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(71) Applicant: **ABB Schweiz AG**
5400 Baden (CH)

(72) Inventors:
• **GENTSCH, Dietmar**
40882 Ratingen (DE)
• **STEFANKA, Martin**
664 61 Rajhrad (CZ)
• **REUBER, Christian**
47877 Willich (DE)

(74) Representative: **Maiwald Patent- und Rechtsanwaltsgesellschaft mbH**
Elisenhof
Elisenstraße 3
80335 München (DE)

(54) **A LOW, MEDIUM OR HIGH VOLTAGE TWO OR THREE POSITION SWITCH**

(57) The present invention relates to a low, medium or high voltage two or three position switch, comprising: a shaft (6); a sun cogwheel (5); at least one planetary cogwheel (4); and a cogwheel ring (7). The shaft is fixedly connected to the sun cogwheel such that an axis of the shaft is coaxial with an axis of the sun cogwheel and the shaft and sun cogwheel rotate together. The sun cogwheel comprises a plurality of outward facing teeth. An axis of the cogwheel ring is coaxial with the axis of the sun cogwheel. The cogwheel ring comprises a plurality of inward facing teeth. The at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring. The at least one planetary cogwheel comprises a plurality of outward facing teeth. Some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring. In a first switching action, a rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in a first rotational direction is configured to rotate the sun cogwheel in the first rotational direction; and the rotation of the shaft associated with the rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

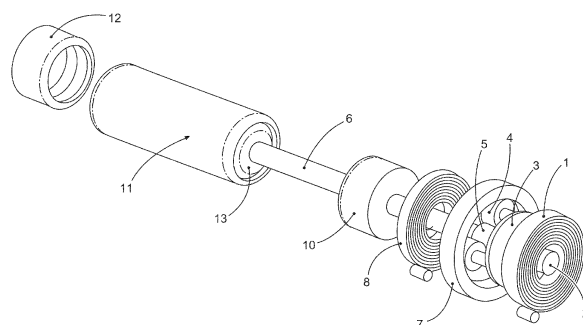


Fig. 1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a low, medium or high voltage two or three position switch, a low, medium or high voltage vacuum circuit breaker, and a low, medium or high voltage switching system.

BACKGROUND OF THE INVENTION

[0002] Low, medium or high voltage two-position switches such as switching poles or circuit breakers (CBs) and three-position switches with earth, centre and line contacts, generally use for example levers or shafts. For example, levers or shafts are used to connect several switching poles (usually 3) or other devices mechanically to one drive. The poles themselves require a translational movement (like SF6 poles or vacuum poles). With levers and shafts, it is difficult to connect several switching poles or devices unless they are arranged in one line.

[0003] For applications where an individual pole driving or a concentric device installed at the insulation part without a breaker housing is required, e.g. for synchronised switching or for having more freedom in the design of switchgears, the known mechanical CB drives are relatively large and complex. With magnetic drives, on the other hand, such solutions are possible, because these drives can be coupled relatively easily to Vacuum Interrupters (Vis) resulting in compact in-axis design for complete switching poles that already include the drive.

[0004] However, such magnetic drives are not always an optimal solution.

[0005] Three-position switches also require more mechanical stability and control of contact movement than presently achievable.

[0006] There is a need to address these issues.

SUMMARY OF THE INVENTION

[0007] Therefore, it would be advantageous to have an improved low, medium or high voltage two or three position switch..

[0008] The object of the present invention is solved with the subject matter of the independent claims, wherein further embodiments are incorporated in the dependent claims.

[0009] In a first aspect, there is provided a low, medium or high voltage two or three position switch, comprising:

- a shaft;
- a sun cogwheel;
- at least one planetary cogwheel; and
- a cogwheel ring.

[0010] The shaft is fixedly connected to the sun cogwheel such that an axis of the shaft is coaxial with an axis of the sun cogwheel and the shaft and sun cogwheel

rotate together. The sun cogwheel comprises a plurality of outward facing teeth. An axis of the cogwheel ring is coaxial with the axis of the sun cogwheel. The cogwheel ring comprises a plurality of inward facing teeth. The at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring. The at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring. In a first switching action:

a rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in a first rotational direction is configured to rotate the sun cogwheel in the first rotational direction; and
the rotation of the shaft associated with the rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

[0011] In this manner, rotational movement of planetary cogwheels about a centre axis leads to each planetary cogwheel also rotating about its own axis and this rotation is coupled to the sun cogwheel which then rotates and in doing so rotates the shaft that can be used to transition the switch from one state to another.

[0012] In an example, the at least one planetary cogwheel comprises three planetary cogwheels.

[0013] In an example, the low, medium or high voltage switch is a vacuum circuit breaker or two-position switch or three-position switch.

[0014] In an example, in the first switching action the switch is configured such that the cogwheel ring does not rotate.

[0015] In an example, the switch comprises a piston with a threaded portion. The shaft comprises a threaded portion, and the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

[0016] In an example, in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

[0017] In this way, because the shaft is threaded and the piston is threaded, rotation of the shaft whilst the piston cannot rotate necessarily leads to translation of the piston.

[0018] In an example, the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

state.

[0019] In an example, the shaft comprises at least one crankshaft portion coupled to a lever system comprising a pushrod. In the first switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

[0020] In an example, the switch comprises a carrier. An axis of the carrier is coaxial with the axis of the sun cogwheel. Each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier. In the first switching action a rotation of the carrier about the axis of the sun cogwheel in the first rotational direction is configured to rotate the at least one planetary cogwheel in the first rotational direction.

[0021] In other words, the carrier can be a ring type structure to which is mounted the planetary cogwheels. Then, the carrier can be stationary and the sun cogwheel and the cogwheel ring can rotate as the individual planetary cogwheels rotate about their own axes. Also, the carrier can rotate, and with the cogwheel ring stationary the individual planetary cogwheels rotate as the carrier rotates and this rotation is coupled to the sun cogwheel which then rotates. Also, the carrier can rotate, and with the sun cogwheel stationary the individual planetary cogwheels rotate as the carrier rotates in this rotation is coupled to the cogwheel ring which then rotates.

[0022] In an example, a first end of a first spring is coupled to the at least one planetary cogwheel. In the first switching action energy release from the first spring is configured to rotate the at least one planetary cogwheel in the first rotational direction about the axis of the sun cogwheel.

[0023] In an example, in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position.

[0024] In an example, the first end of the first spring is coupled to the at least one planetary cogwheel via the carrier.

[0025] In an example, in the first switching action the rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring.

[0026] In this way, the first switching action can store energy required for a return or second switching action bringing the switch back to its original configuration.

[0027] In an example, in a second switching action energy release from the second spring is configured to rotate the sun cogwheel in a second rotational direction opposite to the first rotational direction. The rotation of the shaft associated with the rotation of the sun cogwheel in the second rotational direction is configured to transition the switch from the second switch-state to the first switch-state.

[0028] In an example, a first end of the second spring is connected to the shaft.

[0029] In an example, a second end of the second

spring is held in a fixed position.

[0030] In an example, in the second switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel.

[0031] In other words, the sun cogwheel rotates, but the individual planetary cogwheels are not rotating about the centre axis but are each rotating about their own axes, and this leads to the cogwheel ring rotating. Thus, in this manner the second switching movement is not constrained by storing energy in the first spring used to drive the first switching movement because the planetary cogwheels are not rotating as a whole around a centre axis but only rotating about their own axes.

[0032] In an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

[0033] In an example, in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

[0034] In an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

[0035] In an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the first switch-state.

[0036] In an example, in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

[0037] In an example, the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

[0038] In this manner, a simple way of charging the switch for switching operation is enabled.

[0039] In an example, following the first switching action a further rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

[0040] In an example, prior to the second switching action energy release from the second spring is configured to rotate the sun cogwheel in the second rotational direction to transition the switch from the third switch-state to the second switch-state.

[0041] In a second aspect, there is provided a low, medium or high voltage vacuum circuit breaker comprising a switch according to the first aspect.

[0042] In a third aspect, there is provided a low, medium or high voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to the first aspect;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- a third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch.

[0043] Rotation of the shaft of the first low, medium or high voltage two or three position switch in the first rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

[0044] In a fourth aspect, there is provided a low, medium or high voltage two or three position switch, comprising:

- a shaft;
- a sun cogwheel;
- at least one planetary cogwheel; and
- a cogwheel ring.

[0045] The shaft is fixedly connected to the sun cogwheel such that an axis of the shaft is coaxial with an axis of the sun cogwheel and the shaft and sun cogwheel rotate together. The sun cogwheel comprises a plurality of outward facing teeth. An axis of the cogwheel ring is coaxial with the axis of the sun cogwheel. The cogwheel ring comprises a plurality of inward facing teeth. The at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring. The at least one planetary cogwheel comprises a plurality of outward facing teeth, and some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring. In a first switching action:

a rotation of the cogwheel ring about the axis of the sun cogwheel in a first rotational direction is configured to rotate the sun cogwheel in a second rotational direction opposite to the first rotational direction; and the rotation of the shaft associated with the rotation of the sun cogwheel in the second rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

[0046] In this manner, rotational movement of a cogwheel ring about a centre axis leads to each planetary cogwheel also rotating about its own axis and this rotation is coupled to the sun cogwheel which then rotates and in doing rotates the shaft that can be used to transition the switch from one state to another.

[0047] In an example, the at least one planetary cogwheel comprises three planetary cogwheels.

[0048] In an example, the low, medium or high voltage switch is a vacuum circuit breaker or two-position switch or three-position switch.

[0049] In an example, in the first switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the shaft.

[0050] In an example, the switch comprises a piston with a threaded portion. The shaft comprises a threaded portion, and the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft. In the first switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

[0051] In an example, in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

[0052] In this way, because the shaft is threaded and the piston is threaded, rotation of the shaft whilst the piston cannot rotate necessarily leads to translation of the piston.

[0053] In an example, the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft. In the first switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

[0054] In an example, the shaft comprises at least one crankshaft portion coupled to a lever system comprising a pushrod. In the first switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

[0055] In an example, the switch comprises a carrier. An axis of the carrier is coaxial with the axis of the sun cogwheel. Each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier. The switch is configured such that in the first switching action the carrier is configured not to rotate about the axis of the sun cogwheel.

[0056] In other words, the carrier can be a ring type structure to which is mounted the planetary cogwheels. Then, the carrier can be stationary and the sun cogwheel and the cogwheel ring can rotate as the individual planetary cogwheels rotate about their own axes. Also, the carrier can rotate, and with the cogwheel ring stationary

the individual planetary cogwheels rotate as the carrier rotates and this rotation is coupled to the sun cogwheel which then rotates. Also, the carrier can rotate, and with the sun cogwheel stationary the individual planetary cogwheels rotate as the carrier rotates in this rotation is coupled to the cogwheel ring which then rotates.

[0057] In an example, a first end of a first spring is coupled to the cogwheel ring. In the first switching action energy release from the first spring is configured to rotate the cogwheel ring in the first rotational direction about the axis of the sun cogwheel.

[0058] In an example, in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position.

[0059] In an example, in the first switching action the rotation of the cogwheel ring about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring.

[0060] In this way, the first switching action can store energy required for a return or second switching action bringing the switch back to its original configuration.

[0061] In an example, in a second switching action energy release from the second spring is configured to rotate the sun cogwheel in the first rotational direction. The rotation of the shaft associated with the rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to the first switch-state.

[0062] In an example, a first end of the second spring is connected to the shaft.

[0063] In an example, a second end of the second spring is held in a fixed position.

[0064] In an example, in the second switching action the switch is configured such that the cogwheel ring does not rotate about the axis of the sun cogwheel.

[0065] In other words, the sun cogwheel rotates, and the planetary cogwheels rotate about the centre axis and each planetary cogwheel are each rotating about their own axes, and this with the cogwheel ring not rotating. Thus, in this manner the second switching movement is not constrained by storing energy in the first spring used to drive the first switching movement because the cogwheel ring is not rotating.

[0066] In an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

[0067] In an example, in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

[0068] In an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

[0069] In an example, in the second switching action

the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the first switch-state.

[0070] In an example, in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

[0071] In an example, the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

[0072] In this manner, a simple way of charging the switch for switching operation is enabled.

[0073] In an example, following the first switching action a further rotation of the cogwheel ring about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

[0074] In an example, prior to the second switching action energy release from the second spring is configured to rotate the sun cogwheel in the first rotational direction to transition the switch from the third switch-state to the second switch-state.

[0075] In a fifth aspect, there is provided a low, medium or high voltage vacuum circuit breaker comprising a switch according to the fourth aspect.

[0076] In a sixth aspect, there is provided a low, medium or high voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to the fourth aspect;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- a third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch.

[0077] Rotation of the shaft of the first low, medium or high voltage two or three position switch in the second rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

[0078] In a seventh aspect, there is provided a low, medium or high voltage two or three position switch, comprising:

- a shaft;
- a sun cogwheel;
- at least one planetary cogwheel; and
- a cogwheel ring.

[0079] The shaft is fixedly connected to the cogwheel ring such that an axis of the shaft is coaxial with an axis of the cogwheel ring and the shaft and cogwheel ring rotate together. The sun cogwheel comprises a plurality of outward facing teeth. The axis of the cogwheel ring is coaxial with an axis of the sun cogwheel. The cogwheel ring comprises a plurality of inward facing teeth. The at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring. The at least one planetary cogwheel comprises a plurality of outward facing teeth. Some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring. In a first switching action:

a rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in a first rotational direction is configured to rotate the cogwheel ring in a first rotational direction; and
the rotation of the shaft associated with the rotation of the cogwheel ring in the first rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

[0080] In this manner, rotational movement of planetary cogwheels about a centre axis leads to each planetary cogwheel also rotating about its own axis and this rotation is coupled to the cogwheel ring which then rotates and in doing so rotates the shaft that can be used to transition the switch from one state to another.

[0081] In an example, the at least one planetary cogwheel comprises three planetary cogwheels.

[0082] In an example, the low, medium or high voltage switch is a vacuum circuit breaker or two-position switch or three-position switch.

[0083] In an example, in the first switching action the switch is configured such that the sun cogwheel does not rotate.

[0084] In an example, the switch comprises a piston with a threaded portion. The shaft comprises a threaded portion, and the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

[0085] In an example, in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

[0086] In this way, because the shaft is threaded and the piston is threaded, rotation of the shaft whilst the pis-

ton cannot rotate necessarily leads to translation of the piston.

[0087] In an example, the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

[0088] In an example, the shaft comprises at least one crankshaft portion coupled to a lever system comprising a pushrod. In the first switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

[0089] In an example, the switch comprises a carrier. An axis of the carrier is coaxial with the axis of the sun cogwheel. Each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier. In the first switching action a rotation of the carrier about the axis of the sun cogwheel in the first rotational direction is configured to rotate the at least one planetary cogwheel in the first rotational direction.

[0090] In other words, the carrier can be a ring type structure to which is mounted the planetary cogwheels. Then, the carrier can be stationary and the sun cogwheel and the cogwheel ring can rotate as the individual planetary cogwheels rotate about their own axes. Also, the carrier can rotate, and with the cogwheel ring stationary the individual planetary cogwheels rotate as the carrier rotates and this rotation is coupled to the sun cogwheel which then rotates. Also, the carrier can rotate, and with the sun cogwheel stationary the individual planetary cogwheels rotate as the carrier rotates in this rotation is coupled to the cogwheel ring which then rotates.

[0091] In an example, a first end of a first spring is coupled to the at least one planetary cogwheel. In the first switching action energy release from a first spring is configured to rotate the at least one planetary cogwheel in the first rotational direction about the axis of the sun cogwheel.

[0092] In an example, in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position.

[0093] In an example, the first end of the first spring is coupled to the at least one planetary cogwheel via the carrier.

[0094] In an example, in the first switching action the rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring.

[0095] In this way, the first switching action can store energy required for a return or second switching action bringing the switch back to its original configuration.

[0096] In an example, in a second switching action energy release from the second spring is configured to rotate the cogwheel ring in a second rotational direction

opposite to the first rotational direction.

[0097] In an example, a first end of the second spring is connected to the shaft.

[0098] In an example, a second end of the second spring is held in a fixed position.

[0099] In an example, in the second switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel.

[0100] In other words, the cogwheel ring rotates, but the individual planetary cogwheels are not rotating about the centre axis but are each rotating about their own axes, and this leads to the sun cogwheel rotating. Thus, in this manner the second switching movement is not constrained by storing energy in the first spring used to drive the first switching movement because the planetary cogwheels are not rotating as a whole around a centre axis but only rotating about their own axes.

[0101] In an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

[0102] In an example, in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

[0103] In an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

[0104] In an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the first switch-state.

[0105] In an example, in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

[0106] In an example, the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

[0107] In this manner, a simple way of charging the switch for switching operation is enabled.

[0108] In an example, following the first switching action a further rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

[0109] In an example, prior to the second switching action energy release from the second spring is configured to rotate the cogwheel ring in the second rotational direction to transition the switch from the third switch-state to the second switch-state.

[0110] In an eighth aspect, there is provided a low, medium or high voltage vacuum circuit breaker comprising

a switch according to the seventh aspect.

[0111] In a ninth aspect, there is provided a low, medium or high voltage switching system, comprising:

- 5 - a first low, medium or high voltage two or three position switch according to the seventh aspect;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- 10 - a third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch. Rotation of the shaft of the first low, medium or high voltage two or three position switch in the first rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

[0112] In a tenth aspect, there is provided a low, medium or high voltage two or three position switch, comprising:

- a shaft;
- a sun cogwheel;
- 35 - at least one planetary cogwheel; and
- a cogwheel ring.

[0113] The shaft is fixedly connected to the cogwheel ring such that an axis of the shaft is coaxial with an axis of the cogwheel ring and the shaft and cogwheel ring rotate together. The sun cogwheel comprises a plurality of outward facing teeth. The axis of the cogwheel ring is coaxial with an axis of the sun cogwheel. The cogwheel ring comprises a plurality of inward facing teeth. The at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring. The at least one planetary cogwheel comprises a plurality of outward facing teeth. Some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring. In a first switching action:

- 55 a rotation of the sun cogwheel in a first rotational direction is configured to rotate the cogwheel ring in a second rotational direction counter to the first rotational direction; and
- the rotation of the shaft associated with the rotation

of the cogwheel ring in the second rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

[0114] In an example, the at least one planetary cogwheel comprises three planetary cogwheels.

[0115] In an example, in the first switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel.

[0116] In an example, the switch comprises a piston with a threaded portion. The shaft comprises a threaded portion, and the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft. In the first switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

[0117] In an example, in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

[0118] In an example, the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

[0119] In an example, the shaft comprises at least one crankshaft portion coupled to a lever system comprising a pushrod. In the first switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

[0120] In an example, the switch comprises a carrier. An axis of the carrier is coaxial with the axis of the sun cogwheel. Each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier. The switch is configured such that in the first switching action the carrier is configured not to rotate about the axis of the sun cogwheel.

[0121] In an example, a first end of a first spring is coupled to the sun cogwheel. In the first switching action energy release from the first spring is configured to rotate the sun cogwheel in the first rotational direction about the axis of the sun cogwheel.

[0122] In an example, in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position.

[0123] In an example, in the first switching action the rotation of the sun cogwheel in the first rotational direction is configured to store energy in a second spring.

[0124] In an example, in a second switching action energy release from the second spring is configured to rotate the cogwheel ring in the first rotational direction opposite to the second rotational direction. The rotation of

the shaft associated with the rotation of the cogwheel ring in the first rotational direction is configured to transition the switch from the second switch-state to the first switch-state.

[0125] In an example, a first end of the second spring is connected to the shaft.

[0126] In an example, a second end of the second spring is held in a fixed position.

[0127] In an example, in the second switching action the switch is configured such that the sun cogwheel does not rotate about the axis of the sun cogwheel.

[0128] In an example, in the second switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

[0129] In an example, in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

[0130] In an example, in the second switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

[0131] In an example, in the second switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the first switch-state.

[0132] In an example, in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

[0133] In an example, prior to the first switching action the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

[0134] In an example, following the first switching action a further rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

[0135] In an example, prior to the second switching action energy release from the second spring is configured to rotate the cogwheel ring in the first rotational direction to transition the switch from the third switch-state to the second switch-state.

[0136] In an eleventh aspect, there is provided a low, medium or high voltage vacuum circuit breaker comprising a switch according to the tenth aspect.

[0137] In a twelfth aspect, there is provided a low, medium or high voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to the tenth aspect;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft

of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;

- a third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch. Rotation of the shaft of the first low, medium or high voltage two or three position switch in the second rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

[0138] The above aspects and examples will become apparent from and be elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0139] Exemplary embodiments will be described in the following with reference to the following drawings:

Fig. 1 shows a schematic view of an exemplar three position switch in a disconnected state;

Fig. 2 shows a schematic view of the exemplar three position switch of Fig. 1 in a connected state;

Fig. 3 shows a schematic view of the exemplar three position switch of Figs. 1-2 in an earthed state;

Fig. 4 shows an schematic view of an exemplar three position switch driving two further three position switches as part of a three phase switching system; and

Figs. 5-6 shows schematic representations of exemplar two position switches with vacuum interrupters (or vacuum circuit breakers) forming part of a three phase circuit breaker.

DETAILED DESCRIPTION OF EMBODIMENTS

[0140] Figs. 1-6 relate to examples of a low, medium or high voltage two or three position switches. Not every embodiment described below is actually shown in the figures.

Embodiment 1

[0141] In an example a low, medium or high voltage two or three position switch comprises a shaft 6, a sun cogwheel 5, at least one planetary cogwheel 4, and a

cogwheel ring 7. The shaft is fixedly connected to the sun cogwheel such that an axis of the shaft is coaxial with an axis of the sun cogwheel and the shaft and sun cogwheel rotate together. The sun cogwheel comprises a plurality of outward facing teeth. An axis of the cogwheel ring is coaxial with the axis of the sun cogwheel. The cogwheel ring comprises a plurality of inward facing teeth. The at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring. The at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring. In a first switching action:

a rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in a first rotational direction is configured to rotate the sun cogwheel in the first rotational direction; and
the rotation of the shaft associated with the rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

[0142] In an example, the at least one planetary cogwheel comprises three planetary cogwheels.

[0143] In an example, the low, medium or high voltage switch is a vacuum circuit breaker or two-position switch or three-position switch.

[0144] According to an example, in the first switching action the switch is configured such that the cogwheel ring does not rotate. This can for example be via it being locked or latched in position.

[0145] According to an example, the switch comprises a piston 13 with a threaded portion. The shaft comprises a threaded portion, and the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

[0146] According to an example, in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates. This can for example be via it being able to slide but not rotate.

[0147] According to an example, the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

[0148] According to an example, the shaft comprises at least one crankshaft portion 30 coupled to a lever system comprising a pushrod 31. In the first switching action the rotation of the shaft in the first rotational direction is

configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

[0149] According to an example, the switch comprises a carrier 3. An axis of the carrier is coaxial with the axis of the sun cogwheel. Each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier. In the first switching action a rotation of the carrier about the axis of the sun cogwheel in the first rotational direction is configured to rotate the at least one planetary cogwheel in the first rotational direction.

[0150] According to an example, a first end of a first spring 1 is coupled to the at least one planetary cogwheel. In the first switching action energy release from the first spring 1 is configured to rotate the at least one planetary cogwheel in the first rotational direction about the axis of the sun cogwheel.

[0151] According to an example, in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position. This can for example be via it being locked or latched in position.

[0152] According to an example, the first end of the first spring is coupled to the at least one planetary cogwheel via the carrier.

[0153] According to an example, in the first switching action the rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring 8.

[0154] According to an example, in a second switching action energy release from the second spring is configured to rotate the sun cogwheel in a second rotational direction opposite to the first rotational direction. The rotation of the shaft associated with the rotation of the sun cogwheel in the second rotational direction is configured to transition the switch from the second switch-state to the first switch-state.

[0155] According to an example, a first end of the second spring is connected to the shaft.

[0156] According to an example, a second end of the second spring is held in a fixed position. This can for example be via it being locked or latched in position.

[0157] According to an example, in the second switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel. This can for example be via it being locked or latched in position.

[0158] According to an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

[0159] According to an example, in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates. This can for example be via it being able to slide but not

rotate.

[0160] According to an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

[0161] According to an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the third switch-state.

[0162] According to an example, in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

[0163] According to an example, the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

[0164] According to an example, following the first switching action a further rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

[0165] According to an example, prior to the second switching action energy release from the second spring is configured to rotate the sun cogwheel in the second rotational direction to transition the switch from the third switch-state to the second switch-state.

[0166] The above described switch of embodiment 1 can form part of a low, medium or high voltage vacuum circuit breaker.

[0167] One switch of embodiment 1 can be coupled to two switches that do not have their own planetary drive systems, and as such are in effect "pared down" switches. This enables a three phase switch system to be implemented. An example of such a low, medium or high voltage switching system comprises a first low, medium or high voltage two or three position switch as described above. It also has a pared down second low, medium or high voltage two or three position switch, comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch. It also has a pared down third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch. Rotation of the shaft of the first low, medium or high voltage two or three position switch in the first rotational direction is configured to transition each switch from a first switch-state to a sec-

ond switch-state and optionally from the second switch-state to a third switch-state.

Embodiment 2

[0168] In an example a low, medium or high voltage two or three position switch comprises a shaft 6, a sun cogwheel 5, at least one planetary cogwheel 4, and a cogwheel ring 7. The shaft is fixedly connected to the sun cogwheel such that an axis of the shaft is coaxial with an axis of the sun cogwheel and the shaft and sun cogwheel rotate together. The sun cogwheel comprises a plurality of outward facing teeth. An axis of the cogwheel ring is coaxial with the axis of the sun cogwheel. The cogwheel ring comprises a plurality of inward facing teeth. The at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring. The at least one planetary cogwheel comprises a plurality of outward facing teeth, and some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring. In a first switching action:

a rotation of the cogwheel ring about the axis of the sun cogwheel in a first rotational direction is configured to rotate the sun cogwheel in a second rotational direction opposite to the first rotational direction; and the rotation of the shaft associated with the rotation of the sun cogwheel in the second rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

[0169] In an example, the at least one planetary cogwheel comprises three planetary cogwheels.

[0170] In an example, the low, medium or high voltage switch is a vacuum circuit breaker or two-position switch or three-position switch.

[0171] According to an example, in the first switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the shaft. This can for example be via it being locked or latched in position.

[0172] According to an example, the switch comprises a piston 13 with a threaded portion. The shaft comprises a threaded portion, and the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft. In the first switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

[0173] According to an example, in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates. This can for example be via it being able to slide but not rotate.

[0174] According to this way, because the shaft is threaded and the piston is threaded, rotation of the shaft

whilst the piston cannot rotate necessarily leads to translation of the piston.

[0175] According to an example, the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft. In the first switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

[0176] According to an example, the shaft comprises at least one crankshaft portion 30 coupled to a lever system comprising a pushrod 31. In the first switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

[0177] According to an example, the switch comprises a carrier 3. An axis of the carrier is coaxial with the axis of the sun cogwheel. Each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier. The switch is configured such that in the first switching action the carrier is configured not to rotate about the axis of the sun cogwheel. This can for example be via it being locked or latched in position.

[0178] According to an example, a first end of a first spring 1 is coupled to the cogwheel ring. In the first switching action energy release from the first spring 1 is configured to rotate the cogwheel ring in the first rotational direction about the axis of the sun cogwheel.

[0179] According to an example, in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position. This can for example be via it being locked or latched in position.

[0180] According to an example, in the first switching action the rotation of the cogwheel ring about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring 8.

[0181] According to an example, in a second switching action energy release from the second spring is configured to rotate the sun cogwheel in the first rotational direction. The rotation of the shaft associated with the rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to the first switch-state.

[0182] According to an example, a first end of the second spring is connected to the shaft.

[0183] According to an example, a second end of the second spring is held in a fixed position.

[0184] According to an example, in the second switching action the switch is configured such that the cogwheel ring does not rotate about the axis of the sun cogwheel. This can for example be via it being locked or latched in position.

[0185] According to an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first

direction to transition the switch from the second switch-state to the first switch-state.

[0186] According to an example, in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates. This can for example be via it being able to slide but not rotate.

[0187] According to an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

[0188] According to an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the first switch-state.

[0189] According to an example, in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

[0190] According to an example, the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

[0191] According to an example, following the first switching action a further rotation of the cogwheel ring about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

[0192] According to an example, prior to the second switching action energy release from the second spring is configured to rotate the sun cogwheel in the first rotational direction to transition the switch from the third switch-state to the second switch-state.

[0193] The above described switch of embodiment 2 can form part of a low, medium or high voltage vacuum circuit breaker.

[0194] One switch of embodiment 2 can be coupled to two pared down switches that do not have their own planetary drive systems. This enables a three phase switch system to be implemented. An example of such a low, medium or high voltage switching system comprises a first low, medium or high voltage two or three position switch as described above. It also has a pared down second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch. It also has a pared down third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low,

medium or high voltage two or three position switch. Rotation of the shaft of the first low, medium or high voltage two or three position switch in the second rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

Embodiment 3

[0195] In an example a low, medium or high voltage two or three position switch comprises a shaft 6, a sun cogwheel 5, at least one planetary cogwheel 4, and a cogwheel ring 7. The shaft is fixedly connected to the cogwheel ring such that an axis of the shaft is coaxial with an axis of the cogwheel ring and the shaft and cogwheel ring rotate together. The sun cogwheel comprises a plurality of outward facing teeth. The axis of the cogwheel ring is coaxial with an axis of the sun cogwheel. The cogwheel ring comprises a plurality of inward facing teeth. The at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring. The at least one planetary cogwheel comprises a plurality of outward facing teeth. Some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring. In a first switching action:

a rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in a first rotational direction is configured to rotate the cogwheel ring in a first rotational direction; and
the rotation of the shaft associated with the rotation of the cogwheel ring in the first rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

[0196] In an example, the at least one planetary cogwheel comprises three planetary cogwheels.

[0197] In an example, the low, medium or high voltage switch is a vacuum circuit breaker or two-position switch or three-position switch.

[0198] According to an example, in the first switching action the switch is configured such that the sun cogwheel does not rotate. This can for example be via it being locked or latched in position.

[0199] According to an example, the switch comprises a piston 13 with a threaded portion. The shaft comprises a threaded portion, and the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

[0200] According to an example, in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates. This

can for example be via it being able to slide but not rotate.

[0201] According to an example, the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

[0202] According to an example, the shaft comprises at least one crankshaft portion 30 coupled to a lever system comprising a pushrod 31. In the first switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

[0203] According to an example, the switch comprises a carrier 3. An axis of the carrier is coaxial with the axis of the sun cogwheel. Each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier. In the first switching action a rotation of the carrier about the axis of the sun cogwheel in the first rotational direction is configured to rotate the at least one planetary cogwheel in the first rotational direction.

[0204] According to an example, a first end of a first spring 1 is coupled to the at least one planetary cogwheel. In the first switching action energy release from a first spring 1 is configured to rotate the at least one planetary cogwheel in the first rotational direction about the axis of the sun cogwheel.

[0205] According to an example, in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position. This can for example be via it being locked or latched in position.

[0206] According to an example, the first end of the first spring is coupled to the at least one planetary cogwheel via the carrier.

[0207] According to an example, in the first switching action the rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring 8.

[0208] According to an example, in a second switching action energy release from the second spring is configured to rotate the cogwheel ring in a second rotational direction opposite to the first rotational direction.

[0209] According to an example, a first end of the second spring is connected to the shaft.

[0210] According to an example, a second end of the second spring is held in a fixed position. This can for example be via it being locked or latched in position.

[0211] According to an example, in the second switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel. This can for example be via it being locked or latched in position.

[0212] According to an example, in the second switching action the rotation of the shaft in the second rotational

direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

5 **[0213]** According to an example, in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates. This can for example be via it being able to slide but not rotate.

10 **[0214]** According to an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

15 **[0215]** According to an example, in the second switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the first switch-state.

20 **[0216]** According to an example, in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

25 **[0217]** According to an example, the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

30 **[0218]** According to an example, following the first switching action a further rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

35 **[0219]** According to an example, prior to the second switching action energy release from the second spring is configured to rotate the cogwheel ring in the second rotational direction to transition the switch from the third switch-state to the second switch-state.

40 **[0220]** The above described switch of embodiment 3 can form part of a low, medium or high voltage vacuum circuit breaker.

45 **[0221]** One switch of embodiment 3 can be coupled to two pared down switches that do not have their own planetary drive systems. This enables a three phase switch system to be implemented. An example of such a low, medium or high voltage switching system comprises a first low, medium or high voltage two or three position switch as described above. It also has a pared down second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch. It also has a pared down third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three po-

sition switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch. Rotation of the shaft of the first low, medium or high voltage two or three position switch in the first rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

Embodiment 4

[0222] In an example a low, medium or high voltage two or three position switch comprises a shaft 6, a sun cogwheel 5, at least one planetary cogwheel 4, and a cogwheel ring 7. The shaft is fixedly connected to the cogwheel ring such that an axis of the shaft is coaxial with an axis of the cogwheel ring and the shaft and cogwheel ring rotate together. The sun cogwheel comprises a plurality of outward facing teeth. The axis of the cogwheel ring is coaxial with an axis of the sun cogwheel. The cogwheel ring comprises a plurality of inward facing teeth. The at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring. The at least one planetary cogwheel comprises a plurality of outward facing teeth. Some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring. In a first switching action:

a rotation of the sun cogwheel in a first rotational direction is configured to rotate the cogwheel ring in a second rotational direction counter to the first rotational direction; and
the rotation of the shaft associated with the rotation of the cogwheel ring in the second rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

[0223] In an example, the at least one planetary cogwheel comprises three planetary cogwheels.

[0224] In an example, in the first switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel. This can for example be via it being locked or latched in position.

[0225] According to an example, the switch comprises a piston 13 with a threaded portion. The shaft comprises a threaded portion, and the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft. In the first switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

[0226] According to an example, in the first switching action the switch is configured such that the piston does

not rotate about the shaft axis as the shaft rotates. This can for example be via it being able to slide but not rotate.

[0227] According to an example, the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft. In the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

[0228] According to an example, the shaft comprises at least one crankshaft portion 30 coupled to a lever system comprising a pushrod 31. In the first switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

[0229] According to an example, the switch comprises a carrier 3. An axis of the carrier is coaxial with the axis of the sun cogwheel. Each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier. The switch is configured such that in the first switching action the carrier is configured not to rotate about the axis of the sun cogwheel.

[0230] According to an example, a first end of a first spring 1 is coupled to the sun cogwheel. In the first switching action energy release from the first spring 1 is configured to rotate the sun cogwheel in the first rotational direction about the axis of the sun cogwheel.

[0231] According to an example, in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position. This can for example be via it being locked or latched in position.

[0232] According to an example, in the first switching action the rotation of the sun cogwheel in the first rotational direction is configured to store energy in a second spring 8.

[0233] According to an example, in a second switching action energy release from the second spring is configured to rotate the cogwheel ring in the first rotational direction opposite to the second rotational direction. The rotation of the shaft associated with the rotation of the cogwheel ring in the first rotational direction is configured to transition the switch from the second switch-state to the first switch-state.

[0234] According to an example, a first end of the second spring is connected to the shaft.

[0235] In an example, a second end of the second spring is held in a fixed position. This can for example be via it being locked or latched in position.

[0236] According to an example, in the second switching action the switch is configured such that the sun cogwheel does not rotate about the axis of the sun cogwheel. This can for example be via it being locked or latched in position.

[0237] According to an example, in the second switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis

of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

[0238] According to an example, in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates. This can for example be via it being able to slide but not rotate.

[0239] According to an example, in the second switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

[0240] According to an example, in the second switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the first switch-state.

[0241] According to an example, in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

[0242] According to an example, prior to the first switching action the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

[0243] According to an example, following the first switching action a further rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

[0244] According to an example, prior to the second switching action energy release from the second spring is configured to rotate the cogwheel ring in the first rotational direction to transition the switch from the third switch-state to the second switch-state.

[0245] The above described switch of embodiment 4 can form part of a low, medium or high voltage vacuum circuit breaker.

[0246] One switch of embodiment 4 can be coupled to two pared down switches that do not have their own planetary drive systems. This enables a three phase switch system to be implemented. An example of such a low, medium or high voltage switching system comprises a first low, medium or high voltage two or three position switch as described above. It also has a pared down second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch. It also has a pared down third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low,

medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch. Rotation of the shaft of the first low, medium or high voltage two or three position switch in the second rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

10 Summary of specific examples of the Embodiments

[0247]

Embodiment 1

- shaft fixed to sun cogwheel.
- in the first switching action, the planetary carrier is driven by the first spring to rotate the sun cogwheel and shaft, whilst the cogwheel ring is blocked.
- in the second switching action, the sun cogwheel is driven by the second spring to rotate the sun cogwheel and shaft in the opposite direction, whilst the planetary carrier is blocked.

Embodiment 2

- shaft fixed to sun cogwheel.
- in the first switching action, the cogwheel ring is driven by the first spring to rotate the sun cogwheel and shaft, whilst the planetary carrier is blocked.
- in the second switching action, the sun cogwheel is driven by the second spring to rotate the sun cogwheel and shaft in the opposite direction, whilst the cogwheel ring is blocked.

Embodiment 3

- shaft fixed to cogwheel ring.
- in the first switching action, the planetary carrier is driven by the first spring to rotate the cogwheel ring and shaft, whilst the sun cogwheel is blocked.
- in the second switching action, the cogwheel ring is driven by the second spring to rotate the shaft in the opposite direction, whilst the planetary carrier is blocked.

Embodiment 4

- shaft fixed to cogwheel ring.
- in the first switching action, the sun cogwheel is driven by the first spring to rotate the cogwheel ring and shaft, whilst the planetary carrier is blocked.
- in the second switching action, the cogwheel ring is driven by the second spring to rotate the

cogwheel ring and shaft in the opposite direction, whilst the sun cogwheel is blocked.

[0248] Continuing with the figures, the low, medium or high voltage two or three position switch, the vacuum circuit breaker, and the low, medium or high voltage switching system are described in further detail, with respect to specific embodiments.

[0249] The following relates primarily to embodiment 1 described above, but with the driving of different cogwheels whilst other cogwheels are held stationary, with respect to rotation about a centre axis of the drive, provides for the other embodiments, as briefly referred to below.

[0250] Figs 1 to 3 show one phase of a two or three position switch driven by a planetary gear drive in disconnected, connected and earthed position, respectively.

[0251] In any idle state of the switch, both the carrier 3 of the planetary cogwheels and the hollow cogwheel 7 (also called cogwheel ring) are latched or locked against rotation. For driving the piston 13 from the earthed position to the disconnected position, or from the disconnected position to the connected position, the carrier 3 of the planetary cogwheels is unlatched while the hollow cogwheel 7 is further latched.

[0252] So, the main spring 1 (also termed first spring) can rotate the carrier 3 of the planetary cogwheels, which then rotates the sun cogwheel 5 and the shaft 6 that is fixed to the sun cogwheel 5 with one end. At its other end, which reaches up to the inside of the centre contact 11, shaft 6 is connected to the piston 13 or a lever of a three position switch (not shown) by a threaded connection, so that the rotation of the shaft 6, driven by shaft 2 that is itself fixedly connected to the carrier 3. The rotation of the shaft 6 results in a linear motion of the piston 13 (or rotation of a blade in case of lever position switch) from the earthed position (as shown in Fig. 3) to the disconnected position (as shown in Fig. 1), or from the disconnected position to the connected position (as shown in Fig 2). The shaft 6 has to be made from an insulating material.

[0253] Furthermore, the auxiliary spring 8 (also termed second spring) is charged by the above described rotation. Its outer end is fixed. The threaded connection of the shaft 6 to the piston 13 can be a high-helix thread so that the piston can be moved with a relatively high speed. This enables the switch to connect on a short-circuit without being damaged by excessive pre-arcing; a so-called making ability.

[0254] The carrier 3 of the planetary cogwheels is latched when the desired position of the piston is reached. The total rotation of the shaft 6 from one position to the next can be one rotation, less than one or more than one rotation. For driving the piston 13 from the connected position to the disconnected position, or from the disconnected position (or rotation of a blade in case of a lever position switch) to the earthed position, the hollow

cogwheel 7 is unlatched while the carrier 3 of the planetary cogwheels is further latched. So, the auxiliary spring 8 can rotate the shaft 6 in the opposite direction compared to the previously described rotation driven by the main spring 1. The rotation driven by the auxiliary 8 results in a linear motion of the piston 13 from the connected position (as shown Fig. 2) to the disconnected position (as shown in Fig. 1), or from the disconnected position to the earthed position (as shown in Fig. 3). The threaded connection of the shaft 6 can as described above be a high-helix thread so that the piston (or a blade in case of a lever position switch) can be moved with a relatively high speed. This enables the switch to earth on a short-circuit without being damaged by excessive pre-arcing; a so-called making ability.

[0255] The hollow cogwheel 7 is latched when the desired position of the piston is reached. The total rotation of the shaft 6 from one position to the next can be one rotation, less than one or more than one rotation. The main spring 1 can be recharged by a rotation of its outer end.

[0256] With respect to the above described switching actions, the following non-limiting actions can then occur:

- As shown in Fig. 3 the piston 13 can be positioned contacting both the earth contact 10 and the centre contact 11 placing the switch in an earthed state.

- Energy release from the first spring 1 (main-spring) can then lead to the shaft 6 rotating clockwise and the thread on the shaft 6 with the corresponding thread in the piston 13 can lead to a first switching action that moves the piston 13 such that it contacts the centre contact 11 and the line contact 12 to place the switch in a connected state, as shown in Fig. 2.

- The above described second switching action can then move the piston in the opposite direction.

- Alternatively, energy release from the first spring 1 (mainspring) can then lead to the shaft 6 rotating clockwise and the thread on the shaft 6 with the corresponding thread in the piston 13 can lead to a first switch action that moves the piston 13 such that it contacts only the centre contact 11 to place the switch in a disconnected state, as shown in Fig. 1.

- The above described second switching action can then move the piston in the opposite direction.

- However, also a further rotation of the shaft in the clockwise direction can move the piston from the centre position to the connected position if required, constituting the further switching action described above.

- It is clear that, in an alternative arrangement the thread on the shaft 6 can be in the opposite sense to that described above, and then an anticlockwise rotation of the shaft 6 can then lead to the above described movements of the piston 13 within described as the first switching action.
- As shown in Fig. 1 the piston 13 can be positioned contacting only the centre contact 11 to place the switch in a disconnected state.
 - Energy release from the first spring 1 can then lead to the shaft 6 rotating clockwise and the thread on the shaft 6 with the corresponding thread in the piston 13 can lead to a first switching action that moves the piston 13 such that it contacts the centre contact 11 and the line contact 12 to place the switch in a connected state, as shown in Fig. 2.
 - Alternatively, the first switching action can constitute movement of the piston 13 from the centre position to contact both the earth contact 10 and the centre contact 11 placing the switch in an earthed state, as shown in Fig. 3.
 - The above described second switching action can then move the piston in the opposite direction.
- As shown in Fig. 2 the piston 13 can be positioned contacting both the line contact 20 and the centre contact 11 placing the switch in a connected state.
 - Energy release from the first spring 1 (main-spring) can then lead to the shaft 6 rotating clockwise and the thread on the shaft 6 with the corresponding thread in the piston 13 can lead to a first switching action that moves the piston 13 such that it contacts the centre contact 11 and the earth contact 10 to place the switch in an earthed state, as shown in Fig. 3.
 - The above described second switching action can then move the piston in the opposite direction.
 - Alternatively, energy release from the first spring 1 (mainspring) can then lead to the shaft 6 rotating clockwise and the thread on the shaft 6 with the corresponding thread in the piston 13 can lead to a first switch action that moves the piston 13 such that it contacts only the centre contact 11 to place the switch in a disconnected state, as shown in Fig. 1.
 - The above described second switching action can then move the piston in the opposite direction.
 - However, also a further rotation of the shaft in the clockwise direction can move the piston from the centre position to the

earthed position if required, constituting the further switching action described above.

- The above says to indicate that there is no specific limitation on what the first switching action means with respect to a movement from one state to another state of a 2 or 3 position switch, and no specific limitation with respect to the second switching action means with respect movement from one state to another state of a 2 or 3 position switch.

[0257] Continuing with the figures, as shown in Fig 4, the planetary gear drive can additionally be used for more than one phase. In this embodiment, wheels 20 and a corresponding chain or toothed belt 21 mechanically connect the three phases so that they are operated in parallel.

[0258] Figs. 5 and 6 show a three phase circuit breaker (CB) with vacuum interrupters (VI) as a further advantageous application of the planetary gear drive (here that can be also a single or a two phase breaker). The main spring 1 is a closing spring here. Its rotation results in a rotation of the crankshaft 30, a closing motion of the VIs and a charging of the auxiliary spring 8, which is an opening spring here. Fig. 5 shows the open position.

[0259] The crankshaft is in the vicinity of the bottom dead end of its cranks so that the VIs are open. Fig. 6 shows the closed position. The crankshaft is in the vicinity of the top dead end (or a bit above to get a self back-movement locking function) of its cranks so that the VIs are closed and the contact springs (not shown; inside the pushrods) are compressed. The end of the closing operation can be defined by a fixedly installed limit stop shortly after the top dead end of the crankshaft. The force of the pushrods will then latch the closed position of the CB.

[0260] The planetary gear drive can also be used for load break switches. The planetary gear drive can also be used for HV and LV equipment

[0261] Due to the combination of high-helix thread (or another thread type or even directly a rotary wheel) and planetary gear, the main axis of the drive can be in line with the main axis of the switch, so that compact designs of complete switches including the mechanical drives are possible and derived from it the switchgear will be smaller.

[0262] Due to the features of the planetary gear, the switch does not require means for driving forth and back - the rotation of springs and main drive parts is always the same. This reduces the complexity of the switch, and so also overall costs and size.

[0263] In summary, a planetary gear system is used for driving a two or three position switching device such as an interruption device e.g. a vacuum circuit breaker with springs, for obtaining a small and less complex in-axis design.

[0264] The following examples provide specific details of how technical features, in certain embodiments, can

be combined.

Example 1. A low, medium or high voltage two or three position switch, comprising:

- a shaft 6;
- a sun cogwheel 5;
- at least one planetary cogwheel 4; and
- a cogwheel ring 7;

wherein, the shaft is fixedly connected to the sun cogwheel such that an axis of the shaft is coaxial with an axis of the sun cogwheel and the shaft and sun cogwheel rotate together;

wherein, the sun cogwheel comprises a plurality of outward facing teeth;

wherein, an axis of the cogwheel ring is coaxial with the axis of the sun cogwheel;

wherein, the cogwheel ring comprises a plurality of inward facing teeth;

wherein, the at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring;

wherein, the at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring; and

wherein, in a first switching action:

a rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in a first rotational direction is configured to rotate the sun cogwheel in the first rotational direction; and the rotation of the shaft associated with the rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

In this manner, rotational movement of planetary cogwheels about a centre axis leads to each planetary cogwheel also rotating about its own axis and this rotation is coupled to the sun cogwheel which then rotates and in doing so rotates the shaft that can be used to transition the switch from one state to another.

Example 2. Switch according to Example 1, wherein in the first switching action the switch is configured such that the cogwheel ring does not rotate.

Example 3. Switch according to any of Examples

1-2, wherein the switch comprises a piston 13 with a threaded portion, wherein the shaft comprises a threaded portion, wherein the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

Example 4. Switch according to Example 3, wherein in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

Example 5. Switch according to any of Examples 1-2, wherein the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

Example 6. Switch according to any of Examples 1-2, wherein the shaft comprises at least one crankshaft portion 30 coupled to a lever system comprising a pushrod 31, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

Example 7. Switch according to any of Examples 1-6, wherein the switch comprises a carrier 3, wherein an axis of the carrier is coaxial with the axis of the sun cogwheel, wherein each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier, and wherein in the first switching action a rotation of the carrier about the axis of the sun cogwheel in the first rotational direction is configured to rotate the at least one planetary cogwheel in the first rotational direction.

Example 8. Switch according to any of Examples 1-7, wherein a first end of a first spring 1 is coupled to the at least one planetary cogwheel, and wherein in the first switching action energy release from the first spring 1 is configured to rotate the at least one planetary cogwheel in the first rotational direction about the axis of the sun cogwheel.

Example 9. Switch according to Example 8, wherein in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position.

Example 10. Switch according to any of Examples 8-9 when dependent upon Example 7, wherein the first end of the first spring is coupled to the at least one planetary cogwheel via the carrier.

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Example 11. Switch according to any of Examples 1-10, wherein in the first switching action the rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring 8.

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Example 12. Switch according to Example 11, wherein in a second switching action energy release from the second spring is configured to rotate the sun cogwheel in a second rotational direction opposite to the first rotational direction, and wherein the rotation of the shaft associated with the rotation of the sun cogwheel in the second rotational direction is configured to transition the switch from the second switch-state to the first switch-state.

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Example 13. Switch according to any of Examples 11-12, wherein a first end of the second spring is connected to the shaft.

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Example 14. Switch according to Example 13, wherein a second end of the second spring is held in a fixed position.

Example 15. Switch according to any of Examples 12-14, wherein in the second switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel.

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Example 16. Switch according to any of Examples 12-15 when dependent upon Example 3 or when dependent upon any of Examples 4 or 7-10 when dependent upon Example 3, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

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Example 17. Switch according to Example 16, wherein in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

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Example 18. Switch according to any of Examples 12-15 when dependent upon Example 5 or when dependent upon any of Examples 7-11 when dependent upon Example 5, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

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Example 19. Switch according to any of Examples 12-15 when dependent upon Example 6 or when dependent upon any of Examples 7-10 when dependent upon Example 6, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the first switch-state.

Example 20. Switch according to any of Examples 12-19 when dependent upon Example 8 or when dependent upon any of Examples 9-11 when dependent upon Example 8, wherein in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

Example 21. Switch according to any of Examples 9-20, wherein the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

Example 22. Switch according to any of Examples 1-21, wherein following the first switching action a further rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

Example 23. Switch according to Example 22 when dependent upon any of Examples 12-21, wherein prior to the second switching action energy release from the second spring is configured to rotate the sun cogwheel in the second rotational direction to transition the switch from the third switch-state to the second switch-state.

Example 24. A low, medium or high voltage vacuum circuit breaker comprising a switch according to any of Examples 1-21.

Example 25. A low, medium or high voltage voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to any of Examples 1-24;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- a third low, medium or high voltage two or three

position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch ; wherein, rotation of the shaft of the first low, medium or high voltage two or three position switch in the first rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

Example 26. A low, medium or high voltage two or three position switch, comprising:

- a shaft 6;
- a sun cogwheel 5;
- at least one planetary cogwheel 4; and
- a cogwheel ring 7;

wherein, the shaft is fixedly connected to the sun cogwheel such that an axis of the shaft is coaxial with an axis of the sun cogwheel and the shaft and sun cogwheel rotate together;

wherein, the sun cogwheel comprises a plurality of outward facing teeth;

wherein, an axis of the cogwheel ring is coaxial with the axis of the sun cogwheel;

wherein, the cogwheel ring comprises a plurality of inward facing teeth;

wherein, the at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring;

wherein, the at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring; and

wherein, in a first switching action:

a rotation of the cogwheel ring about the axis of the sun cogwheel in a first rotational direction is configured to rotate the sun cogwheel in a second rotational direction opposite to the first rotational direction; and

the rotation of the shaft associated with the rotation of the sun cogwheel in the second rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

Example 27. Switch according to Example 26, wherein in the first switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the shaft.

Example 28. Switch according to any of Examples 26-27, wherein the switch comprises a piston 13 with a threaded portion, wherein the shaft comprises a threaded portion, wherein the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft, and wherein in the first switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

Example 29. Switch according to Example 28, wherein in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

Example 30. Switch according to any of Examples 26-27, wherein the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft, and wherein in the first switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

Example 31. Switch according to any of Examples 26-27, wherein the shaft comprises at least one crankshaft portion 30 coupled to a lever system comprising a pushrod 31, and wherein in the first switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

Example 32. Switch according to any of Examples 26-31, wherein the switch comprises a carrier 3, wherein an axis of the carrier is coaxial with the axis of the sun cogwheel, wherein each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier, and wherein the switch is configured such that in the first switching action the carrier is configured not to rotate about the axis of the sun cogwheel.

Example 33. Switch according to any of Examples 26-32, wherein a first end of a first spring 1 is coupled to the cogwheel ring, and wherein in the first switching action energy release from the first spring 1 is configured to rotate the cogwheel ring in the first rotational direction about the axis of the sun cogwheel.

Example 34. Switch according to Example 33, wherein in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position.

Example 35. Switch according to any of Examples 33-34, wherein in the first switching action the rotation of the cogwheel ring about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring 8.

Example 36. Switch according to Example 35, wherein in a second switching action energy release from the second spring is configured to rotate the sun cogwheel in the first rotational direction, and wherein the rotation of the shaft associated with the rotation of the sun cogwheel ring in the first rotational direction is configured to transition the switch from the second switch-state to the first switch-state.

Example 37. Switch according to any of Examples 35-36, wherein a first end of the second spring is connected to the shaft.

Example 38. Switch according to Example 37, wherein a second end of the second spring is held in a fixed position.

Example 39. Switch according to any of Examples 36-38, wherein in the second switching action the switch is configured such that the cogwheel ring does not rotate about the axis of the sun cogwheel.

Example 40. Switch according to any of Examples 36-39 when dependent upon Example 28 or when dependent upon any of Examples 29 or 32-35 when dependent upon Example 28, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

Example 41. Switch according to Example 40, wherein in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

Example 42. Switch according to any of Examples 36-39 when dependent upon Example 30 or when dependent upon any of Examples 32-36 when dependent upon Example 30, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

Example 43. Switch according to any of Examples

36-39 when dependent upon Example 31 or when dependent upon any of Examples 32-35 when dependent upon Example 31, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the third switch-state.

Example 44. Switch according to any of Examples 36-43 when dependent upon Example 33 or when dependent upon any of Examples 34-35 when dependent upon Example 33, wherein in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

Example 45. Switch according to any of Examples 33-44, wherein the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

Example 46. Switch according to any of Examples 1-21, wherein following the first switching action a further rotation of the cogwheel ring about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

Example 47. Switch according to Example 46 when dependent upon any of claims 36-45, wherein prior to the second switching action energy release from the second spring is configured to rotate the sun cogwheel in the first rotational direction to transition the switch from the third switch-state to the second switch-state.

Example 48. A low, medium or high voltage vacuum circuit breaker comprising a switch according to any of Examples 26-45.

Example 49. A low, medium or high voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to any of Examples 26-47;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- a third low, medium or high voltage two or three

position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch; wherein, rotation of the shaft of the first low, medium or high voltage two or three position switch in the second rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

Example 50. A low, medium or high voltage two or three position switch, comprising:

- a shaft 6;
- a sun cogwheel 5;
- at least one planetary cogwheel 4; and
- a cogwheel ring 7;

wherein, the shaft is fixedly connected to the cogwheel ring such that an axis of the shaft is coaxial with an axis of the cogwheel ring and the shaft and cogwheel ring rotate together;

wherein, the sun cogwheel comprises a plurality of outward facing teeth;

wherein, the axis of the cogwheel ring is coaxial with an axis of the sun cogwheel;

wherein, the cogwheel ring comprises a plurality of inward facing teeth;

wherein, the at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring;

wherein, the at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring; and

wherein, in a first switching action:

a rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in a first rotational direction is configured to rotate the cogwheel ring in a first rotational direction; and the rotation of the shaft associated with the rotation of the cogwheel ring in the first rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

Example 51. Switch according to Example 50, wherein in the first switching action the switch is configured such that the sun cogwheel does not rotate.

Example 52. Switch according to any of Examples

50-51, wherein the switch comprises a piston 13 with a threaded portion, wherein the shaft comprises a threaded portion, wherein the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

Example 53. Switch according to any of Examples 50-52, wherein in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

Example 54. Switch according to any of Examples 50-51, wherein the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

Example 55. Switch according to any of Examples 50-51, wherein the shaft comprises at least one crankshaft portion 30 coupled to a lever system comprising a pushrod 31, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

Example 56. Switch according to any of Examples 50-55, wherein the switch comprises a carrier 3, wherein an axis of the carrier is coaxial with the axis of the sun cogwheel, wherein each planetary cogwheel of the at least one planetary cogwheel is rotationally connected to the carrier, and wherein in the first switching action a rotation of the carrier about the axis of the sun cogwheel in the first rotational direction is configured to rotate the at least one planetary cogwheel in the first rotational direction.

Example 57. Switch according to any of Examples 50-56, wherein a first end of a first spring 1 is coupled to the at least one planetary cogwheel, and wherein in the first switching action energy release from a first spring 1 is configured to rotate the at least one planetary cogwheel in the first rotational direction about the axis of the sun cogwheel.

Example 58. Switch according to Example 57, wherein in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position.

Example 59. Switch according to any of Examples 57-58 when dependent upon Example 56, wherein the first end of the first spring is coupled to the at least one planetary cogwheel via the carrier.

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Example 60. Switch according to any of Examples 50-59, wherein in the first switching action the rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring 8.

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Example 61. Switch according to Example 60, wherein in a second switching action energy release from the second spring is configured to rotate the cogwheel ring in a second rotational direction opposite to the first rotational direction.

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Example 62. Switch according to any of Examples 60-61, wherein a first end of the second spring is connected to the shaft.

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Example 63. Switch according to Example 62, wherein a second end of the second spring is held in a fixed position.

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Example 64. Switch according to any of Examples 61-63, wherein in the second switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel.

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Example 65. Switch according to any of Examples 61-64 when dependent upon Example 52 or when dependent upon any of Examples 53 or 56-60 when dependent upon Example 52, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

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Example 66. Switch according to Example 65, wherein in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

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Example 67. Switch according to any of Examples 61-64 when dependent upon Example 54 or when dependent upon any of Examples 56-60 when dependent upon Example 54, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

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Example 68. Switch according to any of Examples 61-64 when dependent upon Example 55 or when

dependent upon any of Examples 56-60 when dependent upon Example 55, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the third switch-state.

Example 69. Switch according to any of Examples 61-68 when dependent upon Example 57 or when dependent upon any of Examples 58-60 when dependent upon claim 57, wherein in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

Example 70. Switch according to any of Examples 58-69, wherein the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

Example 71. Switch according to any of Examples 50-70, wherein following the first switching action a further rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

Example 72. Switch according to Example 71 when dependent upon any of Examples 61-70, wherein prior to the second switching action energy release from the second spring is configured to rotate the cogwheel ring in the second rotational direction to transition the switch from the third switch-state to the second switch-state.

Example 73. A low, medium or high voltage vacuum circuit breaker comprising a switch according to any of Examples 50-70.

Example 74. A low, medium or high voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to any of Examples 50-72;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- a third low, medium or high voltage two or three position switch comprising a shaft coupled to the

shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch ; 5

wherein, rotation of the shaft of the first low, medium or high voltage two or three position switch in the first rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state. 10

Example 75. A low, medium or high voltage two or three position switch, comprising: 15

- a shaft 6;
- a sun cogwheel 5;
- at least one planetary cogwheel 4; and 20
- a cogwheel ring 7;

wherein, the shaft is fixedly connected to the cogwheel ring such that an axis of the shaft is coaxial with an axis of the cogwheel ring and the shaft and cogwheel ring rotate together; 25

wherein, the sun cogwheel comprises a plurality of outward facing teeth;

wherein, the axis of the cogwheel ring is coaxial with an axis of the sun cogwheel; 30

wherein, the cogwheel ring comprises a plurality of inward facing teeth;

wherein, the at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring; 35

wherein, the at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring; and 40

wherein, in a first switching action:

a rotation of the sun cogwheel in a first rotational direction is configured to rotate the cogwheel ring in a second rotational direction counter to the first rotational direction; and 45

the rotation of the shaft associated with the rotation of the cogwheel ring in the second rotational direction is configured to transition the switch from a first switch-state to a second switch-state. 50

Example 76. Switch according to Example 75, wherein the at least one planetary cogwheel comprises three planetary cogwheels. 55

Example 77. Switch according to any of Examples 75-76, wherein in the first switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel.

Example 78. Switch according to any of Examples 75-77, wherein the switch comprises a piston 13 with a threaded portion, wherein the shaft comprises a threaded portion, wherein the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft, and wherein in the first switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

Example 79. Switch according to any of Examples 75-78, wherein in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

Example 80. Switch according to any of Examples 75-77, wherein the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

Example 81. Switch according to any of Examples 75-77, wherein the shaft comprises at least one crankshaft portion 30 coupled to a lever system comprising a pushrod 31, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

Example 82. Switch according to any of Examples 75-81, wherein the switch comprises a carrier 3; wherein an axis of the carrier is coaxial with the axis of the sun cogwheel; wherein each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier; and wherein the switch is configured such that in the first switching action the carrier is configured not to rotate about the axis of the sun cogwheel.

Example 83. Switch according to any of Examples 75-82, wherein a first end of a first spring 1 is coupled to the sun cogwheel; and wherein in the first switching action energy release from the first spring 1 is configured to rotate the sun cogwheel in the first rotational direction about the axis of the sun cogwheel.

Example 84. Switch according to Example 83, wherein in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position.

Example 85. Switch according to any of Examples 75-84, wherein in the first switching action the rotation of the sun cogwheel in the first rotational direction is configured to store energy in a second spring 8.

Example 86. Switch according to Example 85, wherein in a second switching action energy release from the second spring is configured to rotate the cogwheel ring in the first rotational direction opposite to the second rotational direction, and wherein the rotation of the shaft associated with the rotation of the cogwheel ring in the first rotational direction is configured to transition the switch from the second switch-state to the first switch-state.

Example 87. Switch according to any of Examples 85-86, wherein a first end of the second spring is connected to the shaft.

Example 88. Switch according to any of Examples 85-87, wherein, a second end of the second spring is held in a fixed position.

Example 89. Switch according to any of Examples 86-88, wherein in the second switching action the switch is configured such that the sun cogwheel does not rotate about the axis of the sun cogwheel.

Example 90. Switch according to any of Examples 86-89 when dependent upon Example 78 or when dependent upon any of Examples 79 or 82-85 when dependent upon Example 78, wherein in the second switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

Example 91. Switch according to Example 90, wherein in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

Example 92. Switch according to any of Examples 86-89 when dependent upon Example 80 or when dependent upon any of Examples 82-85 when dependent upon Example 80, wherein in the second switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.

Example 93. Switch according to any of Examples 86-89 when dependent upon Example 81 or when dependent upon any of Examples 82-85 when dependent upon Example 81, wherein in the second switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the third switch-state.

Example 94. Switch according to any of Examples 86-93, wherein in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.

Example 95. Switch according to any of Examples 75-94, wherein prior to the first switching action the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.

Example 96. Switch according to any of Examples 75-95, wherein following the first switching action a further rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.

Example 97. Switch according to Example 96 when dependent upon any of Examples 86-95, wherein prior to the second switching action energy release from the second spring is configured to rotate the cogwheel ring in the first rotational direction to transition the switch from the third switch-state to the second switch-state.

Example 98. A low, medium or high voltage vacuum circuit breaker comprising a switch according to any of Examples 75-95.

Example 99. A low, medium or high voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to any of Examples 75-97;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- a third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the

shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch;

wherein, rotation of the shaft of the first low, medium or high voltage two or three position switch in the second rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

Reference Numerals

[0265]

- 1 Main spring - or first spring
- 2 Shaft fixedly connected to carrier 3
- 3 Carrier of the planetary cogwheels
- 4 Planetary cogwheel(s)
- 5 Sun cogwheel
- 6 Shaft fixedly connected to the sun cogwheel 5
- 7 Hollow cogwheel - or cogwheel ring
- 8 Auxiliary spring - or second spring
- 10 Earthed contact of three position switch
- 11 Centre contact of three position switch
- 12 Line contact of three position switch
- 13 Piston of three position switch
- 20 Wheel
- 21 Chain or toothed belt
- 30 Crankshaft - or crankshaft portion of shaft 6
- 31 Pushrod
- 32 Vacuum Interrupter - VI

Claims

1. A low, medium or high voltage two or three position switch, comprising:

- a shaft (6);
- a sun cogwheel (5);
- at least one planetary cogwheel (4); and
- a cogwheel ring (7);

wherein, the shaft is fixedly connected to the sun cogwheel such that an axis of the shaft is coaxial with an axis of the sun cogwheel and the shaft and sun cogwheel rotate together;

wherein, the sun cogwheel comprises a plurality of outward facing teeth;

wherein, an axis of the cogwheel ring is coaxial with the axis of the sun cogwheel;

wherein, the cogwheel ring comprises a plurality of inward facing teeth;

wherein, the at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring;

wherein, the at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring; and

wherein, in a first switching action:

a rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in a first rotational direction is configured to rotate the sun cogwheel in the first rotational direction; and the rotation of the shaft associated with the rotation of the sun cogwheel in the first rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

2. Switch according to claim 1, wherein in the first switching action the switch is configured such that the cogwheel ring does not rotate.

3. Switch according to any of claims 1-2, wherein the switch comprises a piston (13) with a threaded portion, wherein the shaft comprises a threaded portion, wherein the threaded portion of the piston is rotationally engaged with the threaded portion of the shaft, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to move the piston along the axis of the shaft in a first direction to transition the switch from the first switch-state to the second switch-state.

4. Switch according to claim 3, wherein in the first switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.

5. Switch according to any of claims 1-2, wherein the shaft comprises a blade extending in a direction substantially perpendicular to the axis of the shaft, and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the first switch-state to the second switch-state.

6. Switch according to any of claims 1-2, wherein the shaft comprises at least one crankshaft portion (30) coupled to a lever system comprising a pushrod (31), and wherein in the first switching action the rotation of the shaft in the first rotational direction is configured to move the pushrod in a direction perpendicularly to the axis of the shaft in a first radial direction to transition the switch from the first switch-state to the second switch-state.

7. Switch according to any of claims 1-6, wherein the

switch comprises a carrier (3), wherein an axis of the carrier is coaxial with the axis of the sun cogwheel, wherein each planetary cogwheel of the at least one planetary cogwheel is rotational connected to the carrier, and wherein in the first switching action a rotation of the carrier about the axis of the sun cogwheel in the first rotational direction is configured to rotate the at least one planetary cogwheel in the first rotational direction.

8. Switch according to any of claims 1-7, wherein a first end of a first spring (1) is coupled to the at least one planetary cogwheel, and wherein in the first switching action energy release from the first spring (1) is configured to rotate the at least one planetary cogwheel in the first rotational direction about the axis of the sun cogwheel.
9. Switch according to claim 8, wherein in the first switching action the switch is configured such that a second end of the first spring is held in a fixed position.
10. Switch according to any of claims 8-9 when dependent upon claim 7, wherein the first end of the first spring is coupled to the at least one planetary cogwheel via the carrier.
11. Switch according to any of claims 1-10, wherein in the first switching action the rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to store energy in a second spring (8).
12. Switch according to claim 11, wherein in a second switching action energy release from the second spring is configured to rotate the sun cogwheel in a second rotational direction opposite to the first rotational direction, and wherein the rotation of the shaft associated with the rotation of the sun cogwheel in the second rotational direction is configured to transition the switch from the second switch-state to the first switch-state.
13. Switch according to any of claims 11-12, wherein a first end of the second spring is connected to the shaft.
14. Switch according to claim 13, wherein a second end of the second spring is held in a fixed position.
15. Switch according to any of claims 12-14, wherein in the second switching action the switch is configured such that the at least one planetary cogwheel does not rotate about the axis of the sun cogwheel.
16. Switch according to any of claims 12-15 when dependent upon claim 3 or when dependent upon any

of claims 4 or 7-10 when dependent upon claim 3, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to move the piston along the axis of the shaft in a second direction opposite to the first direction to transition the switch from the second switch-state to the first switch-state.

17. Switch according to claim 16, wherein in the second switching action the switch is configured such that the piston does not rotate about the shaft axis as the shaft rotates.
18. Switch according to any of claims 12-15 when dependent upon claim 5 or when dependent upon any of claims 7-11 when dependent upon claim 5, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to rotate the blade about the axis of the shaft to transition the switch from the second switch-state to the first switch-state.
19. Switch according to any of claims 12-15 when dependent upon claim 6 or when dependent upon any of claims 7-10 when dependent upon claim 6, wherein in the second switching action the rotation of the shaft in the second rotational direction is configured to move the pushrod in a radial direction opposite to the first radial direction to transition the switch from the second switch-state to the third switch-state.
20. Switch according to any of claims 12-19 when dependent upon claim 8 or when dependent upon any of claims 9-11 when dependent upon claim 8, wherein in the second switching action the switch is configured such that the second end of the first spring is held in the fixed position.
21. Switch according to any of claims 9-20, wherein the switch is configured such that a rotation of the second end of the first spring in the first rotational direction is configured to store energy in the first spring.
22. Switch according to any of claims 1-21, wherein following the first switching action a further rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in the first rotational direction is configured to transition the switch from the second switch-state to a third switch-state.
23. Switch according to claim 22 when dependent upon any of claims 12-21, wherein prior to the second switching action energy release from the second spring is configured to rotate the sun cogwheel in the second rotational direction to transition the switch from the third switch-state to the second switch-state.

24. A low, medium or high voltage vacuum circuit breaker comprising a switch according to any of claims 1-21.

25. A low, medium or high voltage voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to any of claims 1-24;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- a third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch ;

wherein, rotation of the shaft of the first low, medium or high voltage two or three position switch in the first rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

26. A low, medium or high voltage two or three position switch, comprising:

- a shaft (6);
- a sun cogwheel (5);
- at least one planetary cogwheel (4); and
- a cogwheel ring (7);

wherein, the shaft is fixedly connected to the sun cogwheel such that an axis of the shaft is coaxial with an axis of the sun cogwheel and the shaft and sun cogwheel rotate together;

wherein, the sun cogwheel comprises a plurality of outward facing teeth;

wherein, an axis of the cogwheel ring is coaxial with the axis of the sun cogwheel;

wherein, the cogwheel ring comprises a plurality of inward facing teeth;

wherein, the at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring;

wherein, the at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel

are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring; and

wherein, in a first switching action:

a rotation of the cogwheel ring about the axis of the sun cogwheel in a first rotational direction is configured to rotate the sun cogwheel in a second rotational direction opposite to the first rotational direction; and
the rotation of the shaft associated with the rotation of the sun cogwheel in the second rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

27. A low, medium or high voltage vacuum circuit breaker comprising a switch according to claim 26.

28. A low, medium or high voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to claim 26;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- a third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch;

wherein, rotation of the shaft of the first low, medium or high voltage two or three position switch in the second rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

29. A low, medium or high voltage two or three position switch, comprising:

- a shaft (6);
- a sun cogwheel (5);
- at least one planetary cogwheel (4); and
- a cogwheel ring (7);

wherein, the shaft is fixedly connected to the cogwheel ring such that an axis of the shaft is coaxial with an axis of the cogwheel ring and the shaft and cogwheel ring rotate together;

wherein, the sun cogwheel comprises a plurality of outward facing teeth;

wherein, the axis of the cogwheel ring is coaxial with an axis of the sun cogwheel;

wherein, the cogwheel ring comprises a plurality of inward facing teeth;

wherein, the at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring;

wherein, the at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring; and

wherein, in a first switching action:

a rotation of the at least one planetary cogwheel about the axis of the sun cogwheel in a first rotational direction is configured to rotate the cogwheel ring in a first rotational direction; and the rotation of the shaft associated with the rotation of the cogwheel ring in the first rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

30. A low, medium or high voltage vacuum circuit breaker comprising a switch according to claim 29.

31. A low, medium or high voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to claim 29;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;
- a third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch ;

wherein, rotation of the shaft of the first low, medium

or high voltage two or three position switch in the first rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

32. A low, medium or high voltage two or three position switch, comprising:

- a shaft (6);
- a sun cogwheel (5);
- at least one planetary cogwheel (4); and
- a cogwheel ring (7);

wherein, the shaft is fixedly connected to the cogwheel ring such that an axis of the shaft is coaxial with an axis of the cogwheel ring and the shaft and cogwheel ring rotate together;

wherein, the sun cogwheel comprises a plurality of outward facing teeth;

wherein, the axis of the cogwheel ring is coaxial with an axis of the sun cogwheel;

wherein, the cogwheel ring comprises a plurality of inward facing teeth;

wherein, the at least one planetary cogwheel is located between the sun cogwheel and the cogwheel ring;

wherein, the at least one planetary cogwheel comprises a plurality of outward facing teeth, and wherein some teeth of the at least one planetary cogwheel are engaged with some teeth of the sun cogwheel and some other teeth of the at least one planetary cogwheel are engaged with some teeth of the cogwheel ring; and

wherein, in a first switching action:

a rotation of the sun cogwheel in a first rotational direction is configured to rotate the cogwheel ring in a second rotational direction counter to the first rotational direction; and the rotation of the shaft associated with the rotation of the cogwheel ring in the second rotational direction is configured to transition the switch from a first switch-state to a second switch-state.

33. A low, medium or high voltage vacuum circuit breaker comprising a switch according to claim 32.

34. A low, medium or high voltage switching system, comprising:

- a first low, medium or high voltage two or three position switch according to claim 32;
- a second low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rota-

tion of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the second low, medium or high voltage two or three position switch;

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- a third low, medium or high voltage two or three position switch comprising a shaft coupled to the shaft of the first low, medium or high voltage two or three position switch such that rotation of the shaft of the first low, medium or high voltage two or three position switch leads to an associated rotation of the shaft of the third low, medium or high voltage two or three position switch;

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wherein, rotation of the shaft of the first low, medium or high voltage two or three position switch in the second rotational direction is configured to transition each switch from a first switch-state to a second switch-state and optionally from the second switch-state to a third switch-state.

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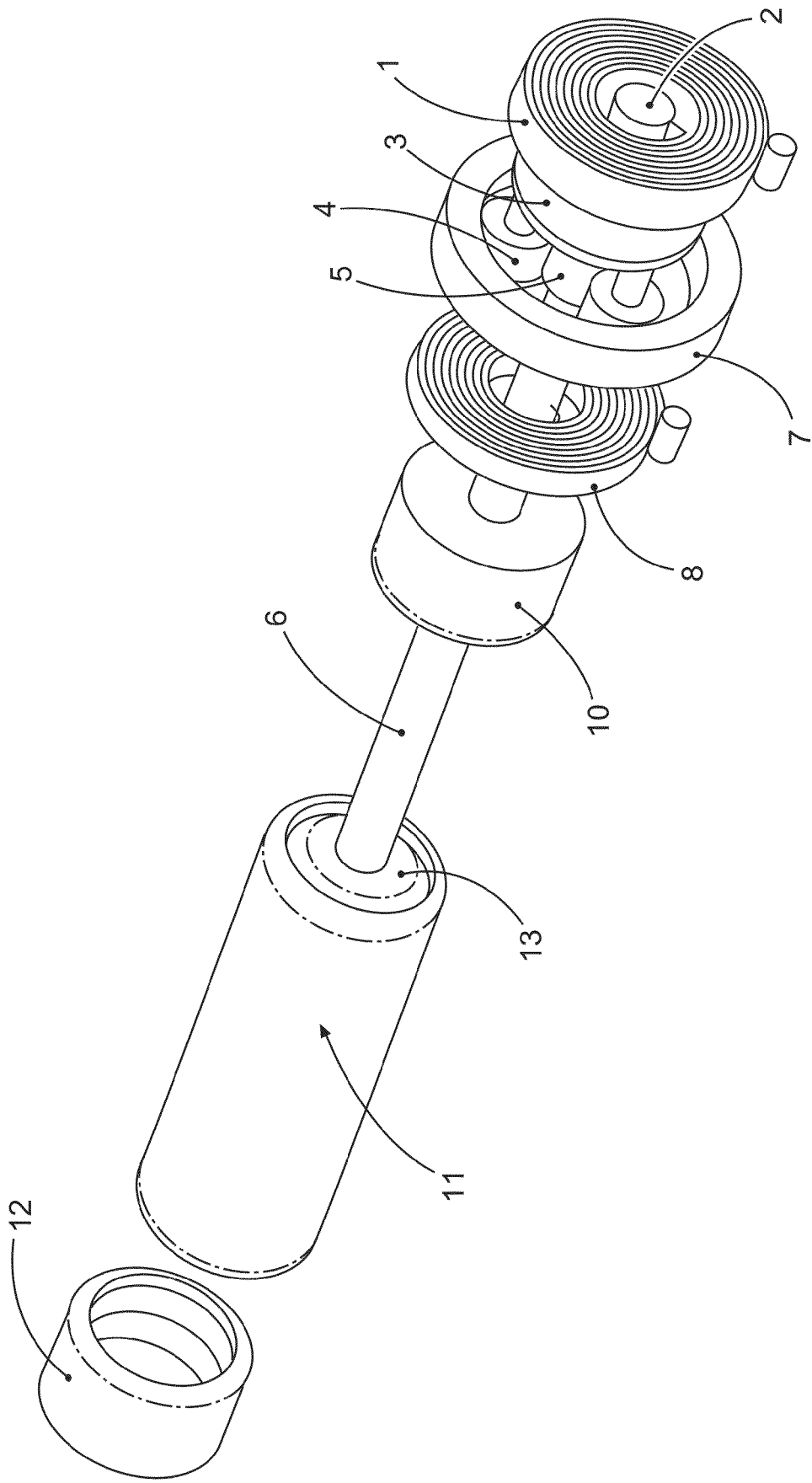


Fig. 1

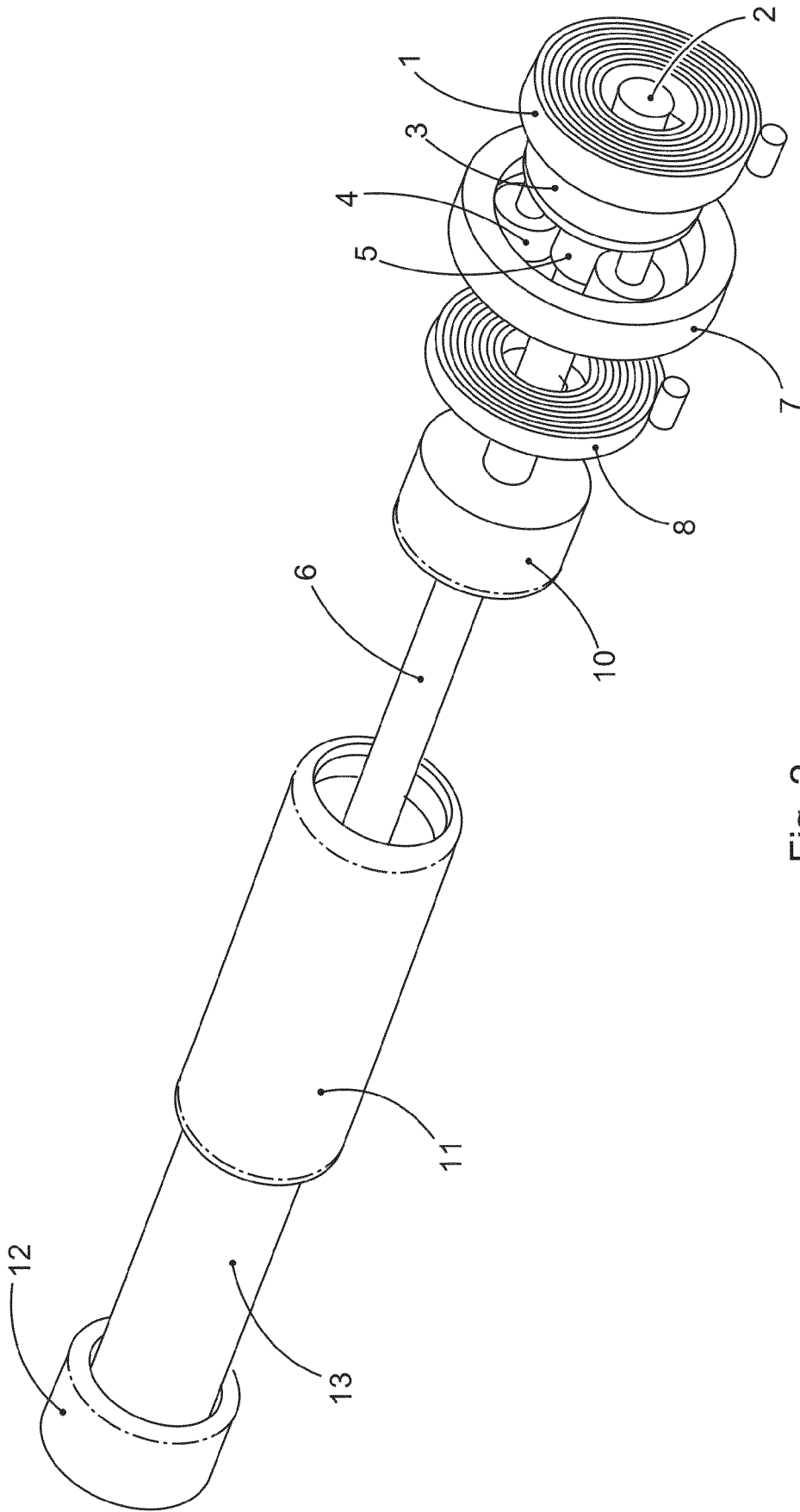


Fig. 2

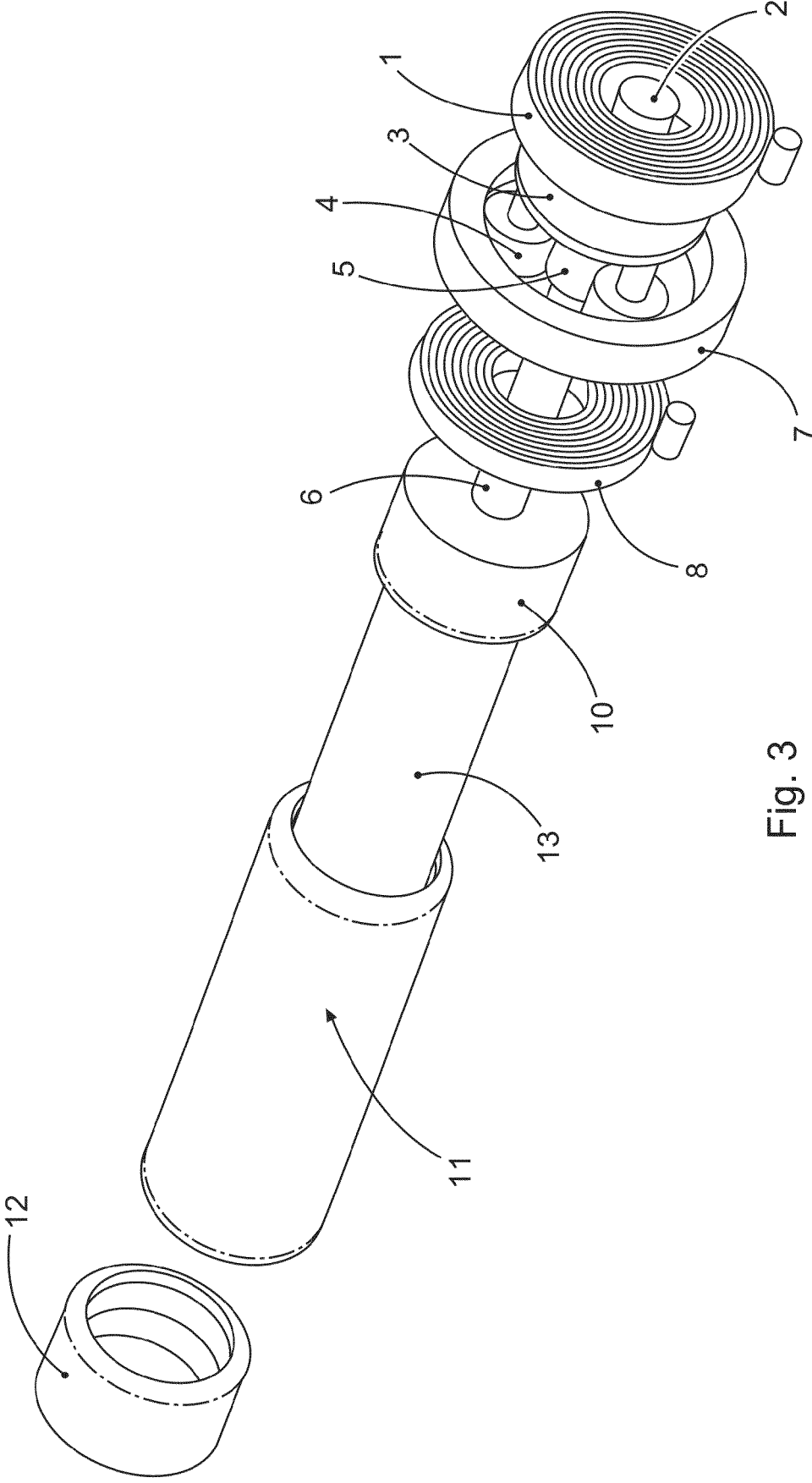


Fig. 3

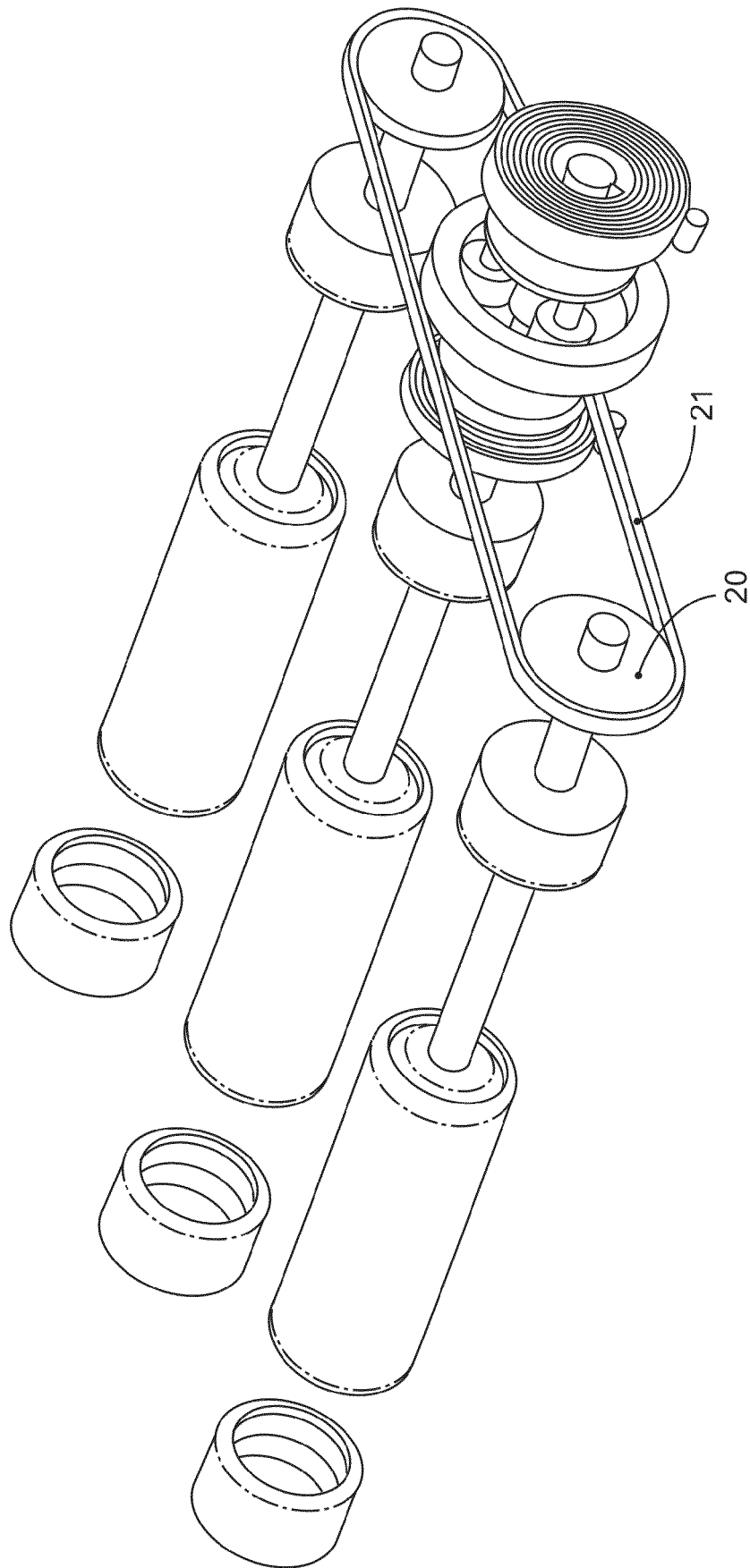


Fig. 4

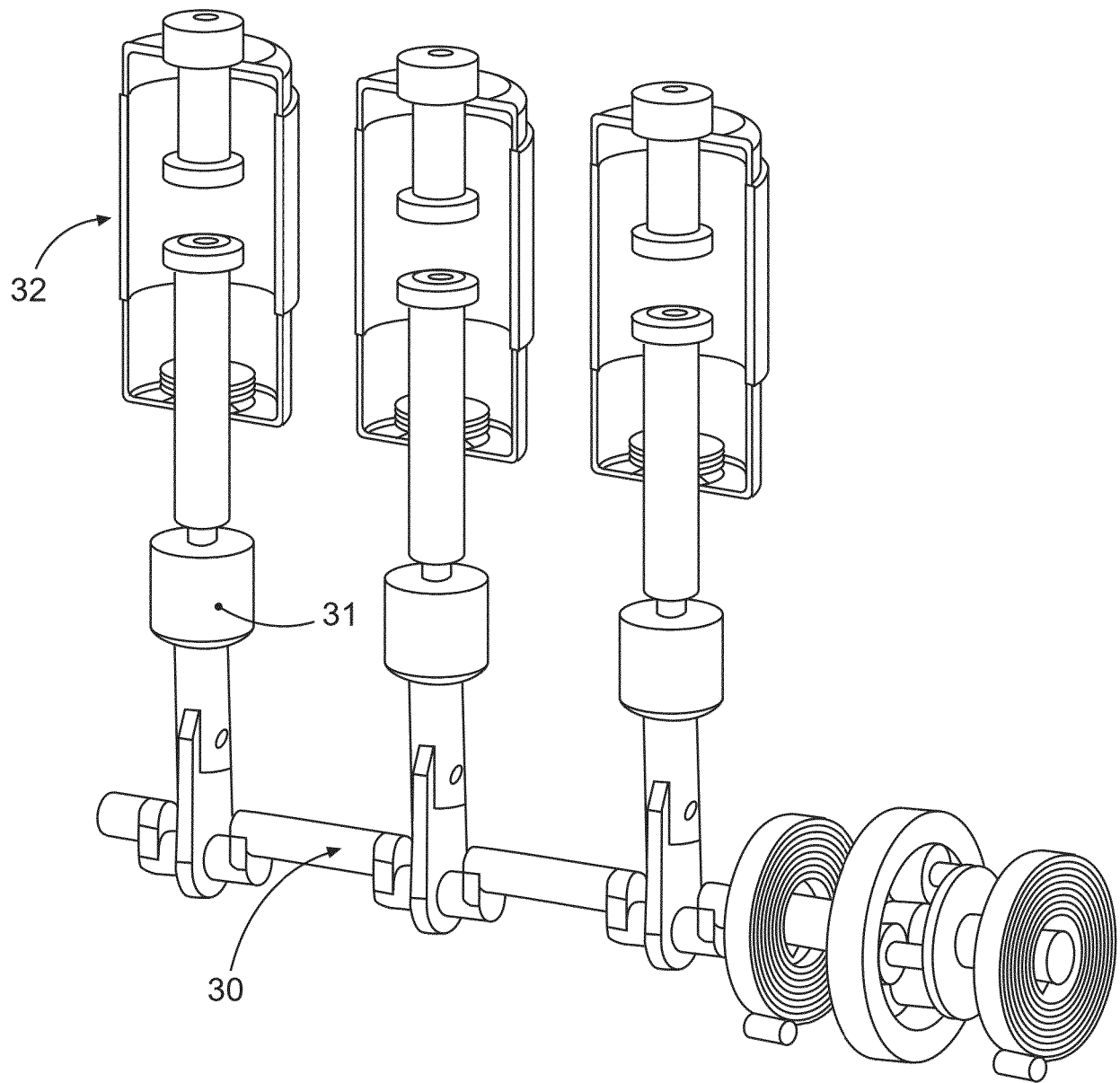


Fig. 5

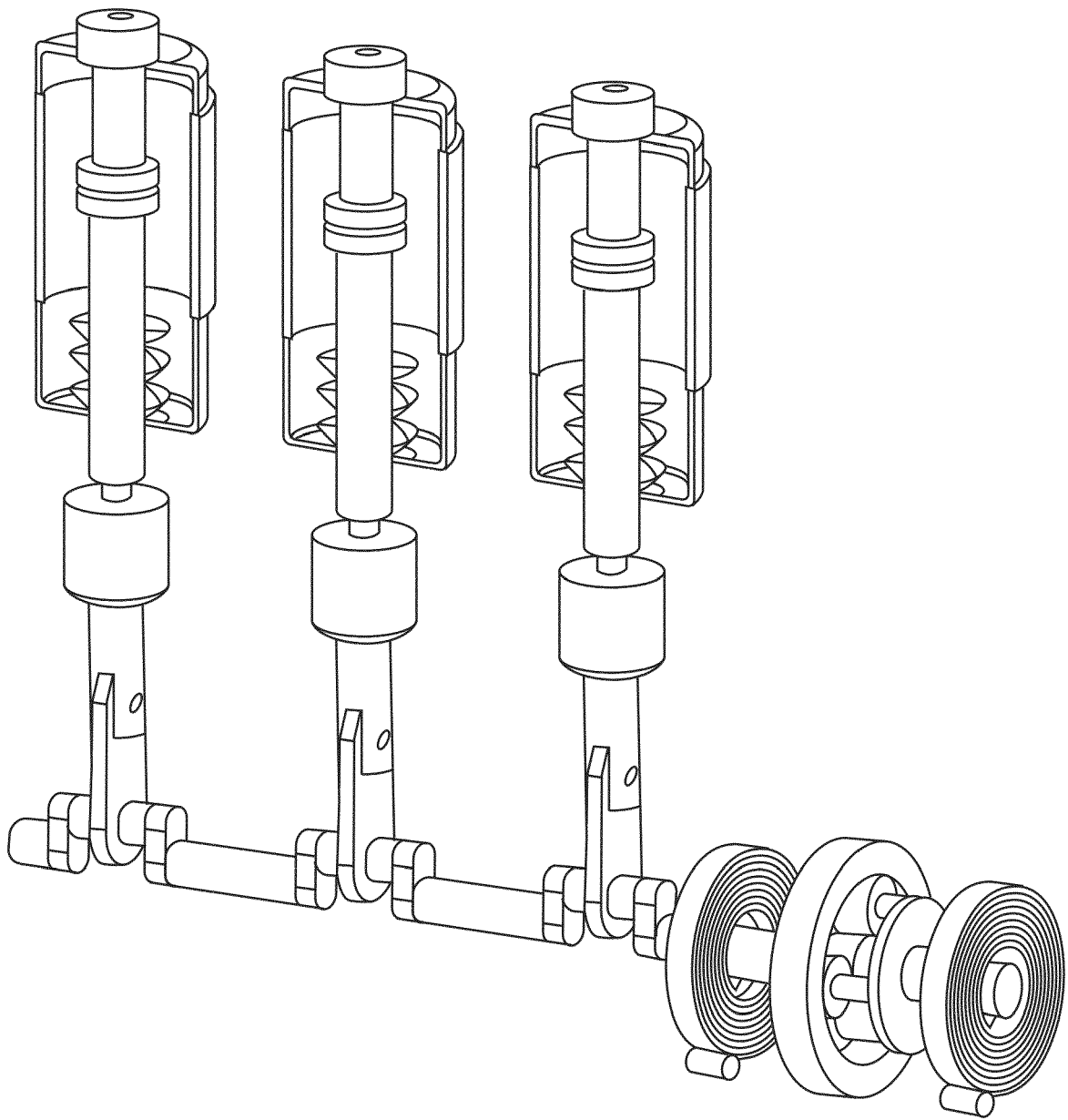


Fig. 6



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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 January 2021	Examiner Meyer, Jan
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