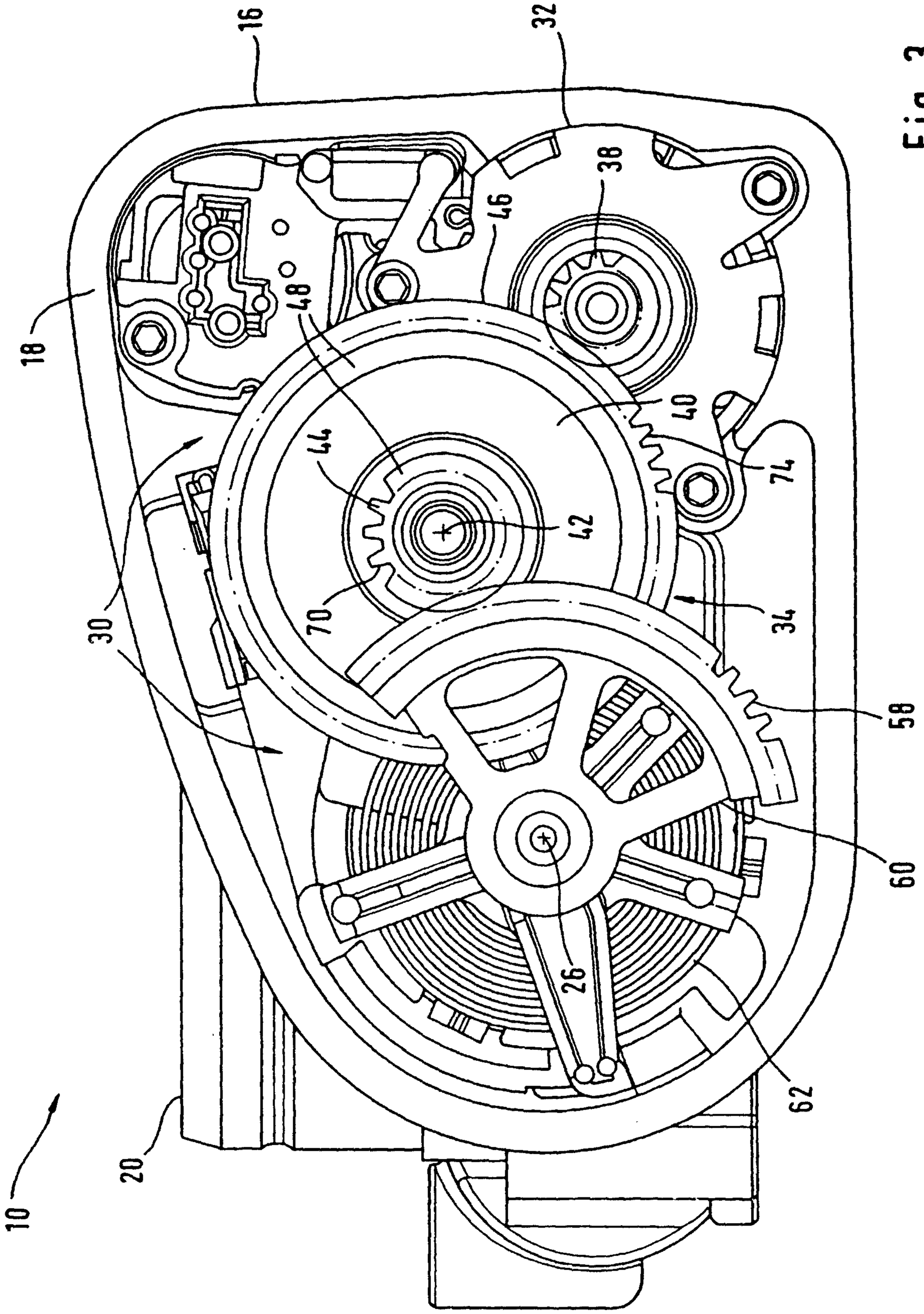


Fig. 3

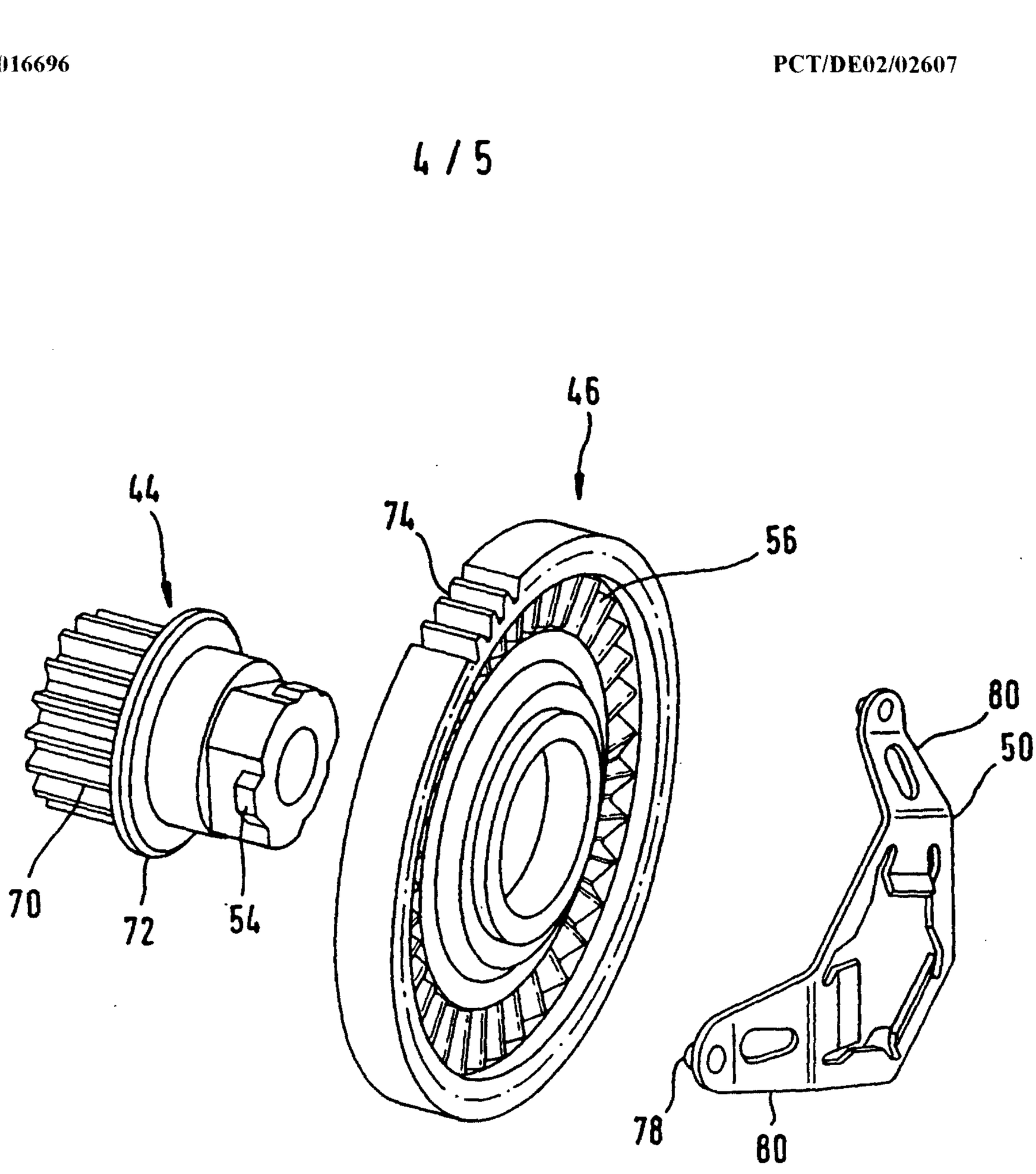


Fig. 4

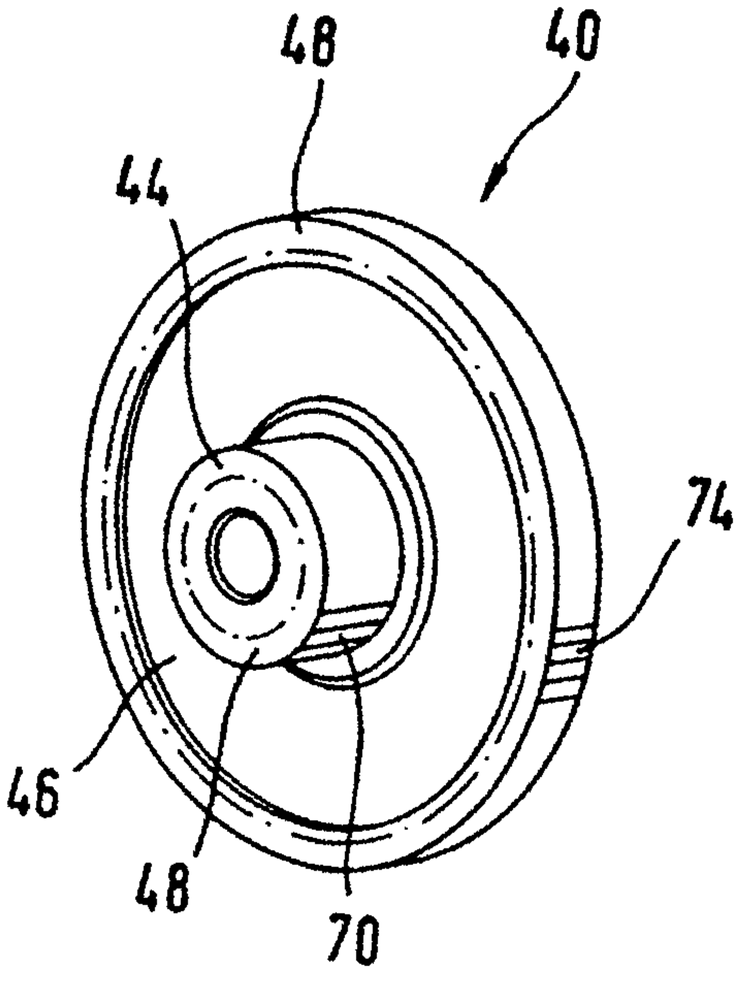


Fig. 5a

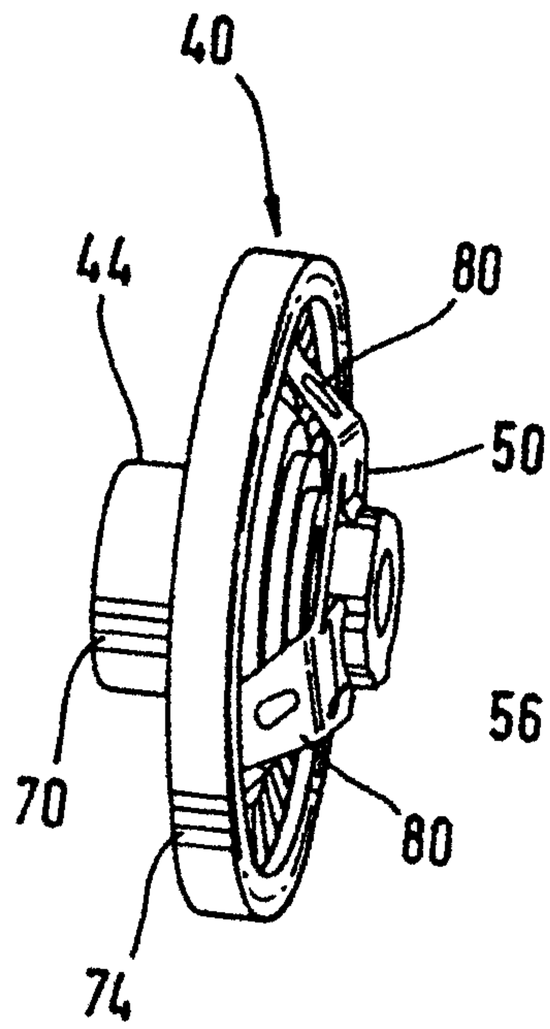


Fig. 5b

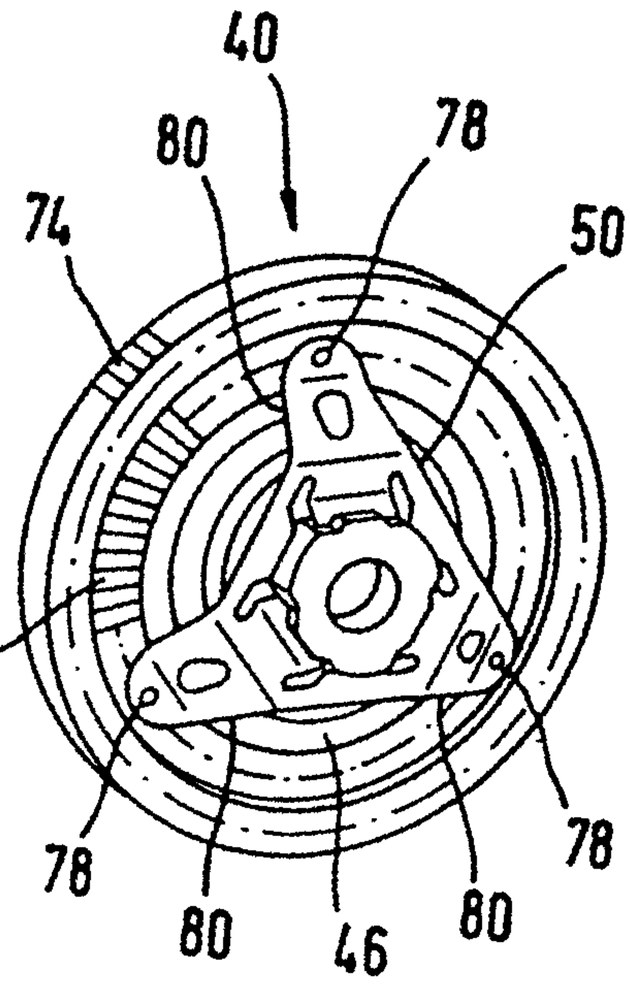
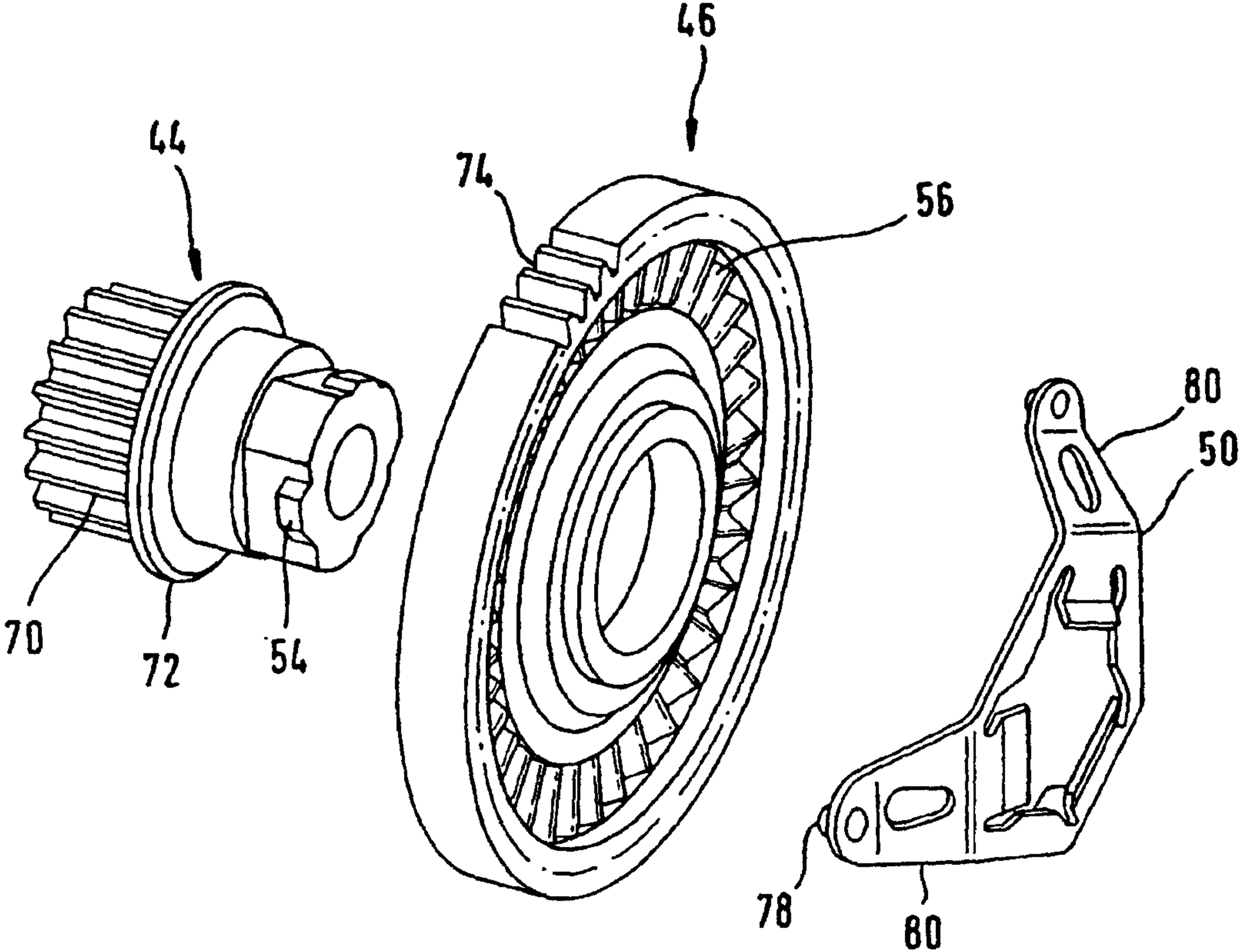


Fig. 5c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